World Bank Loan Project

China: Zhuzhou Brownfield Remediation Project (Qingshuitang Area)

Environment Management Plan (EMP)

Constructed by:
Zhuzhou Recycling Economy Investment and Development Co., Ltd.

Assessed by:
Nanjing Guohuan Environmental Technology and Development Co., Ltd.

September 2015
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1 Overview

This environmental and social management plan (EMP) is applicable to “World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)”, a project undertaken by Zhuzhou Recycling Economy Investment Development Co., Ltd (ZREIDC).

The environmental and social impacts of the project have been detailed in its “Environmental Impact Assessment” (EIA), prepared by Nanjing Guohuan Environmental Technology and Development Co., Ltd. The EIA report consists of: analysis of environmental regulations and policies; on-site surveys; risk assessments; project statuses; remediation plans; analysis of environmental impact factors; alternate plans; environment quality statuses and survey; pollution sources and outputs in existing industries; ecological, social and economic benefits; information disclosure and public participation; environmental management and monitoring. The report has incorporated results of the long-term impact studies from “Qingshuitang Recycling Economy Core Industrial Zone Environmental Impact Report”. According to China’s current regulations and World Bank policy OP/BP4.01 (Environmental Assessment), the project is considered a Class A project, requiring full-scale environmental assessment studies.

This EMP is compliant with requirements of domestic regulations and technical guidelines, and the World Bank’s safeguards policies, including “World Bank Group Environmental, Health & Safety Guidelines”. The EMP should utilize the newest and most economic strategies to realize the project’s impact mitigation goals.

1.1 Background

Qingshuitang Industrial Zone (QIZ), an old industrial base in Zhuzhou of Hunan Province, China, was developed by the government in 1950s. The major industries include lead and zinc smelting and heavy chemical industry. Due to over fifty-year

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1 In this report, ESMP and EMP are interchangeable. EIA and ESIA are interchangeable as well.
history of industrialization, QIZ has been known for its heavy-metal contamination. The remediation of heavy-metal contaminated area in QIZ has become an urgent need to protect human health and the living environment of local residents, and to eliminate the potential hazards entering Xiang River.

During 2011’s National Congress, the Chinese State Council has approved “Xiang River Region Heavy Metal Pollution Remediation Implementation Plan”, and designated QIZ as a pilot zone for China’s heavy metal pollution remediation. The municipal government of Zhuzhou had been greatly concerned about the QIZ problem, which leads to the formation of Zhuzhou Recycling Economy Investment and Development Co., Ltd (ZREIDC), an enterprise dedicated to the remediation and redevelopment of QIZ.

ZREIDC intends to launch the “World Bank-China Proposed Zhuzhou Brownfield Remediation Project” with a fund of 242 million USD. The project is a response to Zhuzhou’s urgent needs for continued economic development and improvement of residents’ health and living environment. It answers the central government’s call for resource-conservative and environment-friendly societies, and will play an important role in balancing Zhuzhou’s economic, social and ecological development, creating an internationally recognized, state-of-the-art national pilot industrial park for recycling economies, and contributing to the Changsha-Zhuzhou-Xiangtan region’s creation of a new industrialization and urbanization pilot region.

See Fig. 1.1-1 for project location.
Figure 1.1-1 Project Location and Project Area
1.2 Project Components

The project will include four components:

- Component 1: Remediation of contaminated plots in the proposed project Area.
- Component 2: Treatment/disposal facilities
- Component 3: Capacity building and knowledge management.
- Component 4: Project management, monitoring and evaluation

The project focuses on a portion of QIZ with a total area of 8.48km²(Fig. 1.2-1). According to administrative zoning, the project area is divided into seven sub-areas, i.e. Xiangshiling, Qingshi, Tongtangwan, Tongxia, Qingshui, Yinfeng and Qingshuihu. Based on the site investigation and risk assessment, the project area is classified into three parts: risk acceptable area (2.02km²), risk controllable area (3.73km²) and remediation area (2.73km²). See Fig. 1.2-2 and 1.2-3.

The remediation works under the project will focus on the 2.73 km² remediation area and 0.11 dispersed open soil plots outside the remediation area. While, as part of the overall project area, the future remediation works in the non-remediation area will follow the same environmental and social framework requirements set by this project, as documented in the ESMF.

The detailed remediation works are shown in Table 1.2-1.
<table>
<thead>
<tr>
<th>Item</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land clearing and soil remediation</td>
<td>Land clearing and dismantlement of buildings of six closed enterprises (total building dismantlement areas: 9546.8m²; total demolition waste: 6532m³; building areas to be cleaned: 7710.8m²). Relocation of 94 families (total demolition area: 21993m²; total waste: 39310m³). Clean soil replacement for residential areas (total area of 0.11km², and clean soil of 55427.5m³). Soil remediation: remediation of heavy metal contaminated soil (2.29km² with total amount of 1374874m³) using various technologies; and remediation of sites of 6 closed companies, with total area of 0.13km² including Solidification/stabilization (S/S) treatment of heavy-metal contaminated soil of 74313m³, and incineration of 8274m² (with total amount of 16548m³) organic pollution soil in Tiancheng Chemical Co. S/S remediation and landfill disposal of waste piles in the project area and closed companies (total amount of 84700m³).</td>
</tr>
<tr>
<td>Water ponds sediment treatment and ecological restoration of channels/ponds</td>
<td>Dewatering, S/S remediation and eco-restoration of 26 ponds (total area: 0.17km²; total sediment: 173,000m³) Ecological restoration of Old Xiawangang channel after dredging (total area 54279m³)</td>
</tr>
<tr>
<td>Supporting facilities</td>
<td>Rental of existing Xinqiao waste pile site as S/S site (4000m², with capacity of 400m³/d) Rental of existing Xiawangang dewatering site for dewatering and storage site (dewatering site 4000m², storage site 1500m³) New construction of dewatering site (4200m², including 4000m² for dewatering and 200m² for storage) New construction of temporary soil storage site besides the Xinqiao S/S site (with an area of 10000m², and capacity of 150,000m³) Solid waste landfill: use an abandoned quarry pit as landfill site (total area of 38265m², with capacity of 2 million m³) Temporary access roads: renovation of village roads (13832m) and construction of new temporary access roads (1802m)</td>
</tr>
<tr>
<td>Environmental Information and Demonstration Center</td>
<td>Specific activities include a management building with a construction area of 820m²; an environmental protection exhibition center with construction area of 7,150m², and an experiment/demonstration base with an area of 40,000m².</td>
</tr>
<tr>
<td>Studies</td>
<td>(1) Study on Qingshuitang Brownfield Remediation and Strategic Planning: (i) recommendations for filling the potential gaps between the remediation results and future land use/urban development strategic planning, through defining remedial remediation targets or refining the strategic planning; (ii) a strategic environmental and social impact assessment for the remediation and redevelopment of Qingshuitang core zone; (iii) application of green remediation in the future remediation practices in Qingshuitang that will address among other issues conversion of land use and its impacts on land value and beneficiaries; (iv) policy recommendations for addressing policy, regulation, financing and market issues in the remediation and redevelopment. (2) Study on the compliance framework for Qingshuitang environmental quality and industrial pollution control: (i) regional groundwater monitoring and modelling; (ii) monitoring of industrial emissions, secondary pollution analysis and data analysis for environmental management.</td>
</tr>
</tbody>
</table>

The total cost of the project is 242 million USD, with a World Bank loan of 150
million USD. The project plans to complete the preparation work in 2015, and start the construction from 2016 to 2022.

Most of the project activities will take place within the project area, except that 1) excavated soils from Tiancheng Chemical Plant will be moved to a cement plant outside QIZ for treatment because the soils contain organic pollutants, and 2) backfilling clean soils will come from other places in Zhuzhou. These off-site impacts and measures have been included in the project EA.
Note: Zhuzhou Brownfield Remediation Project covers an area of 8.48 km², dividing into seven sub-areas.

Fig. 1.2-1 Project area and divisions
Fig. 1.2-2 Risk-acceptable areas and risk controllable areas (brown: risk-acceptable; yellow: remediation completed; grey: Tongxia Road; light green: enterprises in production; blue: large residential areas; violet: area of exposed soil survey)
Fig. 1.2-3 Areas requiring remediation

Notes:
Land clearance area of the project counts to 2.30km². An area of 9546.8m² within closed enterprises needs structures demolition, generating 6532m³ construction waste; An area of 21993m² within remediation residential site needs structures demolition, generating 101448.8m³ construction waste.
1.3 Goal of the EMP

The EMP is concerned with mitigations for identified environmental impacts, and supervising the validity of said mitigations during the project lifecycle. It is based on the “Environmental Impact Assessment” (EIA) and “Plan Environmental Assessment”, and prepared according to China’s environmental legislations and guidelines, safeguards policies of World Bank, and best practices from similar projects. The EMP is aimed at ensuring the consistency with the EIA, and satisfying relevant standards of environmental protection. It is designed as a guide for the project owner to manage its contractor and subcontractors.

1.4 Structure of the EMP

The EMP’s key components are the procedures on environmental management during the project’s construction, operation and closedown periods. Its main content consists of the following:

- Roles and responsibilities in environmental management;
- Remediation plan;
- Mitigation methods;
- Environmental management plan;
- Environmental regulations on contractors;
- Accident prevention and safety measures for environmental emergencies;
- Water & soil conservation plan;
- Mitigation and tracking plans for accumulated environmental impacts;
- Information disclosure and public consultation;
- Training plan for environmental protection;
- Implementation budget of the EMP.

The EMP provides the owner, contractor and subcontractors with sufficient information, particular for the implementation of the following:

- Meeting the environmental requirements from the national and Hunan provincial governments, and World Bank;
- Meeting all the environmental, social and economical conditions conferred by decisions, approvals and policies from the national, provincial, and municipal governments;
- Fostering and encouraging the participants’ mutual sense of responsibility towards the environmental and social benefits during the implementation period;
- Improving the supervising institutions and ZREIDC’s (including its
contractors’) awareness of environmental issues through training and delegation of roles in environmental management;

- Supervising the environmental and social benefits during the project lifecycle, and using an adaptive method of management to achieve the continued improvement of the environment and the minimization of impacts;
- Cooperating with local communities and stakeholders, and ensuring their benefits through the project;
- Facilitating participation of local stakeholders in each stage of the project’s supervision.
2 Environmental Policies and Regulations

The following list shows the laws and regulations from various levels of domestic governments and World Bank. Chapter 2 of the EIA report has summarized the relevant regulations, policies, guidelines, standards and plans, and the EMP is compliant to these requirements and procedures.

2.1 Domestic regulations

2.1.1 National regulations of environmental protection

(1) Environmental Protection Law of the People’s Republic of China (Apr 24, 2014);
(2) Atmospheric Pollution Prevention and Control Law of the People’s Republic of China (Feb 28, 2008);
(3) Water Pollution Prevention and Control Law of the People’s Republic of China (Feb 28, 2008);
(4) Cleaner Production Promotion Law of the People’s Republic of China (Feb 29, 2012);
(5) Land Management Law of the People’s Republic of China (Jan 1, 1999);
(6) Water and Soil Conservation Law of the People’s Republic of China (Dec 25, 2010);
(7) Forest Law of the People’s Republic of China (Jan 1, 1985);
(8) Water Law of the People’s Republic of China (Oct 1, 2002);
(9) Urban and Rural Plan Law of the People’s Republic of China (Jan 1, 2008);
(10) Solid Waste Pollution Prevention and Control Law of the People’s Republic of China (Revised Jun 29, 2013);
(11) Cultural Relics Protection Law of the People’s Republic of China (Revised Jun 29, 2013);
(12) Environmental Impact Assessment Law of the People’s Republic of China (Sep 1, 2003);
(13) Recycling Economy Promotion Law of the People’s Republic of China (Jan 1, 2009);
(14) Regulations on Environmental Protection in Construction Projects (State Council Order No. 253, Nov 29, 1998);
(15) Classified Administration Catalogue of Environmental Impact Assessment in Construction Projects (Ministry of Environmental Protection Order No. 33, Apr 20, 2015);
(16) Notice on Issuing Provisional Methods for Public Consultation in Environmental
Impact Assessments (State Administration of Environmental Protection, H.F. [2006] No. 28, Feb 14, 2006);


(18) Policies on Solid Waste Pollution Prevention and Control;

(19) Method for the Administration of Hazardous Waste Transfer Forms (Oct 1, 1999);

(20) Notice on Effective Environmental Pollution Prevention and Control in Enterprise Relocations (H.B. [2004] No. 47);

(21) Method for Prevention and Control of Environmental Pollution by Discarded Hazardous Chemicals (State Administration of Environmental Protection Order No. 27, 2005);

(22) Opinion on Strengthening Soil Pollution Prevent and Control (H.F. [2008] No. 48);

(23) Notice on Ensuring Environmental Safety in Redevelopment of Industrial Enterprise Sites (H.F. [2012] No. 140);

(24) State Council Opinion on Strengthening Key Environmental Protection Tasks (G.F. [2011] No. 35);

(25) Notice on Strengthening the Administration of Environmental Impact Assessment Management in Projects Financed by Loans of International Financial Organizations (Jun 21, 1993);

(26) Public Notice on Issuing “Industrial Enterprise Site Environment Survey, Assessment and Remediation Guidelines (Provisional)” (Ministry of Environmental Protection Public Notice, No. 78 of 2014);

(27) Notice on Strengthening Pollution Prevention and Control in Closure, Relocation and Site Redevelopment of Industrial Enterprises (H.F. [2014] No. 66)

2.1.2 Local Regulations and Documents on Environmental Protection

(1) Regulations on Environmental Protection Management of Hunan Province (May 27, 2013);

(2) Measures for Environmental Protection Management of Construction Projects in Hunan Province (October 1, 2007);

(3) Regulation for Water Pollution Control in Xiang River Basin of Hunan Province;

(4) Measures for Environmental Protection of Eco-economy Zone at Changsha, Zhuzhou and Xiangtan Section of Xiang River (September 1, 2013);
EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)

(5) Division of Surface Water Environmental Function Area for Main Water Systems in Hunan Province (DB43/023-2005);
(6) Decision of People’s Government in Hunan Province on the Implementing the Scientific Outlook on Development and Strengthening Environmental Protection (XZF[2006]No. 23);
(8) Decision of People’s Government in Hunan Province on Announcing the Catalogue of Cancelled, Decentralized and Reserved Administrative Licensing Items at the Provincial Level, Order No. 271 of People’s Government of Hunan Province;
(9) Notice of Zhuzhou Environmental Protection Bureau on Issuing Relevant Provisions for Environmental Management of Construction Projects in Zhuzhou (ZHB[2015]No. 12);
(10) Water Environmental Function Zoning in Zhuzhou (ZZF[2003]No. 8, June 4, 2003);
(11) Ambient Air Quality Function Zoning in Zhuzhou (ZZF[1997]No. 46, March 18, 1997);
(12) Notice of Zhuzhou Environmental Protection Bureau on Issuing Acoustic Environmental Function Zoning in the Downtown Area of Zhuzhou (ZHB[2013]No. 125, November 4, 2013);

2.1.3 Relevant Plan for Social, Economic Development, Environmental Protection and Heavy Metal Pollution Control

(1) Zhuzhou Comprehensive Prevention and Control Plan of Heavy Metal Pollution for the Twelveth Five-year ;
(2) Regional Plan of Changsha-Zhuzhou-Xiangtan City Cluster (2012~2020);
(3) Implementation Scheme for Recycling Economy of Qingshuitang Industrial Zone, Zhuzhou (August 2009);
(4) Comprehensive Plan for Environmental Pollution Control in Qingshuitang Industrial Zone (2008~2010);
(5) Plan for Qingshuitang Recycling Economy Industrial Zone, Zhuzhou (China Academy of Urban Plan and Design, Shanghai Branch, June 2009);
(6) Special Plan for Heavy Metal Pollution Control in Xiang River Region, November 2009;
(7) Implementation Plan for Heavy Metal Pollution Control in Xiang River Region, March 2011;

(8) Zhuzhou Urban Master Plan (2006~2020);

(9) Conceptual Plan for New Ecological Town in Qingshui Lake, Zhuzhou;

(10) Regulatory Plan for Core Zone of Qingshuitang Ecological Industrial Town, Zhuzhou (2012);

(11) Zhuzhou Environmental Protection Plan for the Twelveth Five-year (2011~2015);

(12) Zhuzhou Soil Environmental Protection Plan for the Twelveth Five-year (2011~2015);

### 2.1.4 Technical Guidelines for Environmental Impact Assessment

(1) Technical Guidelines for Environmental Impact Assessment – General (HJ2.1-2011);

(2) Technical Guidelines for Environmental Impact Assessment – Atmospheric Environment (HJ2.2-2008);

(3) Technical Guidelines for Environmental Impact Assessment – Surface Water Environment (HJ/T2.3-93);

(4) Technical Guidelines for Environmental Impact Assessment – Acoustic Environment (HJ/T2.4-2009);

(5) Technical Guidelines for Environmental Impact Assessment – Ecological Environment (HJ19-2011);

(6) Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ/T169-2004);

(7) Technical Guidelines for Environmental Impact Assessment – Underground Water (HJ610-2011);

(8) Technical Guidelines for Hazardous Waste Disposal (HJ 2042-2014);

(9) Terms for Contaminated Sites (HJ 682-2014);

(10) Technical Guidelines for Site Environmental Survey (HJ 25.1-2014);

(11) Technical Guidelines for Site Environmental Monitoring (HJ 25.2-2014 replacing HJ/T 25-1999);

(12) Technical Guidelines for Risk Assessment of Contaminated Sites (HJ 25.3-2014 replacing HJ/T 25-1999);

(13) Technical Guidelines for Soil Remediation of Contaminated Sites (HJ 25.4-2014 replacing HJ/T 25-1999);

2.1.5 Other documents

(1) Power of Attorney;
(3) Environmental Survey Report of Xiangshiling Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2012, Nanjing Institute of Soil Science, Chinese Academy of Sciences);
(4) Environmental Survey Report of Qingshi Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2012, Nanjing Institute of Soil Science, Chinese Academy of Sciences);
(5) Environmental Survey Report of Tongtangwan Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2012, Nanjing Institute of Soil Science, Chinese Academy of Sciences);
(6) Soil Pollution Survey Report of Tongxia Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2011, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);
(7) Soil Pollution Survey Report of Qingshui Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2011, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);
(8) Soil Pollution Survey Report of Yingfeng Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);
(9) Soil Pollution Survey Report of Qingshuihu No. I Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);
(10) Soil Pollution Survey Report of Qingshuihu No. II Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);
(11) Special Report for Groundwater Environment Impact Assessment of Qingshuitang Recycling Economy Industrial Zone in Zhuzhou City (2014, Coalfield Geology Bureau of Hunan Province);
(12) Soil Pollution Risk Assessment Report of Tongxia Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2012, Nanjing Institute of Environmental Sciences,
Ministry of Environmental Protection);  
(13) Soil Pollution Risk Assessment Report of Qingshui Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2012, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);  
(14) Soil Pollution Risk Assessment Report of Yingfeng Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);  
(15) Soil Pollution Risk Assessment Report of Qingshuihu No. I Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);  
(16) Soil Pollution Risk Assessment Report of Qingshuihu No. II Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Environmental Sciences, Ministry of Environmental Protection);  
(17) Soil Pollution Risk Assessment Report of Xiangshiling Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Soil Science, Chinese Academy of Sciences);  
(18) Soil Pollution Risk Assessment Report of Tongtangwan Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Soil Science, Chinese Academy of Sciences);  
(19) Soil Pollution Risk Assessment Report of Qingshi Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (2014, Nanjing Institute of Soil Science, Chinese Academy of Sciences);  
(20) Approval of Soil Pollution Risk Assessment Report of Tongxia Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (XHH [2012]No. 104);  
(21) Approval of Soil Pollution Risk Assessment Report of Qingshui Sub-region in Qingshuitang Industrial Zone of Zhuzhou City (XHH [2012]No. 105);  
(22) Reply Letter of Zhuzhou Environmental Protection Bureau on Standards for Remediation of Soil, Pond and Channel in Qingshuitang Industrial Zone;  
(23) Approval of Zhuzhou EPB on Site Assessment Report for former Tiancheng Chemical Plant in Qingshuitang Industrial Zone.  

2.2 World Bank safeguard policies  
(1) OP/BP4.01 Environmental Assessment;  
(2) OP/BP4.04 Natural Habitats;
(3) OP/BP4.11 Physical Cultural Resources;
(4) OP/BP4.12 Involuntary Resettlement.

2.3 Compliance analysis

2.3.1 Compliance with World Bank safeguard policies

Of the World Bank Groups ten safeguards policies, the following are triggered: 1) OP4.01 Environmental Assessment; 2) OP4.11 Physical Cultural Resources; 3) OP4.12 Involuntary Resettlement; and (4) OP4.11 Physical Cultural Resources. The World Bank Group Environmental, Health and Safety Guidelines (WGB EHS Guidelines) also apply to the project. The general principles and measures in the Guidelines are consistent with the requirements of Chinese laws, regulations, guidelines and construction management norms. Compliance with these policies and guidelines is summarized in Table 2.3-1.

<table>
<thead>
<tr>
<th>Safeguard Policies</th>
<th>Compliance</th>
</tr>
</thead>
</table>
| OP/BP 4.01 Environmental Assessment | - Category A project.  
- Full EIA and EMP have been prepared.  
- Two rounds of public consultation conducted as part of EIA process.  
- An ESMF is prepared to guide possible future remediation activities. |
| OP/BP4.04 Natural Habitats | - The proposed remediation activities, including land clearing, earth excavation and dredging of ponds will have potentially adverse impacts on terrestrial and water ecology in the project area. Rehabilitation of these sites are integral part of the project. Both positive and negative impacts on natural habitats are covered in the EIA and EMP |
| OP/BP4.11 Physical Cultural Resources | - There are a few physical cultural resources in the project area, including graves, Dawang Temple and Wuniang Temple. While, these sites will not be undertake remediation or construction activities, thus not directly affected by the project. Precautious measures are incorporated into the EMP.  
- Chance-find procedure has been developed in EMP |
| OP/BP 4.12 Involuntary Resettlement | - Resettlement Action Plans have been prepared as per OP4.12. |
| EHS General Guidelines   | - EIA/EMP are addressed the environmental issues of air, noise, wastewater, waste management, occupational and community health and safety, and construction related impacts |
| EHS Guidelines Waste Management Facility | - Proper measures developed in the EIA/EMP addressing waste collection and transport, unloading, processing and storage; landfill disposal; physiochemical and biological treatment and remediation |


2.3.2 **Compliances with World Bank EHS Guidelines**

The World Bank “Environmental, Health and Safety Guidelines” applies to this project. The EMP’s mitigation measures are completely compliant with its requirements (requirements on construction management in particular). It must be noted that the EHS Guidelines is basically consistent with China’s regulations, guidelines and practices.

### Table 2.3-2 Compliances of requirements from World Bank’s “Environmental, Health and Safety Guidelines”

<table>
<thead>
<tr>
<th>EHS Guidelines</th>
<th>Compliances in EIA and EMP</th>
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<tbody>
<tr>
<td><strong>Dusts:</strong> The most common pollutant involved in fugitive emissions is dust or particulate matter (PM). This is released during certain operations, such as transport and open storage of solid materials, and from exposed soil surfaces, including unpaved roads. Recommended prevention and control of these emissions sources include: Use of dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles, or controls, including air extraction and treatment through a baghouse or cyclone for material handling sources, such as conveyors and bins; Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust.</td>
<td>Dust control measures will be implemented during the construction and operation periods, such as covers, water suppression, or increased moisture content for open materials storage piles. Water suppression will be used on surfaces of paved or unpaved roads. Compliant.</td>
</tr>
<tr>
<td><strong>Industrial wastewater:</strong> Transfer of pollutants to another phase, such as air, soil, or the sub-surface, should be minimized through process and engineering controls. <strong>Stormwater:</strong> Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present;</td>
<td>Wastewater generated by the project will be pre-treated. Unrecyclable wastewater will be discharged at processing plants. Leakage prevention on pipelines and facilities to reduce transmission of pollutants. The first flush of stormwater from construction and stabilization/solidification facilities will be collected and processed. Compliant.</td>
</tr>
<tr>
<td><strong>Noise:</strong> Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the</td>
<td>Low-noise equipment will be used. Vibration-reduction devices will be installed. Running time of certain facilities or operations will be restricted, particularly mobile noise</td>
</tr>
</tbody>
</table>
### EHS Guidelines \hspace{1cm} Compliances in EIA and EMP

<table>
<thead>
<tr>
<th>Construction and Decommissioning: […] prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities.</th>
<th>The impacts of construction and decommissioning are considered in the EMP and its mitigation measures.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHS Guidelines Waste Management Facility</td>
<td>Proper measures developed in the EIA/EMPs addressing waste collection and transport, unloading, processing and storage; landfill disposal; physiochemical and biological treatment and remediation</td>
</tr>
</tbody>
</table>

#### 2.3.3 Compliance of domestic regulations

The EIA documents are prepared according to laws, regulations and guidelines. Table 2.3-3 shows the compliance of domestic regulations.

**Table 2.3-3 Compliance of Chinese regulations**

<table>
<thead>
<tr>
<th>Chinese Regulations</th>
<th>Relevant Provisions</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Impact Assessment Law of the People's Republic of China</td>
<td>[…] to build any project within the territory of the People's Republic of China or within other seas subject to the jurisdiction of the People's Republic of China, appraisals shall be conducted about the environmental impacts according to the present Law.</td>
<td>The full EIA report was prepared by qualified organizations, and approved by Bureau of Environmental Protection of Shifeng District. Two rounds of public consultations are to be conducted.</td>
</tr>
<tr>
<td>Environmental Protection Law of the People's Republic of China</td>
<td>Article 50: The people's governments at various levels shall allocate funds in their fiscal budgets to support protection of rural drinking water sources, treatment of domestic sewage and other waste, pollution prevention and control for livestock and poultry breeding and slaughtering, prevention and control of soil pollution, management of rural industrial and mining pollution and other environmental protection work.</td>
<td>The project involves the remediation of contaminated soils, which conforms to the policy requirements on soil remediation and pollution.</td>
</tr>
<tr>
<td>Chinese Regulations</td>
<td>Relevant Provisions</td>
<td>Compliance</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Cultural Relics Protection Law of the People’s Republic of China | Article 32: The State shall strengthen the protection of atmosphere, water and soil, establish and improve the corresponding investigation monitoring, assessment and remediation systems.  
Article 33: The people's governments at various levels shall enhance the protection of the agricultural environment, promote the application of new technologies for agricultural environmental protection, strengthen the monitoring and early warning system for agricultural pollution sources, and coordinate relevant departments to take measures to prevent the occurrence and deterioration of soil pollution, desertification, salinization, impoverishment, rocky desertification, and ground subsidence, prevent and control vegetation damage, soil erosion, water eutrophication, water depletion, provenance extinction and other ecological imbalances, and promote integrated plant pest management. | prevention and treatment.                                                                           |
<p>| Notice on Strengthening the Administration of Environmental | Article 32: In construction projects or agricultural production, any entity or individual that discovers cultural relics shall protect the scene and immediately report the discoveries to the local department of cultural relics administration, which shall hurriedly go to the scene upon receipt of the report if there are no special circumstances, and shall give opinions on handling within 7 days; discoveries of important cultural relics shall be immediately reported to the department of cultural relics administration under the State Council, which shall give opinions on handling within 15 days from the day of receipt of the report. | Cultural resources including graves, Dawang Shrine and Wuniang Shrine are found in project area. Graves and Dawang Shrine are located on mountains; Wuniang Shrine is also not within the remediation areas. They will not be affected by the construction works. The EMP includes measures to prevent impacting these resources. The EMP includes procedures for incidental discoveries. |
| EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area) | In EIA for loan-financed projects, attention should be paid to temporal coordination between domestic and foreign procedures. The development and review of the Assessment Outline should be completed during the EIA report and EMP conforms to World Bank safeguard policies. |                                                                                                  |</p>
<table>
<thead>
<tr>
<th>Chinese Regulations</th>
<th>Relevant Provisions</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact Assessment Management in Projects Financed by Loans of International Financial Organizations</td>
<td>the preparation stage of the IFO-financed project. When submitting the Outline to environmental protection authorities for review, another copy should also be submitted to the relevant IFO for comments. The feedback comments should also be promptly submitted to the EP authorities responsible for reviewing the Project Report. The preparation stage of the IFO-financed project. When submitting the Outline to environmental protection authorities for review, another copy should also be submitted to the relevant IFO for comments. The feedback comments should also be promptly submitted to the EP authorities responsible for reviewing the Project Report.</td>
<td>For the project, risk assessment has been conducted in accordance to relevant requirements, and remediation and remediation will be performed, in compliance with the document.</td>
</tr>
<tr>
<td>Opinion on Strengthening Soil Pollution Prevention and Control (H.F. [2008] No. 48)</td>
<td>Systems of soil pollution risk assessment and remediation shall be established. If the sites of moved polluting enterprises and other potentially polluted areas shall be used for development, the environmental protection authorities shall urge responsible organizations or individuals to conduct risk assessment, clarify the responsible parties and technical requirements for the remediation, supervise the soil remediation of polluted areas, and reduce the risks on human health after their redevelopment, particularly as residential land. Regarding environmental issues caused by residual pollutants, such as soil and groundwater contamination, the original production/operation organizations shall be responsible for the remediation and function-restoration of the soils. Supervision on key polluting industries, such as chemicals, electric plating and oil storage should be strengthened, and discovered soil pollution issues should be promptly handled. If development plans shall include the repurposing of regional or concentrated industrial lands, the local EP authorities should urge relevant organizations to conduct risk assessments, and use the assessment results as an important evidence in the EIA of the plans. At the same time, they should also urge other relevant authorities to conduct the EIA of the plans, and arrange for the review of said EIA reports according to proper procedures; for areas whose plans have failed to receive EIA legally, the EP authorities shall not approve the EIA documents on new construction projects in said areas.</td>
<td></td>
</tr>
<tr>
<td>Chinese Regulations</td>
<td>Relevant Provisions</td>
<td>Compliance</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Industrial Enterprise Sites (H.F. [2012] No. 140)</td>
<td>guidance of the local governments. Higher priority should be given to polluted areas with significant potential risks to the safety of residents, drinking water etc. The responsible parties should be urged to take measures that prevent pollution spreading, including quarantinization. Remediated areas can be reused after their conditions have met the requirements. Redevelopment of unremediated areas, and construction of any projects unrelated to their remediation are forbidden.</td>
<td>pollution remediation. The area will be repurposed after soil remediation, in compliance with H.F. [2012] No. 140.</td>
</tr>
<tr>
<td>Catalogue for the Guidance of Industrial Structure Adjustment (2013, Revised)</td>
<td>“</td>
<td>The project does not fall into any of the encouraged, restricted or obsoleted categories.</td>
</tr>
<tr>
<td>Xiang River Region Heavy Metal Pollution Remediation Implementation Plan</td>
<td>The plan includes a total of 927 projects, and a total investment of CNY 59.5 billion. Of these, 17 projects have been approved for the Qingshuitang Industrial Zone, including the industrial wastewater treatment and recycling, comprehensive treatment of heavy metal wastes, soil remediation of heavy metal contaminated brownfields, etc.</td>
<td>This project is the soil remediation project for key areas in the plan. Compliant.</td>
</tr>
<tr>
<td>Zhuzhou Environmental Remediation and Protection Development Plan for the Twelfth Five-year</td>
<td>Comprehensive remediation of heavy metal pollution will be conducted, with detailed implementation plans for key areas, according to the provisions of “Heavy Metal Pollution Comprehensive Prevention and Control Plan for the Twelfth Five-year” and “Xiang River Region Heavy Metal Pollution Remediation Implementation Plan” as approved by the State Council. The potential risks of heavy metal contamination will be gradually eliminated through a series of key projects: replacement of sintering-blast furnace lead smelting with Kivcet direct lead smelting for Zhuzhou Smelter Group; remediation of gaseous heavy metal pollution; remediation of heavy metal sedimentation in Qingshuitang; remediation of wastewater and gas in heavy metal-related enterprises in Chaling, You County; remediation of heavy metal pollution from ceramics and paint industries in Liling; resettlement of residents in areas with heavy metal soil pollution; etc.</td>
<td>This project is the project for “remediation of heavy metal sedimentation in Qingshuitang” in the document. Compliant.</td>
</tr>
</tbody>
</table>
3 Roles and Duties of Environmental Management

3.1 Agencies participating in environmental management

Implementing the Environmental Management Plan requires participation from multiple agencies and departments. Different agencies play different roles to ensure effective environmental management of the project.

Environmental management will involve two groups of agencies: agencies that organize or implement the Environmental Management Plan; and agencies that implement the standards, laws, and regulations related to the project and that also supervise the implementation of the Environmental Management Plan (EMP) and overall environmental performance during the project’s implementation and operation. See the project’s environmental management and monitoring agencies in Fig.3.1-1.
Fig. Error! Use the Home tab to apply  标题 2 to the text that you want to appear here. -1 Framework of Environmental Management & Supervision Organizations of the Project

3.2 Duties of environmental management agencies

See primary duties of environmental management agencies in table 3.2-1:
### Table 3.2-1  Environmental monitoring and management duties

<table>
<thead>
<tr>
<th>No.</th>
<th>Agencies/Authorities</th>
<th>Duties</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zhuzhou Municipal People’s Government (the Project Management Office)</td>
<td>Undertake the project’s environmental management work, including effectively implementing, supervising, and monitoring mitigation measures, and reporting the use of budgets to the World Bank and local environmental protection agency (EPA); Ensure that measures stated in the Environmental Management Plan are included in bidding documents and construction contracts; Supervise construction undertakers to ensure that they implement measures for pollution prevention and control; and timely report violations to the construction undertakers; Ensure the content that the EPA supervises is included in bidding documents and in the contracts entered into with the project supervision engineers; monitor and participate in supervising the project; Commission environmental monitoring agencies to monitor environment during construction; and support the work of these agencies during construction; Organize environment-related training for the Contractor and the Environmental Supervision Engineer.</td>
</tr>
<tr>
<td>2</td>
<td>The EPA of the Shifeng District and Zhuzhou City</td>
<td>Undertake the project’s environmental monitoring and management work; monitor and supervise environmental protection during construction and operation on behalf of the provincial environmental protection bureau; investigate and handle complaints about noise filed by residents during construction and operation; ensure the “three simultaneity”; and ensure that environmental protection facilities function normally.</td>
</tr>
<tr>
<td>3</td>
<td>Zhuzhou Recycling Economy Investment and Development Co., Ltd (PIU)</td>
<td>ZREIDC will implement the infrastructure construction project funded by the World Bank, including procurement, construction management, implementation of security policies, and monitoring and reporting.</td>
</tr>
<tr>
<td>4</td>
<td>The project operator</td>
<td>Operate environmental protection facilities and conduct environmental management work while the project is being undertaken.</td>
</tr>
<tr>
<td>5</td>
<td>The supervision engineer(SE)</td>
<td>Undertake the investment control, construction schedule control, engineering quality control, safety control of engineering construction, conduct the information management, construction contract management; And coordinate the working relationship between the relevant units, namely &quot;four control, two management and one coordination&quot;.</td>
</tr>
<tr>
<td>6</td>
<td>The Environmental Supervision Engineer (ESE)</td>
<td>Examine and evaluate whether the design for construction meets the requirements of the Environmental Impact Assessment and the Environmental Management Plan; Especially examine and evaluate the on-site environmental management work and measures required to mitigate impacts; Supervise the on-site environmental management work of the Contractor and provide correct guidance; Examine the Contractor’s implementation of the environmental management plan; verify and confirm the procedures, parameters, locations, equipment, and results of environmental monitoring and management; Report on the implementation of the Environmental Management Plan; Examine and approve invoices or expenditures associated with the implementation of the Environmental Management Plan.</td>
</tr>
<tr>
<td>7</td>
<td>The Contractor</td>
<td>Make detailed environmental protection plans, which are required to be</td>
</tr>
</tbody>
</table>
### Environmental management duties during construction


The PMO under Zhuzhou Municipal Government and housed in the Development and Reform Commission (DRC) takes overall responsibility of the project implementation, including safeguards. ZREIDC, the project owner and Project Implementation Unit (PIU), takes charge of the day-to-day management and coordination of the project’s implementation, and supervise the implementation of the project so as to ensure it meets the requirements of the World Bank. The ZREIDC is the project implementing agency. In order to ensure that the EPA of the Shifeng District in Zhuzhou and the World Bank monitor the implementation of the project, the ZREIDC needs to ensure that the project’s environmental management meets the requirements of the EMP and relevant laws and regulations.

   Environmental management duties of the ZREIDC include, but are not limited to the following:

   - Supervise the implementation of various mitigation and environmental protection measures during construction; write these measures into bidding documents and contracts; organize training for the Contractor; implement other environmental management plans, and regularly examine the

<table>
<thead>
<tr>
<th>No.</th>
<th>Agencies/Authorities</th>
<th>Duties</th>
</tr>
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<tbody>
<tr>
<td>8</td>
<td>Independent Environmental Management Consultant (IEMC)</td>
<td>The IEMC, employed by the project owner, is independent from the ESE and the Contractor. The IEMC’s tasks include evaluating implementation of the Environmental Management Plan while the project is being undertaken; offering advice on management to the project owner, and ensuring that the project meets the requirements of the Environmental Management Plan.</td>
</tr>
<tr>
<td>9</td>
<td>Environmental Quality Monitoring Consultant (EQMC)</td>
<td>The EQMC is a professional agency that undertakes environmental quality monitoring work according to the environmental monitoring plan included in the environmental impact assessment report. The project owner will hire the EQMC to implement monitoring plan.</td>
</tr>
</tbody>
</table>
construction site.

- Hire an environmental monitoring consultant and supervise it (e.g. the IEMC and the EQMC) ; and monitor the environment according to the project’s environmental monitoring plan.
- Hire and supervise the IEMC and offer technical support for it, including management advice, training, regular on-the-spot investigation, and the writing of various reports.

The ZREIDC will assign 1-2 environmental workers to take charge of the overall coordination of implementation of the Environmental Management Plan. These workers need to be familiar with environmental management and environmental regulations, and can grasp and implement the EMP. The responsibilities of environmental workers include:

- Ensure that the project’s environmental management meets the requirements of the EMP and relevant regulations. Where the project’s environmental management fails to meet the requirements of the EMP and relevant regulations, proper measures should be taken to deal with it.
- Keep open and smooth communication on environmental issues with the Project Management Office (PMO) of the Zhuzhou Municipal People’s Government, supervision engineers, and the Contractor.
- Examine and approve the Environmental Protection Implementation Plan that is made by the Contractor and might exert serious environmental impacts on the project’s key activities.
- Regularly inspect all construction sites according to the EMP.
- Examine and archive the Contractor’s and the ESE’s various reports concerning environmental management.
- Report monthly on environmental issues on construction sites to the PMO of the Zhuzhou municipal government

2. Zhuzhou Municipal EPB and Shifeng District EPB

The environmental supervision team affiliated to Zhuzhou Environmental Protection Bureau has a Class II supervision capacity according to national standardization construction, responsible for supervising the implementation of “three simultaneities” and performance of pollution treatment by organizations directly under its administration.

The environmental monitoring center affiliated to Zhuzhou Environmental Protection Bureau meet the Class-II standards according to national standardization construction, responsible for regular and unscheduled monitoring of pollutants discharged by various organizations in the city. Current monitoring frequency is once
a month for key enterprises and ordinary enterprises in administrative region.

Shifeng District Environmental Protection Bureau is in charge of supervising and implementing environmental management plan, handling complaints during project construction, formulating and establishing environmental protection system and policies, supervising the implementation of environmental measures, as well as operation and maintenance of equipment, and inspecting environmental protection sites beyond administration of municipal bureau but under its administration.

or the regularly or irregularly monitoring measurement of the pollutant emission situation within the municipal related departments. The current monitoring frequency shows as: conduct the a monthly monitoring for the key controlled enterprises, and conduct a monthly monitoring for the ordinary enterprises. Shifeng District EPB is responsible for supervising and implementing the environmental management scheme for project constructing; Monitoring, investigating, and dealing with the nuisance complaints during construction period; Also responsible for the development and establishment of the related environmental protection system and policy; Besides, the District EPB has to supervise the implementing of the environmental protection and the operation, maintenance of the equipment during construction period, to ensure its normal and stable operation; As well as conducting the environmental protection inspection except for the municipal governing departments.

3. The Contractor

At any time, the Contractor and his employees should first try to prevent the project’s construction from exerting any negative impacts, and then implement the mitigation measures stipulated in the EMP and the contract, so as to minimize the impacts and damages of the project’s construction on the environment and local communities.

Remedial measures that fail to be effectively implemented during construction shall be implemented after the project is complete and before the acceptance test conducted upon completion of the project.

The Contractor should build a strong environmental management system to meet the requirements of the mechanism, on-site measures, monitoring, training, and
Chapter 7 contains detailed environmental specifications that the Contractor shall meet.

3. Environmental Supervision Engineer (ESE)

Providing an ESE is a function of supervision engineer companies. Each supervision engineer company will assign at least one ESE to every working group under each contract. ESE has the following duties:

- Examine the Contractor’s construction organization plan and ensure that the plan meets the EMP and the requirements of the project’s construction in environmental protection and impacts mitigation.
- Regarding the project’s key activities that may have impacts on the environment, examine the implementation of the Environmental Protection Implementation Plan and the Environmental Protection Plan for Organizing Construction by the Contractor on construction sites before the project owner approves the key activities.
- Carry out day-to-day site inspections, and ensure that activities conducted by the Contractor meet the EMP and other relevant regulations; where the activities fail to meet the EMP and other relevant regulations, guide the Contractor to adopt remedial measures within the time period required by the ESE.
- In the implementation of environmental monitoring and management, if necessary, assist the PMO of the Zhuzhou municipal government in finishing relevant work.
- Regularly monitor the Contractor’s implementation of the environmental management system, including environmental workers, procedures, and reports; examine and confirm environmental monitoring and management procedures, parameters, monitoring locations, equipment, and results. In case of non compliance, the ESE will instruct the Contractor to adopt remedial measures, including measures to replace environmental workers and to increase the ability of the Contractor to protect the environment.
- Write environmental monitoring and management report on a regular basis and submit the report to the PMO of the Zhuzhou municipal government for reviewing and archiving.
- As a supervision engineer, prepare various invoices or payments associated with the implementation of the EMP

4. Independent Environmental Management Consultant (IEMC)

The PMO of the Zhuzhou municipal government needs to hire an IEMC to provide technical support for environmental protection during construction. The IEMC will be independent from both the ESE and the Contractor, and will report its work directly to the PMO. The IEMC will be led by a person who can independently...
and professionally examine various records, procedures, and processes. He/she can require that a small team be built to help inspect construction sites (i.e. independent environmental management consultant team) . The IEMC should be knowledgeable and experienced in environmental monitoring and audit so that it can provide independent, objective, and professional advice on the project’s environmental performance (needs at least five years of relevant experience) . Through examining various reports, the IEMC should get familiar with the project, including the project’s Environmental Management Plan. The IEMC has the following duties:

- Examine and audit the EMP in a comprehensive, independent, objective, and professional way;
- Test and confirm the accuracy of monitoring results, monitoring equipment, monitoring location, monitoring procedures, and sensitive areas;
- Select and test random samples, and examine monitoring data and sampling procedures;
- Conduct random on-site tests;
- According to the implementation of environmental protection measures, examine the advice and requirements on the environmental impact assessment;
- Examine the project’s environmental performance and the effectiveness of mitigation measures;
- Test and prove the acceptability of construction methods, relevant designs and plans, and submitted materials to ensure they meet environmental protection standards; where necessary, the IEMC should cooperate with designers, the Contractor, and the ZREIDC to develop alternatives for minimizing impacts;
- Test the findings of environmental non-compliance;
- Validity of environmental quality and performance and of remedial measures;
- Give feedback on findings of procedures that fail to comply with the Environmental Management Plan to the PMO and the environmental supervision engineer team; and offer advice on shutdown or other punishments to supervision engineers (ESE);
- Before and during the project’s construction, provide training for workers employed by the Contractor, the ESE, and the PMO;
- Help write semi-annual environmental monitoring reports that will be submitted to the ZREIDC and the World Bank.

5. Environmental Quality Monitoring Consultant (EQMC)

In order to closely monitor environmental quality of the project area and minimize impacts of construction and operation on the environment, the PMO of the Zhuzhou municipal government will hire a professional environmental monitoring consultant to implement the environmental monitoring plan that was developed when assessing environmental impacts. The EQMC has the following duties:
- Get familiarized with both the project and the Environmental Management Plan, especially the environmental monitoring plan;
- Try to use professional methods to monitor environmental quality according to the environmental monitoring plan;
- Examine and confirm monitoring results’ accuracy, monitoring equipment, monitoring locations, monitoring procedures, and sensitive areas;
- Submit monitoring results to the ZREIDC in a timely manner and offer them advice

3.4 Managing the Contractor

During construction, the Contractor is required to take the responsibility of controlling and mitigating the impacts of construction on the environment, and implement all environmental protection measures, including taking the following measures into consideration:

In pre-qualification, write environmental management into article of assessing and approving the eligibility of the Contractor; under the same condition, give priority to the bidder who is certified by the ISO9001 and ISO14001;

At each construction stage, assign at least one full-time person to undertake environmental monitoring and control, and implement specific environmental protection measures;

In making the bidding documents, the project owner should write all environmental protection measures (required by the project that has been approved by the environmental impact assessment and environmental management plan) into Contract Terms, so as to ensure that the regulations, responsibilities, and budgets with regard to environmental protection are well understood. It should be made clear in the contract terms that: as to environmental issues identified by the environmental engineer, the contractor shall take all effective measures to solve it on time, and have the result reported to the environmental engineer. In case the contractor is refusing to solve the environmental issues, or the environmental issues remain unresolved at the required time, the contractor shall shoulder relevant financial responsibility and other responsibilities.

Prior to construction, the Contractor will receive environment-related training. Each department of the Contractor should assign at least one senior manager and one
environmental protection professional to participate in the training. The training will be provided by a consultancy that is rich in environmental protection experience and is in close contact with local administrative departments. The training includes:

- Relevant national and local laws, regulations, and emissions standards;
- Technical guidance for protecting the environment;
- The project’s Environmental Impact Assessment and Environmental Management Plan;
- Specific requirements, methods, and parameters with regard to all monitoring locations;
- Specific requirements for feedback on monitoring reports and monitoring data;
- Applicable mitigation measures;
- Emergency measures for hazardous material leakage situations;
- Involving the public and addressing their complaints during construction;
- The Contractor’s duty to protect the environment.

Based on environmental monitoring and management responsibilities, designate a construction supervision engineering company (or companies) to appoint the environmental supervision engineer; include the requirements for environmental monitoring and management in the bidding documents and also the contract that will be given to the supervision engineer company.

3.5 Environmental management agencies during the project’s operation

1. Environmental Protection Agency (EPA) of the Shifeng District in Zhuzhou

The EPA has the following duties:

(1) Supervise and implement the project’s environmental management plan;

(2) Develop the project’s environmental protection policies and systems;

(3) Gather environmental statistics, archive the sources of pollution, and report on both;

(4) Supervise the operation and maintenance of the project’s environmental protection facilities so as to ensure that the facilities function normally and stably;
(5) Supervise, investigate, and address complaints of disturbances while the project is underway; ensure that environmental protection facilities function normally.

2. The project’s operator

Set up an environmental management office specifically for the implementation of the environmental management plan while the project is underway. The environmental management office has the following responsibilities:

(1) Manage implementation of the project’s environmental protection measures;

(2) Coordinate with environmental supervision and management departments as well as the residents in the area surrounding the project’s site to solve environmental issues;

(3) Follow the project’s environmental monitoring plan; commission the monitoring station in the city to monitor the waste gas, waste water, and solid wastes discharged by the project’s facilities and to also monitor the area’s environmental quality, at the frequency and locations specified by the plan’s requirements.

(4) Respond to environmental emergencies;

(5) In a timely manner, report the information gathered from corporate environmental management to the EPA of the city and the PMO;

(6) Record and file archives regarding corporate environmental management.
4 Remediation plan

4.1 Overview of remediation plan

This project is implemented in the Qingshuitang Industrial Zone (QIZ), located in the Shifeng District in Zhuzhou, Province of Hunan. The Zone covers a total area of 8.48 km², with the Xiangtian Road in the east, the Beijing-Guangzhou high-speed railway in the west, the Zhuzhou Smelting Plant in the north, and the Xiang River in the south.

The area which this project treats is the remediation area identified in the stage of both risk assessment and feasibility study. The area, covering 2.73 km², is the risk unacceptable area identified in the risk assessment report and not included in the risk controllable areas.

The remediation plan that is implemented in the area includes:

- Cleanup plan for sites outside closed facilities, channels, ponds, and waste dumps;
- Remediation plan for closed facilities;
- Remediation plan for soil contaminated by heavy metals;
- Remediation plan for soil contaminated by organic pollutants;
- Waste pile cleanup plan;
- Channel and pond remediation plan;
- Replacement and backfill plan for uncovered soil in the area that is not treated by the project;
- Manage construction of treatment works—construction plan for the stabilization/solidification sites, dewatering sites, and temporary storage sites;
- Plan for temporary roads and transport routes;
- Construction plan for solid wastes landfill;

See distribution map of remediation technology in the remediation area in map 4.1-1.
Map 3.5-1  Distribution map of remediation technology for contaminated lands in the area

<table>
<thead>
<tr>
<th>Remediation Technologies</th>
<th>Area(m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-situ stabilization + capping</td>
<td>75,456.35973</td>
</tr>
<tr>
<td>In-situ stabilization + vegetation</td>
<td>12,618.9807</td>
</tr>
<tr>
<td>Ex-situ S/S</td>
<td>42,657.4299</td>
</tr>
<tr>
<td>Transport to planned industrial land</td>
<td>64,092.538</td>
</tr>
<tr>
<td>Residential land transport to industrial land</td>
<td>65,476.678</td>
</tr>
<tr>
<td>Vegetation</td>
<td>18,638.754</td>
</tr>
<tr>
<td>Phytoremediation interception</td>
<td>5,4821.043</td>
</tr>
</tbody>
</table>
4.2 Cleanup plan for sites outside closed facilities, channels, ponds, and waste dumps

The project first cleans up sites in the area being treated, then treats wastes that have accumulated over time and sediment in channels and ponds, and finally it treats the soil on contaminated sites. See cleanup routes in Fig 4.2-1.

![Diagram of cleanup routes in the area being treated]

This project needs to treat a total area of 2.30 km² outside closed facilities, channels, ponds, and waste dumps; recycle the large trees felled while cleaning up the surface of the site; and safely dispose of all other debris into a landfill.

21993 m³ of a floor area of the residential housing to be demolished needs to be cleaned up, producing wastes amounting to 39310 m³. Construction waste in residential areas will be directly smashed and then used for making concrete, building roadbed, or backfilling in the area.

Cleaned sites can be then treated.
Table 4.2-1 Estimation of quantities for cleaning up sites outside closed facilities, channels, ponds, and waste dumps

<table>
<thead>
<tr>
<th>No.</th>
<th>Sub-region</th>
<th>Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yingfeng</td>
<td>183376</td>
</tr>
<tr>
<td>2</td>
<td>Qingshui</td>
<td>895948</td>
</tr>
<tr>
<td>3</td>
<td>Qingshi</td>
<td>411982</td>
</tr>
<tr>
<td>4</td>
<td>Tongxia</td>
<td>231317</td>
</tr>
<tr>
<td>5</td>
<td>Qingshi</td>
<td>28150</td>
</tr>
<tr>
<td>6</td>
<td>Tongtangwan</td>
<td>538789</td>
</tr>
<tr>
<td>7</td>
<td>Xiangshiling</td>
<td>1895</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2291457</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Sub-region</th>
<th>Area of buildings to be demolished (m²)</th>
<th>Amount of construction waste (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Xiangshiling</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>Qingshui</td>
<td>2464.3</td>
<td>763.93</td>
</tr>
<tr>
<td>3</td>
<td>Qingshi</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>Yingfeng</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>Qingshi</td>
<td>145.7</td>
<td>45.17</td>
</tr>
<tr>
<td>6</td>
<td>Tongxia</td>
<td>6291.9</td>
<td>4167.9</td>
</tr>
<tr>
<td>7</td>
<td>Tongtangwan</td>
<td>13091.1</td>
<td>34332.9</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>21993</td>
<td>39310</td>
</tr>
</tbody>
</table>

4.3 Remediation plan for closed facilities

The project has investigated six closed facilities, namely, Zhuzhou Yongfa Metal Refining Co., Ltd. (Yongfa Refinery), Zhuzhou Brothers Industry Co., Ltd. (Brothers Industry), Zhuzhou Kangli Smelting Plant (Kangli Smelter), Zhuzhou Tiancheng Chemical Co., Ltd. (Tiancheng Chemicals), Zhuzhou Xinda Smelting Co., Ltd. (Xinda Smelter), and Zhuzhou Hehua Cement Plant (Hehua Cement). See locations of the closed facilities in table 4.3-1.
<table>
<thead>
<tr>
<th>NO.</th>
<th>Facilities</th>
<th>Area of currently occupied land (m²)</th>
<th>Area of buildings to be demolished (m²)</th>
<th>Amount of construction waste (m³)</th>
<th>Area of buildings to be cleaned up (m²)</th>
<th>Equipment to be demolished</th>
<th>Amount of wash water (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Xinda Smelter</td>
<td>12270.6</td>
<td>4753.6</td>
<td>3252.5</td>
<td>97.8</td>
<td>0</td>
<td>1410.9</td>
</tr>
<tr>
<td>2</td>
<td>Brothers Industry</td>
<td>22929.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>3</td>
<td>Yongfa Refinery</td>
<td>12779.2</td>
<td>3677</td>
<td>2515.8</td>
<td>180.0</td>
<td>production equipment</td>
<td>1150.9</td>
</tr>
<tr>
<td>4</td>
<td>Kangli Smelter</td>
<td>9906</td>
<td>1116.2</td>
<td>763.7</td>
<td>116.5</td>
<td>0</td>
<td>384.6</td>
</tr>
<tr>
<td>5</td>
<td>Tiancheng Chemicals</td>
<td>104813.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>6</td>
<td>Hehua Cement</td>
<td>28879.4</td>
<td>0.0</td>
<td>0.0</td>
<td>7316.5</td>
<td>ball mill</td>
<td>4170.4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>191579</td>
<td>9546.8</td>
<td>6532.0</td>
<td>7710.8</td>
<td></td>
<td>7116.8</td>
</tr>
</tbody>
</table>
Fig. Locations of the closed facilities in the project area
4.3.1 Remediation plan for Yongfa Refinery

Remediation for contaminated sites in Yongfa Refinery includes:

(1) site cleanup (including demolishing and cleaning buildings and equipment, and washing the exterior of buildings in the office area);

(2) excavate and restore contaminated soil;

(3) treat wastes that have accumulated over time with stabilization/solidification technology;

(4) collect and treat waste wash water.

Fig. Error! Use the Home tab to apply 标题 2 to the text that you want to appear here. remediation technology roadmap for contaminated sites in the closed facilities

1) Site cleanup

Facilities produce dustfall during operation and this dustfall has been left in workshops of the closed facilities. In order to prevent transport of construction waste from polluting the
environment, construction waste produced during building demolition needs to be cleaned up.

Based on the on-site investigation, some of the buildings in the facilities are office buildings, which can still be used. So decision has been made to wash the exterior of these buildings and then collect and treat the waste wash water.

Regarding the construction waste that is produced while demolishing sites contaminated by heavy metals, workers select and classify the recyclable substances, such as metallic materials, wood materials, and plastics, and deliver them directly to relevant companies for disposal. Substances in construction waste, such as bricks, marble, and large pieces of concrete, are smashed by mobile crusher and then transported to the Zhuzhou building materials factory for integrated utilization. The construction waste is sorted out, smashed, and then washed. The wash water joins the nearby municipal water supply pipelines and the waste water produced thereby is collected through grooves and flows to a preliminary sedimentation tank where it is sedimented; after the waste water is sedimented, supernatant flows into water treatment vehicle and then the waste water can be reused as wash water. Sludge is transported to stabilizing treatment system for disposal.

Each facility site contaminated by heavy metals needs to build a preliminary sedimentation tank; the size of such a tank is determined by the amount of waste water produced through flushing the contaminated facility site. Sedimentation tank is built in rectangular shape and in brick-concrete structure.

Buildings and equipment are demolished primarily by crushers, which have a capacity of 10-25 t/h and a power of 18.5 kW. Water treatment vehicle has a treatment capacity of about 400m³/d.

See Figure Fig. 4.2-4 to view the structures that will be treated.
2) Treatment of contaminated soil with stabilization/solidification technology

After buildings on the contaminated site are demolished and cleaned up, excavate both the contaminated soil on the site and the soil underneath demolished buildings, with a excavation depth of 1m; the excavated soil is sealed and transported to temporary storage sites for stabilization/solidification; stabilized soil that meets treatment standards is safely backfilled.

According to the Regulatory Plan for the Core Area of the Zhuzhou Qingshuitang Eco-Industrial City and the locations of six closed facilities shown in map 4.3-4, the area where the Yongfa Refinery is located is planned to be used as parks and green space.
Fig. 4.2-5 Plan for the core area of the Qingshuitang eco-industrial city and locations of six closed facilities
4.3.2 Remediation plan for Brothers Industry

According to data analysis and site survey, uncovered soil in the Brothers Industry has been severely contaminated. In the Brothers Industry there is a large concrete area and it has been around for quite a while, moreover, the structures in the area are relatively intact and can still be used, so structures in the Brothers Industry will not be demolished, but uncovered soil in the area will be excavated and restored. Uncovered soil to be restored covers an area of 1146m²; no buildings are to be demolished and cleaned out. See map Fig. 4.2-6. to view the structures that will be treated.

Remediation plan for the contaminated site in the Brothers Industry focuses on excavation and restoration of contaminated soil.

According to the Regulatory Plan for the Core Area of the Zhuzhou Qingshuitang Eco-Industrial City and the locations of six closed facilities shown in map 4.3-4, the area where the Brothers Industry is located is planned to be used as commercial land, water area, and parks and green space.
4.3.3 Remediation plan for Kangli Smelter

According to the site survey and data analysis for Kangli Smelter, remediation for its contaminated site includes:

(1) Demolition and cleanout of the buildings;

(2) Excavation and restoration of contaminated soil;

(3) Demolition of disused pools and treatment of waste water

Uncovered soil in the area where the Kangli Smelter is located has been severely contaminated; production-oriented structures left in the area have been worn out and soil in the surrounding area has been contaminated in various degrees. In order to keep the restored soil from being re-contaminated by the original manufacturing facility, disused production-oriented structures need to be demolished and treated while soil in the area is being restored. In the Kangli Smelter there is an office area that is intact and relatively far from workshops so it is not to be demolished. In the east corner of the Plant area there are two disused waste water treatment pools with 20 m³ of waste water. In the area, uncovered soil to be restored covers 1837m², the area of buildings to be demolished covers 1116m², and the area of buildings to be cleaned out covers 116 m². See map 4.3-6 to view the structures that will be treated.

According to the Regulatory Plan for the Core Area of the Zhuzhou Qingshuitang Eco-Industrial City and the locations of six closed facilities shown in map 4.3-4, the area where the Kangli Smelter is located is planned to be used as parks and green space.
Fig. 4.2-7 classification of buildings to be demolished and cleaned out in the Kangli Smelter

4.3.4 Remediation plan for Xinda Smelter

Remediation for the contaminated site in the Xinda Smelter includes:

(1) Demolition and cleanout of the buildings;

(2) Excavation and restoration of contaminated soil.

Data analysis and site survey show that the soil in the area where the Xinda Smelter is located and the soil in the company’s original workshops have been severely contaminated, so it is necessary to demolish the workshops and restore the soil underneath the workshops. In the area, soil to be restored covers 1840m², the area of structures to be demolished covers 4753.6m², and the area of structures to be cleaned out covers 97.8m². See map 4.3-7 to view the structures that will be treated.

According to the Regulatory Plan for the Core Area of the Zhuzhou Qingshuitang Eco-Industrial City and the locations of six closed facilities shown in map 4.3-4, the area where
the Xinda Smelter is located is planned to be used as Class I industrial land.

Fig. 4.2-8 classification of buildings to be demolished and cleaned out in the Xinda Smelter

4.3.5 Remediation plan for Hehua Cement

Remediation for the contaminated site in the Hehua Cement includes:

(1) Site cleanup (including cleanout of buildings and demolition of equipment);

(2) Collection and treatment of waste water;

(3) Excavation and restoration of contaminated soil

Data analysis and site survey show that the soil in the area where the Hehua Cement is located has been contaminated in some degree, so it is necessary to excavate the soil and then restore it. Production-oriented structures in the area are generally intact, and the land on which production is conducted is covered by concrete, so the soil underneath has not been much exposed to contamination. Therefore, it is advisable to clean out the original workshops
with water and collect and treat the waste water. In the area there is a ball mill left by Hehua Cement that needs to be demolished. In the area, soil to be restored covers 4331 m², and the area of structures to be cleaned out covers 7316 m². See map 4.3-8 to view the structures that will be treated.

According to the Regulatory Plan for the Core Area of the Zhuzhou Qingshuitang Eco-Industrial City and the locations of six closed facilities shown in map 4.3-4, the area where the Hehua Cement is located is planned to be used as Class I industrial land.

Fig. 4.2-9 classification of buildings to be demolished and cleaned out in the Hehua Cement

4.3.6 Remediation plan for Tiancheng Chemicals

The data analysis and site survey show that soil in the area where Tiancheng Chemicals is located has been severely contaminated and that there has been cross contamination from heavy metals and organics. Soil to be restored in the area covers 104813.7 m². Of the soil to be restored, soil contaminated by organics covers about 8274 m². There is no buildings to be demolished in the area.
Considering that in the Tiancheng Chemicals there is contamination from heavy metals and organics as well as combined contamination of soil, it is necessary to restore the soil in the area in two ways: one is to excavate soil contaminated by heavy metals and then treat it with stabilization/solidification technology; the other is to treat soil contaminated by organics and by combined pollutants with the help of cement kiln. See remediation technology roadmap in Fig 4.3-10. Contaminated soil that needs to be stabilized/solidified will be excavated and then transported to the Xinqiao stabilization/solidification site for disposal. Soil contaminated by organics and by combined pollutants will be excavated, packaged in jumbo bags (non-woven bags, see picture 4.3-9), transported to the stabilization/solidification site for temporary storage, and finally transported to the Sinoma Cement for disposal.

According to the Regulatory Plan for the Core Area of the Zhuzhou Qingshuitang Eco-Industrial City and the locations of six closed facilities shown in map 4.3-4, the area where the Tiancheng Chemicals is located is planned to be used as Class II residential land and land for business facilities.

Fig. 4.2-10 excavation and packaging of contaminated soil
EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)

Fig. 4.2-11 Remediation technology roadmap for the contaminated site in the Tiancheng Chemicals

Fig. 4.2-12 Buildings to be demolished and cleared in Tiancheng Chemicals
4.4 Remediation plan for soil contaminated by heavy metals

4.4.1 Ex-situ treatment

The area under the ex-situ treatment includes sensitive land and non-sensitive land. If $P \leq 1.5$, the soil on both the residential land and the land used for education that are marked as sensitive land as well as the soil in areas that are marked as water areas will be moved to non-sensitive land or transported to an industrial solid waste landfill for disposal; if $P \geq 1.5$, the soil will be treated with ex-situ stabilization/solidification technology. If $P \geq 2$, the soil on the planned non-sensitive land, such as the industrial land, commercial land, roads, and land used as treatment facilities area, will be stabilized/solidified with ex-situ treatment technology.

The soil contaminated by heavy metals that needs to be treated with ex-situ technology amounts to 658,300 m³, of which the soil that needs to be moved to the non-sensitive land amounts to 373,800 m³ and the soil that needs to be stabilized/solidified with ex-situ treatment technology amounts to 284,500 m³.

Table 4.2-3 quantities for treating contaminated soil with ex-situ treatment technology

<table>
<thead>
<tr>
<th>Sub-region</th>
<th>Ex-situ stabilization/solidification</th>
<th>Move to planned industrial land</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area (m²)</td>
<td>Volume (m³)</td>
</tr>
<tr>
<td>Xiangshiling</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Qingshuihu</td>
<td>50185</td>
<td>30111</td>
</tr>
<tr>
<td>Qingshui</td>
<td>79365</td>
<td>47619</td>
</tr>
<tr>
<td>Yingfeng</td>
<td>18227</td>
<td>10936</td>
</tr>
<tr>
<td>Qingshi</td>
<td>28150</td>
<td>16890</td>
</tr>
<tr>
<td>Tongxia</td>
<td>133765</td>
<td>80259</td>
</tr>
<tr>
<td>Tongtangwan</td>
<td>164510</td>
<td>98706</td>
</tr>
<tr>
<td>Total</td>
<td>474202</td>
<td>284521</td>
</tr>
</tbody>
</table>

Notes: If the amount of soil moved to the planned non-sensitive area exceeds the area’s capacity, the excess soil should be transported to an industrial solid waste landfill for disposal. If the amount of soil moved to the planned non-sensitive area falls short of the capacity of the area, the area should be backfilled with uncontaminated soil that has been transported to the area from elsewhere.

(3) Soil excavation, cleanup, and transport
According to the soil transport distance and the project’s implementation progress, this project requires the following excavation and transportation equipment:

1. Excavator: 8 excavators, each with a bucket capacity of 1.5~2.0 m³.
2. Soil transporter: 24 windtight transporters, each with a loading capacity of 10.0 m³.

4. Stabilization/solidification treatment

Based on the technology roadmap, the soil that needs to be stabilized/solidified with the ex-situ technology in this project amounts to 284,500 m³.

This project will use the existing disposal sites to treat contaminated soil with the help of the Xinqiao disposal site that is newly-built and well-equipped.

Quantity of agents to be used/added: prior to construction, it is advisable to commission eligible laboratories to conduct pre-production tests; assess the effects of stabilization/solidification agents on treating Pb, As, and Cd in contaminated soil in the project area; screen and select the optimal reagent ratios; determine the process parameters and the quantity of agents for soil that has various degrees of contamination.

Proportion of Stabilizer and curing agent, and quantities of agents in this project are shown in table 4.4-2 respectively:

<table>
<thead>
<tr>
<th>Powder quantity (t)</th>
<th>Quantity of water aqua (t)</th>
<th>Quantity of curing agents (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7156.15</td>
<td>143122.30</td>
<td>17890.40</td>
</tr>
</tbody>
</table>

Soil conservation with stabilization/solidification treatment:

- Stir stabilizer and curing agent until both are evenly mixed in the soil; transport the treated soil to a storage site for conservation for no less than 2 days and ensure that the stabilizer is used to maximum effect.

Dispose soil after it is stabilized/solidified:

- Soil that is stabilized/solidified with ex-situ treatment technology amounts to 284,500 m³ with a compatibilization ratio of 10%; earth that is stabilized/solidified with ex-situ treatment technology amounts to 313,000 m³; all the soil and earth are transported to the newly-built
industrial solid waste landfill for disposal.

4.4.2 In-situ treatment

In-situ treatment is applied to the planned sensitive land, including greenbelt, land for squares, and land for sports. Different treatment technologies are applied to lands that have various degrees of contamination.

(1) If $P \leq 1.5$, contaminated soil will be treated to restore its ecology;

(2) If $P \geq 1.5$, contaminated soil will be stabilized with in-situ treatment technology and the area will be treated to restore its ecology;

The area that is marked as non-sensitive land: in the area where $P \leq 2$, contaminated soil will be stabilized with in-situ treatment technology, supplemented by capping measures.

(1) Extent of contaminated soil that will be treated

Soil that needs to be treated with in-situ treatment technology amounts to 693,400 m³, of which soil that is treated with in-situ stabilization and capping measures amounts to 460,100 m³, soil that is treated with in-situ stabilization and ecological restoration technologies amounts to 78,700 m³, soil that undergoes ecological restoration amounts to 117,500 m³, and soil that is treated through phytoremediation amounts to 37,100 m³.

Table 4.2-5 quantities for treating contaminated soil with in-situ treatment technology

<table>
<thead>
<tr>
<th>Sub-region</th>
<th>In-situ stabilization + capping</th>
<th>In-situ stabilization + ecological restoration</th>
<th>Ecological restoration</th>
<th>Phytoremediation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area /m²</td>
<td>Volume /m³</td>
<td>Area /m²</td>
<td>Volume /m³</td>
</tr>
<tr>
<td>Xiangshiling</td>
<td>1895</td>
<td>1137</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Qingshuihu</td>
<td>300529</td>
<td>180317</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Qingshu</td>
<td>127416</td>
<td>76477</td>
<td>7820</td>
<td>4692</td>
</tr>
<tr>
<td>Yingfeng</td>
<td>97278</td>
<td>58367</td>
<td>1037</td>
<td>634</td>
</tr>
<tr>
<td>Qinghui</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tongxia</td>
<td>6510</td>
<td>3906</td>
<td>79190</td>
<td>47514</td>
</tr>
<tr>
<td>Tongtangwan</td>
<td>205295</td>
<td>123177</td>
<td>39987</td>
<td>23992</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>738968</td>
<td>443381</td>
<td>128054</td>
<td>76832</td>
</tr>
</tbody>
</table>

(2) Ecological restoration and ecology
The greenbelt, land for squares, and land for sports that are marked as sensitive areas will be treated to restore their ecologies by growing anti-heavy metals plants, such as oleanders, crape myrtle, cinnamomum camphora, Chinese fringe flower, rosa chinensis, and radix ophiopogonis. The restored area covers 0.23km².

This project will build a phytoremediation zone surrounding the contaminated mountains and forests and collect surface water that will be used to treat areas to restore their ecologies. The phytoremediation zone covers an area of 0.10km².

The period for treating sites to restore their ecologies is 3-5 years; after this period, ecologies of the sites can be restored.

![Fig. 4.2-13 treatment by building phytoremediation zones](image)

(3) In-situ stabilization treatment

According to the combinations of its follow-up treatment technologies, the in-situ stabilization treatment technology can be divided into:
in-situ stabilization treatment + capping, soil covering an area of 0.74km² will be treated, amounting to 443,400 m³;

in-situ stabilization treatment + ecological restoration, soil covering an area of 0.13km² will be treated, amounting to 76,800 m³.

Optimal condition for soil to be treated with in-situ stabilization technology is when powder quantity is at a rate of 5%. It is advisable to commission eligible laboratories to conduct pre-production tests; to assess the effects of stabilization/solidification agents on treating Pb, As, and Cd in contaminated soil in the project area; to screen and select the optimal reagent ratios; and to determine the process parameters and the quantity of agents for soil that has various degrees of contamination.

<table>
<thead>
<tr>
<th>Amount</th>
<th>Proportion %</th>
<th>Quantity/t</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.02</td>
<td>5</td>
<td>42.92</td>
</tr>
</tbody>
</table>

(4) In-situ stabilization + capping

Soil capping technology refers to capping the contaminated soil or treated soil so as to prevent contaminants in the soil from spreading into other areas, thus separating the contaminated soil from its surrounding areas, preventing contaminants from harming human health and the surrounding environment through rainfall or underground water.

In-situ soil capping and covering system consists of system of capping soil, system of covering soil, and system of tests. The system of capping soil, involving HDPE membrane, slurry wall, and other impermeable materials, cuts off the contaminated area by building barriers surrounding the contaminated area; the system of covering soil involves one or more clay layers, packing block made of artificial synthetic materials, sand layers, and covering layers; the system of tests involves monitoring wells up-and downstream of the separated area.

Contaminated soil in areas where P≤2 according to the analysis of pollution levels in the areas marked as non-sensitive areas should be treated with in-situ stabilization technology, and then be covered with concrete according to the usage of land. The treated soil covers 0.74km².
(5) In-situ stabilization + ecological restoration

Regarding the greenbelt, land for squares, land for sports that are marked as sensitive land based on the technology roadmap, contaminated soil in these areas where $P \geq 1.5$ according to the analysis of pollution levels will be stabilized with in-situ treatment technology and then undergo ecological restoration. Ecology of an area of $0.13 \text{km}^2$ will be restored by planting camphor trees, red-leaf nanmu, osmanthus, Chinese ilex, and Bermuda grass.

### 4.5 Treatment plan for soil contaminated by organics

According to the report on site and soil investigation in the early stage of the project as well as the report on soil contamination risk assessment, the site contaminated by organics that needs to be treated in this project is in the area where the original Tiancheng Chemicals is located. Area of the contaminated soil covers $8274 \text{m}^2$ with an amount of $16,548 \text{ m}^3$.

Organic-contaminated soil will be excavated and cleaned up with machinery; soil will be excavated and loaded into transporters at the same time; the foundation pit is to be built for soil excavation so as to prevent dust and pollutants from spreading. Some of the construction wastes on the site and the remaining project entity (foundation piles) increase the amount of construction wastes and make excavation more difficult. The remaining project entity needs to be smashed and removed during excavation; all construction wastes should be piled up in the uncontaminated area. This project uses windtight vehicles to transport contaminated soil to the Sinoma Cement Co., Ltd for incineration.

![Diagram of steps for excavating and cleaning up contaminated soil](image)

**Fig.** Error! Use the Home tab to apply 标题 2 to the text that you want to appear here.---14 steps for excavating and cleaning up contaminated soil
4.6 Treatment plan for wastes

4.6.1 Extent of treatment

The remaining waste dumps in this project include Tongxia sub-region waste dump, remaining wastes in the Yongfa Refinery, and wastes along the low discharge channels. The Tongxia sub-region waste dump is located about 550m north of Tongxia Road. Wastes that have been treated in this project amount to 84,700 m³. See distribution of waste dumps in table 4.6-1.

Table 4.2-7 statistics of waste treatment

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Area (m²)</th>
<th>Amount (10,000m³)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tongxia sub-region waste dump</td>
<td>16815</td>
<td>8.17</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wastes in the Yongfa Refinery</td>
<td></td>
<td>0.3</td>
<td>In the Yongfa Refinery</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>8.47</td>
<td></td>
</tr>
</tbody>
</table>

Notes: According to the site survey, there is a small quantity of wastes in both the Kangli Smelter and the Xinda Smelter. These wastes are used for raw materials in other plants and will be removed to be recycled, so they are not to be treated in this project.

4.6.2 Waste stabilization/solidification treatment

Wastes will be excavated and then directly transported to disposal sites for stabilization/solidification.

The quantity of agents to be used/added will be determined by consulting results from scientific research of “Remediating Heavy Metal Contamination in Xiang River's Water Environment: Key Technology Study and a Demonstration in the Xiawangang Sediment Treatment Project ” under Hunan University’s National Water Pollution Control and Treatment Science and Technology Major Project as well as by consulting results from production-oriented tests conducted in other treatment projects that have been implemented in the Qingshuitang area.

It is advisable to commission eligible laboratories to conduct pre-production tests; assess the effects of stabilization/solidification agents on treating Pb, As, and Cd in contaminated soil in the project area; screen and select the optimal reagent ratios; determine the process parameters and the quantity of agents to be used for soil that has various degrees of
contamination.

Proportion of stabilizer and curing agent to be used/added as well as the quantity of agents to be used in this project are shown in table 4.6-2 and table 4.6-3 respectively.

### Table 4.2-8 Proportion of stabilizer and curing agent to be used/added

<table>
<thead>
<tr>
<th>Powder /%</th>
<th>water aqua /%</th>
<th>curing agent /%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 4.2-9 Quantity of stabilizer/curing agent to be used/added

<table>
<thead>
<tr>
<th>Powder quantity /kg</th>
<th>Quantity of water aqua /kg</th>
<th>Quantity of curing agent /kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>2796</td>
<td>5592</td>
<td>6990</td>
</tr>
</tbody>
</table>

The treated wastes, about 93,100 m³, will be transported to the newly-built industrial solid waste landfill for disposal.

### 4.7 Remediation plan for channels and ponds

#### 4.7.1 Extent of treatment

In this project, 26 ponds need to be treated, covering a total area of 0.17km², and contaminated sediment amounts to 173,000 m³. According to the estimation of water quantity in the dry season, water accumulated in the ponds amounts to 259,500 m³. Quality of water accumulated in the ponds meets Class V standards of the *Environmental Quality Standards for Surface Water* (GB3838-2002), so the water can be directly discharged into the channel nearby.
### Table 4.2-10 quantities required for ponds’ treatment

<table>
<thead>
<tr>
<th>Pond No.</th>
<th>Pond area (m²)</th>
<th>Water volume(m³)</th>
<th>Sediment volume(m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST01</td>
<td>13216.9</td>
<td>19825.4</td>
<td>13216.9</td>
</tr>
<tr>
<td>ST02</td>
<td>8453.9</td>
<td>12680.9</td>
<td>8453.9</td>
</tr>
<tr>
<td>ST03</td>
<td>21365.5</td>
<td>32048.2</td>
<td>21365.5</td>
</tr>
<tr>
<td>ST04</td>
<td>11453.2</td>
<td>17179.8</td>
<td>11453.2</td>
</tr>
<tr>
<td>ST05</td>
<td>2631.0</td>
<td>3946.4</td>
<td>2631.0</td>
</tr>
<tr>
<td>ST06</td>
<td>17159.1</td>
<td>25738.6</td>
<td>17159.1</td>
</tr>
<tr>
<td>ST07</td>
<td>13282.1</td>
<td>19923.2</td>
<td>13282.1</td>
</tr>
<tr>
<td>ST08</td>
<td>18042.5</td>
<td>27063.7</td>
<td>18042.5</td>
</tr>
<tr>
<td>ST09</td>
<td>6437.3</td>
<td>9655.9</td>
<td>6437.3</td>
</tr>
<tr>
<td>ST10</td>
<td>2382.6</td>
<td>3573.8</td>
<td>2382.6</td>
</tr>
<tr>
<td>ST11</td>
<td>4594.8</td>
<td>6892.3</td>
<td>4594.8</td>
</tr>
<tr>
<td>ST12</td>
<td>9603.3</td>
<td>14404.9</td>
<td>9603.3</td>
</tr>
<tr>
<td>ST13</td>
<td>5437.0</td>
<td>8155.6</td>
<td>5437.0</td>
</tr>
<tr>
<td>ST14</td>
<td>3003.1</td>
<td>4504.6</td>
<td>3003.1</td>
</tr>
<tr>
<td>ST15</td>
<td>6908.9</td>
<td>10363.4</td>
<td>6908.9</td>
</tr>
<tr>
<td>ST16</td>
<td>2341.5</td>
<td>3512.3</td>
<td>2341.5</td>
</tr>
<tr>
<td>ST17</td>
<td>5009.0</td>
<td>7513.5</td>
<td>5009.0</td>
</tr>
<tr>
<td>ST18</td>
<td>2365.5</td>
<td>3548.3</td>
<td>2365.5</td>
</tr>
<tr>
<td>ST19</td>
<td>2457.2</td>
<td>3685.8</td>
<td>2457.2</td>
</tr>
<tr>
<td>ST20</td>
<td>1623.3</td>
<td>2435.0</td>
<td>1623.3</td>
</tr>
<tr>
<td>ST21</td>
<td>3245.3</td>
<td>4868.0</td>
<td>3245.3</td>
</tr>
<tr>
<td>ST22</td>
<td>2118.1</td>
<td>3177.2</td>
<td>2118.1</td>
</tr>
<tr>
<td>ST23</td>
<td>1473.6</td>
<td>2210.5</td>
<td>1473.6</td>
</tr>
<tr>
<td>ST24</td>
<td>1139.9</td>
<td>1709.8</td>
<td>1139.9</td>
</tr>
<tr>
<td>ST25</td>
<td>1942.8</td>
<td>2914.2</td>
<td>1942.8</td>
</tr>
<tr>
<td>ST26</td>
<td>5298.7</td>
<td>7948.0</td>
<td>5298.7</td>
</tr>
<tr>
<td>Total</td>
<td>172986.2</td>
<td>259479.3</td>
<td>172986.2</td>
</tr>
</tbody>
</table>

Besides, the Xinqiao low discharge channel and the old Xiawangang need to be treated, covering an area of 0.08km² with contaminated sediment amounting to 62,600 m³. These two channels are not part of the Bank-financed projects as they have to start prior to the project. Nevertheless the project owner agreed to take the same technical approach and standards of Bank-financed activities. The project will finance post-clean up ecological rehabilitation
activity for the Old Xiawangang Channel.

**Table 4.2-11 Quantities required for channels’ treatment**

<table>
<thead>
<tr>
<th>Name</th>
<th>Area (m²)</th>
<th>Length (km)</th>
<th>Sediment volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xinqiao low discharge channel</td>
<td>26316.2</td>
<td>1.5</td>
<td>14028.5</td>
</tr>
<tr>
<td>old Xiawangang</td>
<td>54279.1</td>
<td>5.6</td>
<td>48598.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80595.2458</strong></td>
<td></td>
<td><strong>62626.5</strong></td>
</tr>
</tbody>
</table>

See map 4.7-1 to view the ponds, channel that are to be treated.
List of Ponds and Channels in sub-areas

<table>
<thead>
<tr>
<th>No.</th>
<th>Name of Sub-area</th>
<th>Area/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Qingtai Sub-area</td>
<td>15270.7013</td>
</tr>
<tr>
<td>2</td>
<td>Tongxian Sub-area</td>
<td>76964.1072</td>
</tr>
<tr>
<td>3</td>
<td>Tongtangwan Sub-area</td>
<td>82417.7613</td>
</tr>
<tr>
<td>4</td>
<td>Qinghui Sub-area</td>
<td>42896.6186</td>
</tr>
<tr>
<td>5</td>
<td>Yinfeng Sub-area</td>
<td>9716.0733</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>227265.262</td>
</tr>
</tbody>
</table>

Fig. Error! Use the Home tab to apply 标题 2 to the text that you want to appear here. -15 extent of treatment of channels and ponds
4.7.2 Treatment technology

1) Diversion works: water in ponds is diverted to municipal sewage network.

2) Dredging works: Dredge ponds in manual or mechanical ways. Dredged ponds shall be recovered in time.

3) Sediment treatment works: sediment dug out shall be transported to dewatering yard. After dewatering, sediment shall be transported to stabilization/solidification field for treatment. After treatment, sediment shall be stored temporarily before final safe landfill.

4) Water treatment works: wastewater from dewatering works shall be collected and discharged after treatment in mobile sewage facilities.

4.8 Integrated Wastewater Discharge Standard Design of treatment plan for uncovered soil in the non-treatment area

In this project, uncovered soil in the non-treatment area that needs to be replaced and backfilled covers about 110855m². The depth of soil that needs to be replaced is 0.5m; uncontaminated soil that needs to replace the contaminated uncovered soil amounts to 55427.5m³.

This contaminated uncovered soil that has been replaced will be treated through different methods based on the various degrees of contamination. Soil on the land that is marked as non-sensitive land will be excavated and transported to the industrial land for treatment with an amount of 26758.5m³. Contaminated soil that has exceeded the standard for marking land as non-sensitive land will be treated with ex-situ stabilization/solidification technology, with an amount of 28669m³.

4.9 Construction of treatment facilities for soil remediation

Treatment facilities for soil remediation are used for stabilizing/solidifying contaminated soil, wastes, sediment in channels and ponds with ex-situ treatment. These treatment facilities will use the existing Xinqiao stabilization/solidification site, Xiawan dewatering site, and the newly built Xinqiao dewatering site and temporary storage site (used for temporarily storing the solid wastes before landfill is built). See map 4.9-1 to view the locations of various sites.

Xinqiao waste stabilization/solidification site: covering an area of 4000m³; the maximum
daily treatment capacity is 400m³/d.

Xiawangang dewatering site: covering an area of 5500m², of which the dewatering site covers 4000m² and temporary storage site covers 1500m².

Newly built sediment dewatering site: near the Xinqiao stabilization/solidification treatment site, covering about 4200m², of which the dewatering site covers 4000 m² and dewatered sediment storage site covers 200 m².

Newly built temporary storage site: near the stabilization/solidification site; covers 10000m²; temporarily stored industrial solid wastes amount to 150,000 m³.

**Fig.** Error! Use the Home tab to apply 2 to the text that you want to appear here.-16

locations of various sites

**4.10 Temporary roads and transport routes**

In this project, the Huanbao avenue that is under construction, Tongxia Road, Qingxia
Road, and old Tongxia Road are used as main transport roads; other country roads are used as side roads for transportation. The project uses the existing roads, reconstructs country roads, and builds temporary roads to transport earth and stones. 13832m of country roads are reconstructed and 1802m of temporary roads are built.

### Table 4.2-12 construction of transport roads

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Length (m)</th>
<th>Pavement structure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Existing roads</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tongxia Road</td>
<td>4673</td>
<td>Asphalt concrete</td>
</tr>
<tr>
<td>2</td>
<td>Qingxia Road</td>
<td>1892</td>
<td>Concrete</td>
</tr>
<tr>
<td>3</td>
<td>old Tongxia Road</td>
<td>2502</td>
<td>Asphalt</td>
</tr>
<tr>
<td></td>
<td><strong>Roads under construction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Huanbao avenue</td>
<td>1276</td>
<td>Asphalt concrete</td>
</tr>
<tr>
<td></td>
<td><strong>Reconstructed roads</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Country road 1</td>
<td>1021</td>
<td>Concrete</td>
</tr>
<tr>
<td>6</td>
<td>Country road 2</td>
<td>221</td>
<td>Concrete</td>
</tr>
<tr>
<td>7</td>
<td>Country road 3</td>
<td>659</td>
<td>Concrete</td>
</tr>
<tr>
<td>8</td>
<td>Country road 4</td>
<td>261</td>
<td>Soil</td>
</tr>
<tr>
<td>9</td>
<td>Country road 5</td>
<td>1989</td>
<td>Soil</td>
</tr>
<tr>
<td>10</td>
<td>Country road 6</td>
<td>3000</td>
<td>Asphalt /soil</td>
</tr>
<tr>
<td>11</td>
<td>Country road 7</td>
<td>1273</td>
<td>Concrete</td>
</tr>
<tr>
<td>12</td>
<td>Country road 8</td>
<td>844</td>
<td>Soil</td>
</tr>
<tr>
<td>13</td>
<td>Country road 9</td>
<td>406</td>
<td>Soil</td>
</tr>
<tr>
<td>14</td>
<td>Country road 10</td>
<td>566</td>
<td>Soil</td>
</tr>
<tr>
<td>15</td>
<td>Country road 11</td>
<td>1450</td>
<td>Concrete /rubble</td>
</tr>
<tr>
<td>16</td>
<td>Country road 12</td>
<td>493</td>
<td>Soil</td>
</tr>
<tr>
<td>17</td>
<td>Country road 13</td>
<td>915</td>
<td>Soil</td>
</tr>
<tr>
<td>18</td>
<td>Country road 14</td>
<td>734</td>
<td>Soil</td>
</tr>
<tr>
<td></td>
<td><strong>Newly built roads</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Temporary road 1</td>
<td>304</td>
<td>Rubble /asphalt</td>
</tr>
<tr>
<td>20</td>
<td>Temporary road 2</td>
<td>529</td>
<td>Rubble /asphalt</td>
</tr>
<tr>
<td>21</td>
<td>Temporary road 3</td>
<td>969</td>
<td>Rubble /asphalt</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>25977</td>
<td></td>
</tr>
</tbody>
</table>

See transport routes in map Fig. Error! Use the Home tab to apply 2 to the text that you want to appear here.-17.

Construction of stabilization/solidification site, dewatering site, temporary storage site,
and transport roads is scheduled from November in 2015 to April in 2017.
Fig. Error! Use the Home tab to apply  标题  2 to the text that you want to appear here. - 17 Transport Routes
4.11 Solid waste landfill

This project builds a landfill site in the disused limestone mine in the Hehua Cement. This landfill site covers about 38265m² (see its location in map 4.9-1). The available capacity of the mine is 2 million m³. Length of service: period for the landfill lasts from 2017.11 to December in 2026; period for this project’s landfill lasts to December in 2021. This landfill only serves general industrial wastes produced when treating soil in the Qingshuitang area, excluding industrial solid wastes produced during manufacturing. See table 4.11-1 to view the progress of implementation of the landfill project.

Landfill project includes:

1) Ponded water drainage project: quantity of ponded water is estimated to be 2 million m³; EA consultant suggests that, water drainage plan for landfill shall be prepared based on geological survey results after the completion of geological survey, so as to avoid karst collapse caused by pumping and drainage under circumstances that knowledge of hydrogeological conditions is absent. The ponded water is planned to be drained through pontoon-type water pumping station in one year’s time. The ponded water that is drained from the mine will be treated through breakpoint chlorination in a reaction tank; when the water meets Class I standard of the Integrated Wastewater Discharge Standard (GB8978-1996) shown in table 4, it will be discharged into the brook near the Qingxia Road and then join the Xiang River. DN200' PVC pipes with a length of 490m are used for drainage.

2) Base treatment project: Foundation treatment: it is recommended to conduct geological survey in the area. If survey results show that, foundation has large burial depth, karst cave has thick cover plate and consists of small karst caves that have enough bearing capacity, foundation cannot be treated; if results show that, foundation has small burial depth, karst cave has thin cover plate and consists of full-filled karst caves that have not enough bearing capacity, high-pressure grouting can be employed to improve the bearing capacity of foundation. If results show that, foundation has small burial depth, karst cave has thin cover plate and consists of non-full-filled karst caves that have not enough bearing capacity, cover plate of karst caves will be crushed to enhance foundation, so as to improve the bearing capacity of foundation to standards. 19916m³ of construction waste produced when treating the site will be cleaned out and smashed and then backfilled into the disused mine, so as to elevate the bottom of the mine to 19m. Diameter of particles of the smashed construction
waste is no more than 10cm. 1.0m of clay layer will be coated on the construction waste and the clay layer will be compacted and leveled up with compacting factor $\geq 0.95$; seepage-proofing will be undertaken on the clay layer in the bottom of the landfill.

3) Seepage-proofing project: this landfill will be constructed according to the requirements of the Class II general industrial solid waste landfill. Considering this project’s landscape is complicated by steep side slopes and uncovered rocks, and in order to ensure this project’s safety and long-term stability, the bottom of this landfill will be made seepage-proof by building it as a seepage-proof double-layered structure; the base of the side slopes will be supported with hanging mesh, anchors, and shotcrete.

4) Anti-seepage disposal project: including systems for effluent separation and leachate collection.

5) Exhaust gas treatment: in order to prevent various odours, coverplates or greenbelts will be developed for areas where the sources of odours are concentrated; buildings that disperse odours will be insulated or closed off.

6) Cover project: The process of covering the landfill is divided into three stages: daily, intermediary and final. For the daily stage, after each day's operation, the surface of used areas will be covered to prevent waste in the landfill from polluting the atmosphere; for the intermediary stage, as each sub-region is filled, it is then covered; when the landfill has been filled to its designated height, the landfill will be given a final covering, completing the final stage of the process.

   a) Daily: after solid waste is compacted, it should be immediately covered with a layer of impervious membrane first and then with clay of $0.2 \sim 0.3$m depth.

   b) Intermediary: As all sub-regions are filled to 4m, they are then covered with 0.3m of soil

   c) Final: The landfill will be given a final covering with more than 1m of soil.

After this project’s wastes and soil fill the landfill, it will be used for disposing industrial solid waste produced when treating the site in the later stage of the project; period for land filling spans from 2022 to 2026 and the land filling amount is 1.25 million m$^3$. 

69
When the landfill is filled to its full with contaminated soil, it can be closed, according to the real conditions of the project and the Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB18599-2001).

Period for landfill construction spans from July in 2016 to April in 2018. Before landfill construction is complete, treated soil that needs to be backfilled will be stored temporarily in the temporary storage site near the stabilization/solidification site.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Preliminary works at landfill (land use license/drainage license., etc)</td>
<td>Preliminary works</td>
<td>Design and evaluation of standing water treatment project</td>
<td>Design and evaluation of landfill project</td>
<td>Construction of water treatment supplies</td>
</tr>
<tr>
<td>2</td>
<td>Design and evaluation of standing water treatment project</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Design and evaluation of landfill project</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Construction of three supplies, water treatment buildings (structures) (including monitoring facilities), and top flood ditch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Drainage of the ponded water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Removal of sediment in pit and foundation treatment</td>
<td></td>
<td></td>
<td></td>
<td>Construction of water treatment supplies</td>
</tr>
<tr>
<td>7</td>
<td>Anti-seepage measures treatment</td>
<td></td>
<td></td>
<td></td>
<td>Anti-seepage measures</td>
</tr>
<tr>
<td>8</td>
<td>Start to backfill the remediation soil, sediment., etc</td>
<td></td>
<td></td>
<td></td>
<td>Backfill the solid waste</td>
</tr>
</tbody>
</table>
5 Environmental Protection Measures

Some outstanding environmental impacts and mitigation measures are summarized in this chapter. Key activities and stages, identified potential environmental impacts and typical mitigation measures, and corresponding responsibilities for implementation and supervision are listed in table 5.1-1 to table 5.4-1.

The mitigation measures listed conform to national laws, regulations, guidelines, principles, the policies of the World Bank and requirements regarding the collection and transportation of wastes stipulated in General EHS Guidelines, EHS Guidelines for Water and Sanitation, and EHS Guidelines for Waste Management Facility. In this way, various impacts at stages of design, construction and operation can be handled.

Details about contractor specification, water & soil conservation plan, emergency plan, track plan for cumulative environmental impacts, management plan for training and capacity building are stated in chapters from 7 to 12.
5.1 Environmental protection measures and recommendation in design period

Table 5.1-1 Schedule of Environmental Impacts and Mitigation Measures in Design Period

<table>
<thead>
<tr>
<th>Element</th>
<th>Potential Impacts/Problems</th>
<th>Mitigation Measures</th>
<th>Reference to Environmental Management Plan/Resettlement Action Plan</th>
<th>Implementing party</th>
<th>Supervising party</th>
<th>Monitoring index</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land requisition and resettlement</td>
<td>Potential impacts on original residents in Qingshuitang Industrial Zone</td>
<td>Prepare resettlement plan according to policies of the state and the World Bank.</td>
<td>Resettlement Action Plan</td>
<td>Wuhan University</td>
<td>PMO of Zhuzhou municipal government, the World Bank</td>
<td>Resettlement Action Plan is approved by the World Bank</td>
<td>Before evaluation</td>
</tr>
<tr>
<td>Acoustic environment</td>
<td>Impacts on construction personnel</td>
<td>Since the noise in building and road construction is great, proper sound proofing and noise reduction measures shall be taken during project design to mitigate the impacts of noise on construction personnel.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government, Bureau of Environmental Protection of Shifeng District</td>
<td>EIA is approved by the World Bank and Environmental Protection of Shifeng District, Zhuzhou City</td>
<td>Before evaluation</td>
</tr>
<tr>
<td></td>
<td>Impacts of traffic noise on the lives of residents at sensitive spot along the project</td>
<td>Standard distance of functional areas shall be properly arranged by department carrying out project plan. No sensitive spots shall be built within standard distance.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government, Bureau of Environmental Protection of Shifeng District</td>
<td>EIA is approved by the World Bank and Environmental Protection of Shifeng District, Zhuzhou City</td>
<td>Before evaluation</td>
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<tr>
<td>Atmosphere and water environment</td>
<td>Potential impacts of wastewater treatment device to received water</td>
<td>For newly built wastewater treatment device, pollution prevention principles shall be strictly followed, measures for clean production taken, in order to reduce pollutants at the source and risks to human and environment</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government, Bureau of Environmental Protection of Shifeng District</td>
<td>EIA is approved by the World Bank and Environmental Protection of Shifeng District, Zhuzhou City</td>
<td>Before evaluation</td>
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<td></td>
<td>Impacts of flying dust triggered by transport vehicles on</td>
<td>Raw materials are procured at local place.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government</td>
<td>EIA is approved by the World Bank</td>
<td>Before evaluation</td>
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<td>Element</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Implementing party</td>
<td>Supervising party</td>
<td>Monitoring index</td>
<td>Monitoring frequency</td>
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<td>surrounding residents</td>
<td>Alignment shall be further improved in the design of newly temporary roads construction. Excavated and filled stonework &amp; earthwork shall be balanced as far as possible. Excavation and filling shall be minimized to reduce the damage on vegetation and reduce water &amp; soil loss.</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>Bureau of Environmental Protection of Shifeng District, Zhuzhou City.</td>
<td>Bank and Environmental Protection of Shifeng District, Zhuzhou City.</td>
<td>Before evaluation</td>
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<tr>
<td>Ecological environment</td>
<td>Impacts on water &amp; soil loss</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government, Bureau of Environmental Protection of Shifeng District</td>
<td>EIA is approved by the World Bank and Environmental Protection of Shifeng District, Zhuzhou City.</td>
<td>Before evaluation</td>
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<td>Water and soil conservation plan shall be well prepared. The overall layout shall take into consideration the type, pattern and hazard rating of water &amp; soil loss caused by project construction. It shall combine with the overall plan of management area in project operation period.</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government, Bureau of Environmental Protection of Shifeng District</td>
<td>EIA is approved by the World Bank and Environmental Protection of Shifeng District, Zhuzhou City.</td>
<td>Before evaluation</td>
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<td></td>
<td>In project design, surrounding environment design shall be taken into consideration. A plan for permanent land occupation shall be detailed out. The land shall be properly used.</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government, Bureau of Environmental Protection of Shifeng District</td>
<td>EIA is approved by the World Bank and Environmental Protection of Shifeng District, Zhuzhou City.</td>
<td>Before evaluation</td>
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<td>The landscape design of road works and main works shall be carried out simultaneously. Natural landscape shall be maintained and coordination with surrounding environment shall be achieved as far as possible with the prerequisite that the planned requirements for the road are met. In order to minimize the destruction to existing ecological environment, in project design, landscaping and ecological</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Environmental assessment consultant</td>
<td>PMO of Zhuzhou municipal government, Bureau of Environmental Protection of Shifeng District</td>
<td>EIA is approved by the World Bank and Environmental Protection of Shifeng District, Zhuzhou City.</td>
<td>Before evaluation</td>
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<tr>
<td>Element</td>
<td>Potential Impacts/Problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Implementing party</td>
<td>Supervising party</td>
<td>Monitoring index</td>
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<td>construction works are carried out simultaneously.</td>
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<td>Zhuzhou City.</td>
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</tbody>
</table>
5.2 Environmental protection measures and recommendations in construction period

**Table 5.2-1 Schedule of Environmental Impacts and Mitigation Measures in Construction Period**

<table>
<thead>
<tr>
<th>Element</th>
<th>Potential impacts/problems</th>
<th>Mitigation Measures</th>
<th>Reference to Environmental Management Plan/Resettlement Action Plan</th>
<th>Implementing party</th>
<th>Supervising party</th>
<th>Monitoring index</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social environment</td>
<td>Traffic &amp; transportation</td>
<td>1. Plan for road traffic guiding &amp; diversion, and temporary channels shall be prepared. Sufficient traffic evacuation signs shall be set. Advance notice shall be issued through broadcasting, television and newspaper. 2. Management over construction of structures shall be strengthened. Relevant departments shall be coordinated for construction. Construction time and vehicle travel time shall be well arranged. Eye-catching caution light shall be set on structures to warn passing vehicles. 3. Caution lights shall be set at construction section to guide vehicle travel.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Contractor</td>
<td>Environmental supervision engineer, independent environmental consultant</td>
<td>On-site supervision is carried out by environmental supervision engineer; specifications are followed.</td>
<td>Before construction</td>
</tr>
<tr>
<td>Cultural relics protection</td>
<td>According to on-site investigation and consultation with relevant departments, ensure that no surface cultural relics are occupied by project construction and operation. In construction, if new relics are found, construction undertaker shall keep the relic site well and inform relic department to carry out relic rescue and treatment according to relevant rules for relics. To do so, the cultural relics can be kept safe; construction of road can go smoothly.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Contractor</td>
<td>Environmental supervision engineer, independent environmental consultant</td>
<td>Publicity and training are provided; accident discovery of relics is recorded</td>
<td>Every day</td>
<td></td>
</tr>
<tr>
<td>Ecological environment</td>
<td>All works</td>
<td>Flowers and trees in the middle and two sides of roads shall be transplanted and protected. Original vegetation shall not be destructed completely. The flowers and trees shall be transplanted temporarily. Additional flowers and trees shall be planted as per design. Vegetation such as trees and grassland on adjacent areas shall be protected during construction. Road construction shall be kept within redline as far as possible. Soil stack and material stack shall not occupy nearby farmlands. Demolition in construction may present an image of “ruins”. Therefore, construction works shall be carried out in order to avoid unorganized construction and untidy landscape. Fences (wood, glass, iron sheet) can be provided to reduce pollution on landscape. Excavated and filled earthwork and stonework shall be well coordinated. Excavation and filling shall be avoided in rainy days, in order to minimize water &amp; soil loss, pollution to waters and blockage of drain ditches caused by rain wash. Land occupation shall be as small as possible, but shall meet</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Contractor</td>
<td>Environmental supervision engineer, independent environmental consultant</td>
<td>On-site supervision is carried out by environmental supervision engineer; specifications are followed.</td>
<td>Every day</td>
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<tr>
<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Implementing party</td>
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<tr>
<td>Acoustic environment</td>
<td>Impacts of noise in construction period</td>
<td>- the project demand. Schedule of construction shall be well arranged. Upon the completion of the project, construction site shall be cleaned. Personnel and machinery shall be evacuated out of the site. Roads and landscape shall be restored. Construction time shall be well arranged to avoid construction in rainy seasons and minimize water &amp; soil loss. Management and supervision over construction shall be strengthened to normalize construction behavior. Land occupation, damage of construction activities on vegetation and habitats of wild animals shall be minimized. Construction behavior shall be standardized and construction shall be in order. Construction organization shall be optimized. On the same construction section, construction shall move ahead in same direction. Construction on adjacent sections shall be staggered to avoid large-scale construction in one spot and minimize the disturbing of disordered construction to terrestrial ecological environment. In construction, the environmental awareness and knowledge of wild animal of construction personnel shall be enhanced through various methods such as announcement, leaflets, blackboard newspaper, meetings, etc. Construction personnel are prohibited from hunting wild animals like frogs, snakes, beasts, birds, etc. and committing other acts that could harm ecological environment.</td>
<td>Chapter 6 and 7 of Environmental Management Plan</td>
<td>Contractor</td>
<td>Environmental supervision engineer, independent environmental consultant</td>
<td>On-site supervision is carried out by environmental supervision engineer; specifications are followed.</td>
<td>Every day</td>
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</table>

(1) In construction, *Emission Standard of Environment Noise for Boundary of Construction Site (GB12523-2011)* shall be strictly followed. Operation time of activities producing noise shall be controlled to avoid disturbance to surrounding residents. (2) Construction and operation time shall be properly arranged. High-noise equipment shall not be used in the construction at nighttime (22:00-6:00). Construction activities which produce noises shall be prohibited at noon (12:00-14:00) and night (19:00-22:00), so as to avoid disturbance on surrounding residents. If continuous operation at night is required by construction process or special demand, construction undertaker shall report such operation to local competent environment authorities along with the certificate issued by construction management authorities, and post a notice in surrounding residential areas 7 days in advance. Such construction can be carried out upon the approval of competent environment authorities. (3) Noise source control: construction undertaker shall select low-noise equipment & machinery. At the same time, specially-assigned persons shall be responsible for the regular
<table>
<thead>
<tr>
<th>Element</th>
<th>Potential impacts/problems</th>
<th>Mitigation Measures</th>
<th>Reference to Environmental Management Plan/Resettlement Action Plan</th>
<th>Implementing party</th>
<th>Supervising party</th>
<th>Monitoring index</th>
<th>Monitoring frequency</th>
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</thead>
<tbody>
<tr>
<td>Atmospheric environment</td>
<td>All works</td>
<td>Maintenance of equipment and providing trainings to operation personnel. All machinery shall be operated as per operation specification. (4) According to <em>Notice of People’s Government of Zhuzhou City on Prohibiting Mixing of Concrete at Urban Construction Site</em> ([2005] No.33), commercial concrete shall be used to avoid noise produced by concrete mixer. (5) Transport shall be at daytime as far as possible. Entrance and exit for construction vehicles or access for earth transportation vehicles into soil solidification facility and other construction site shall be away from sensitive targets as much as possible. Vehicles shall be kept at low speed and free from horning when coming-in or going-out. (6) Construction machinery and intensity shall be arranged properly. So do construction organization. High-noise construction machinery and equipment shall be away from residential areas and kept in temporary equipment room to reduce noise impacts.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Contractor</td>
<td>Environmental supervision engineer, independent environmental consultant</td>
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<tr>
<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
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<td>be employed. For designated commercial cement producers, “three-simultaneous” (simultaneous design, production and operation) requirements can apply. Measures that can effectively reduce pollution shall be taken. In order to protect environment and air, environmental monitoring and management can be strengthened.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Contractor</td>
<td>Environmental supervision engineer, independent environmental supervision</td>
<td>On-site supervision is carried out by environmental supervision</td>
<td>Every day</td>
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<td>e) Temporarily occupied land shall be restored after completion to avoid flying dust in windy days.</td>
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<td>(2) Tail gas emitted by fuel machinery and construction vehicles Enclosure shall be provided at excavation and cleaning site. Management over large construction machinery shall be enhanced. Machinery shall be equipped with dust control units which shall be inspected and serviced regularly.</td>
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<td>(3) Odor of sediment a) Desilting work shall be carried out section by section in dry season. Desilting in winter is preferred, because the smell of sludge is not easy to spread and windows are often closed in winter, which mitigates the impacts of noise on surrounding residents. A notice to surrounding residents to close windows shall be given out when construction is carried out in the area. b) Mechanical desilting shall be employed. Sediment shall be immediately transported to dewatering site after dig-out, and shall not be stacked at the site. c) Personal protection for construction personnel shall be carried out well. Protective device shall be given out to labors. Inspection and rescue shall be available at any time. d) Sediment shall be transported through sealed tank truck, in order to avoid spilling. The transportation route shall avoid downtown and populated areas. (4) Organic waste gas from excavated polluted soil Steel plates shall be paved on restoration area. All vehicles shall be cleaned before moving out of the site. Tarpaulins shall be provided to transportation vehicles; excavated foundation pit shall be covered with film for isolation. Organic waste gas from polluted soil can be treated by spraying odor inhibitor. After spraying, polluted soil shall be sealed in bulk bag.</td>
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<td>Surface water environment All works (1) A preliminary stormwater collecting basin of 100m³ shall be set at plant area of each demolished enterprise. Collected stormwater shall be used for flush after subsiding without draining outward. (2) Vehicles on construction site shall be flushed at designed spot. Oil separator, desilting basin shall be provided at flushing spot to recycle</td>
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<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Implementing party</td>
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<td>Groundwater environmental</td>
<td>All works</td>
<td>(1) Anti-seepage measures such as geo-membrane cover or wall hardening shall be applied to preliminary stormwater collecting basin, oil separator, desilting basin and chlorination basin for wastewater treatment, in order to prevent secondary pollution. Floors at site where structures of closed enterprises shall be hardened to prevent wastewater from infiltration. (2) In project design, the quality of design and construction shall be inspected strictly. Anti-seepage of wastewater pipeline shall be well prevented. Wastewater pipeline shall ensure proper connection, which could prevent leakage of pipeline. (3) Rain proof, floor hardening and other measures shall be taken at temporary storages at each site. Floor hardening shall follow the anti-seepage standards of Category II industrial solid waste disposal site. Natural or artificial material shall be employed to construct anti-seepage layer. The thickness of anti-seepage layer shall ensure that the anti-seepage performance of the layer is equivalent to that of Chapter 7 of Environmental Management Plan</td>
<td>Environmental supervision engineer, independent environmental consultant</td>
<td>On-site supervision is carried out by environmental supervision engineer; specifications are followed.</td>
<td>Every day</td>
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<tr>
<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
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<td>1.5m-thick claypan with a permeability coefficient of $1.0 \times 10^{-7}$ cm/s. To do so can prevent pollution to groundwater.</td>
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<td><strong>1. Stabilization/solidification facility</strong></td>
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<td>Rain-proofing and drainage measures: A preliminary stormwater collecting basin of 75m³ shall be built at the facility. Anti-seepage measures shall be carried out in the basin. Stormwater in preliminary stage on the roads within stabilization site shall be collected and stored in collecting basin temporarily, and will be recycled for stabilization treatment. Stormwater in later period and other areas shall be drained to outside via drainage ditches.</td>
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<td>Floor hardening measures: Xingqiao treatment facility is rented as the stabilization/solidification site of the project. The floor in the yard has already been hardened. EIA requires that the anti-seepage performance of hardened floor shall be tested. If the performance fails to reach that of 1.5m-thick claypan with a permeability coefficient of $1.0 \times 10^{-7}$ cm/s, the floor shall be hardened again.</td>
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<td><strong>2. Temporary storage at dewatering site</strong></td>
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<td>Rain-proof and drainage measures: drainage slope shall be constructed at the bottom of dewatering site. The gradient of slope shall not be less than 2%. Drainage ditches and sump wells shall be built around the yard. Drainage ditches of 0.4m wide and 0.6m deep are for collecting waste water within the site.</td>
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<td>Anti-seepage measure: Anti-seepage measures shall be taken to prevent pollution to surrounding soil and groundwater. In anti-seepage system, from up to down are: geo-tube, 300mm thick crushed stone drainage layer, 600g/m² thick polypropylene non-woven fabric, 2mm thick glazed HDPE geo-membrane, 600g/m² polypropylene non-woven fabric and foundation.</td>
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<td><strong>Solid wastes</strong></td>
<td>All works</td>
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<td>(1) Solid wastes from construction shall be cleaned in time to keep the construction tidy.</td>
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<td>(2) For the transportation of bulk-solid materials, sealing, wrapping, coverage shall be adopted. Overloading and spilling is prohibited. Transportation route shall avoid residential area and other sensitive spots.</td>
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<td>(3) Building and household rubbish shall not be thrown into air, and shall be stacked at designated spot and transported outward timely.</td>
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<td>(4) As per the requirements of <em>Provisions on the Administration of Urban Construction Garbage</em>, hazardous substance shall not be mixed into construction garbage. Construction garbage shall not be mixed into any ordinary garbage.</td>
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<p>| Chapter 7 of Environmental Management Plan |
| Contractor |
| Environmental supervision engineer, independent environmental consultant |
| On-site supervision is carried out by environmental supervision engineer; specifications are followed. |
| Every day |</p>
<table>
<thead>
<tr>
<th>Element</th>
<th>Potential impacts/problems</th>
<th>Mitigation Measures</th>
<th>Reference to Environmental Management Plan/Resettlement Action Plan</th>
<th>Implementing party</th>
<th>Supervising party</th>
<th>Monitoring index</th>
<th>Monitoring frequency</th>
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<tbody>
<tr>
<td>Water &amp; soil loss</td>
<td>Impacts on water &amp; soil conservation in the area</td>
<td>(1) Construction shall be arranged in proper season. Construction in rainy season shall be avoided as far as possible. Protection and drainage shall be conducted well in construction. Drainage shall be unblocked. Work interface shall not be in soaked in ponding water. (2) Protection shall be provided for earthwork and stonework. Excavation, transportation, filling and compacting shall be carried out simultaneously. No loose soil shall be left. The exposure time of bare soil shall be minimized. (3) Construction schedule shall be arranged properly. Various construction procedures shall be articulated well. “Three-simultaneous” (simultaneous design, production and operation) principle shall apply. Auxiliary water &amp; soil conservation measure shall be completed in time. Construction schedule shall be tight but in order, so that water &amp; soil loss can be reduced in construction period. (4) Earthwork and stonework in main works shall be balanced. Random excavation and soil abandoning shall be avoided to minimize human-caused water &amp; soil loss.</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Contractor</td>
<td>Environmental supervision engineer, independent environmental consultant</td>
<td>On-site supervision is carried out by environmental supervision engineer; specifications are followed.</td>
<td>Every day</td>
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<td>treated as household garbage.</td>
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</table>
### 5.3 Environmental measures and recommendations in operation period

#### Table 5.3-1 Schedule of Environmental Impacts and Mitigation Measures in Operation Period

<table>
<thead>
<tr>
<th>Element</th>
<th>Potential impacts/problems</th>
<th>Mitigation Measures</th>
<th>Reference to Environmental Management Plan/Resettlement Action Plan</th>
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<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological environment</td>
<td>Impacts on landscape</td>
<td>Regular governance in landscaping, so as to ensure the design effects of landscape are realized</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Upon the completion of the project</td>
</tr>
<tr>
<td>Acoustic environment</td>
<td>Impacts of noise</td>
<td>(1) Imported high-quality low-noise equipment and machinery shall be employed with the prerequisite that production needs are met. (2) Noisy and quiet area in Xinqiao stabilization/solidification facility shall be separated. High-noise equipment shall be kept away from plant boundary and offices in the yard as much as possible, so that the impacts of noise can be controlled by distance to a certain extent. (3) High-noise equipment such as crushers, mixers and vibrators shall be placed within workshop, so that the noise can be isolated by the walls. It is estimated that the noise reduction can reach 20-25dB (A). (4) Shock absorber struts shall be provided to high-noise equipment. Such method can reduce noise by 5–10dB (A). (5) Maintenance of noisy equipment</td>
<td>Chapter 6 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Upon the completion of the project</td>
</tr>
<tr>
<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Implementing party</td>
<td>Supervising party</td>
<td>Monitoring index</td>
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<td>(6) Operation at landfill shall be well scheduled; operation at night (22:00-6:00) shall be prohibited; operation at noon (12:00 to 14:00) and night (19:00 to 22:00) shall be avoided.</td>
<td>Chapter 6 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
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<td>(7) Maintenance of machinery at landfill shall be strengthened. Regular servicing shall be carried out. Equipment and machinery that have abnormal operation shall be timely serviced to keep the normal operation of such equipment and machinery.</td>
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<td>(8) Traffic guidance and control over transportation vehicles shall be enhanced to reduce the blaring of vehicles transporting solid wastes on roads access to landfill.</td>
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<td></td>
<td>Odor shall be enhanced, so as to avoid noise increase caused by abnormal operation.</td>
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<td>Surface sludge shall be stacked layer by layer at the bottom of stacking yard. Odor mainly comes from surface sludge, which can be covered up by subsequent sludge. Therefore, the impacts of odor are relatively small. In addition, slabs or greenbelt will be provided at places where odor is strong, so as to isolate or seal the buildings where odor comes from. In project design, facilities or structures that will produce odor are arranged in the downwind direction. To do so, the environmental can be improved, odor isolated, and impacts of odor on environment reduced.</td>
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<td></td>
<td></td>
<td>Dust from mixing and The water content of soil, sediment,</td>
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</table>
### EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)

<table>
<thead>
<tr>
<th>Element</th>
<th>Potential impacts/problems</th>
<th>Mitigation Measures</th>
<th>Reference to Environmental Management Plan/Resettlement Action Plan</th>
<th>Implementing party</th>
<th>Supervising party</th>
<th>Monitoring index</th>
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<tr>
<td></td>
<td>screening</td>
<td>waste dregs and batching shall be kept at certain degree. Automatic laying-off shall be employed in solidification and mixing. Mixer shall be placed in enclosed workshop. Water shall be sprayed in solidification batching via mixing channels around.</td>
<td>Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>are followed; environmental monitoring plan has been prepared.</td>
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<tr>
<td>Flying dust at landfill</td>
<td>In sunny days, watering shall be carried out at landfill, which could reduce dust by 80%. Therefore, the adverse impacts of flying dust on outside environment can be reduced. For dust caused by transportation vehicles, water spraying in fixed time and quantity shall be carried out to inhibit the dust. Overloading and spilling are not allowed for transportation vehicles. In addition, vehicles shall be provided with tarpaulins. Road management shall be strengthened. Damaged roads shall be repaired in time to keep a smooth pavement for transportation, which is key to dust control.</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
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<tr>
<td>Surface water environment</td>
<td>Wastewater from dewatering of heavy metal polluted sediment, leachate at landfill</td>
<td>Wastewater from dewatering of heavy metal polluted sediment will be subject to treatment of mobile treatment device and then discharged nearby if the treated wastewater reach the Class-I standard in Table 4 of <em>Integrated Wastewater Discharge Standard</em> (GB8978-1996). Leachate at landfill will be directly discharged into Qingshuitang Industrial Wastewater Treatment Plant for treatment.</td>
<td>Chapter 6 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
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<tr>
<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
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<td>Supervising party</td>
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<tr>
<td>Stormwater at each facility at preliminary stage</td>
<td>Preliminary stormwater collecting basins of 75 m³, 75 m³, 100 m³, and 180 m³ shall be constructed respectively at Xinqiao Stabilization and Solidification Facility, Xinqiao Dewatering Site, Xiawan Dewatering Site, and Temporary Storage Yard. Anti-seepage measures shall be taken at these basins. The stormwater collected via stormwater pipe shall be temporarily stored at collecting basin. Stormwater collected at stabilization and solidification facility will be recycled in stabilization process; stormwater collected at dewatering site and temporary storage sites will be used for watering at roads in the facilities after treatment in mobile water treatment device. Stormwater in later period in the site and other areas will be drained to outside the site via stormwater drainage pipe.</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
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<tr>
<td>Wastewater from demonstration center of environmental protection</td>
<td>A water recycling system shall be established to reuse the daily household wastewater from demonstration center of environmental protection during operation period after treatment to clean ground, water flowers, flush toilets and carry out other activities in which humans do not directly contact with the water. In the way, the utilization rate of water resources can be improved. Wastewater from flushing toilets will be directly discharged to the water recycling system.</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
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<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
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<td>Supervising party</td>
<td>Monitoring index</td>
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<td>discharged into Xiawan Wastewater Treatment Plant.</td>
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<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
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<tr>
<td>Wastewater from dewatering of heavy metal polluted sediment</td>
<td>Anti-seepage measures such as paving geo-membrane or hardening basin walls shall be taken for facilities that treat wastewater from dewatering of heavy metal polluted sediment. The performance of anti-seepage of such measures shall reach that of the 1.5m thick claypan with permeability coefficient of 1.0×10^{-7} cm/s.</td>
<td>Chapter 6 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
<td></td>
</tr>
<tr>
<td>Groundwater environment</td>
<td></td>
<td>The anti-seepage performance of the existing hardened floor in the stabilization/solidification facilities shall be inspected. If the performance fails to reach that of 1.5m-thick claypan with a permeability coefficient of 1.0×10^{-7} cm/s, the floor shall be hardened again. Anti-seepage treatment shall be carried out at 75 m³, 75 m³, 100 m³ and 180 m³ initial stormwater collecting basins which are built respectively in Xinqiao Stabilization/Solidification Facility, Xinqiao Dewatering Site and Xiawan Dewatering Site.</td>
<td></td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
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</tr>
<tr>
<td></td>
<td>Dewatered sludge and initial stormwater in stabilization/solidification facilities</td>
<td>A double anti-seepage structure shall be provided at the bottom and mesh shotcrete shall be adopted for the base course of the side slope.</td>
<td></td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
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<tr>
<td>Landfill leachate</td>
<td></td>
<td></td>
<td></td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
</tr>
<tr>
<td>Solid waste</td>
<td>Household garbage</td>
<td>The Environmental Information and Demonstration Center shall be provided</td>
<td>Chapter 7 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Visual check; garbage</td>
<td>Monthly</td>
</tr>
<tr>
<td>Element</td>
<td>Potential impacts/problems</td>
<td>Mitigation Measures</td>
<td>Reference to Environmental Management Plan/Resettlement Action Plan</td>
<td>Implementing party</td>
<td>Supervising party</td>
<td>Monitoring index</td>
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<tr>
<td>Risk</td>
<td>Secondary pollution</td>
<td>with multiple garbage spots (cans). Household garbage shall be cleared and transported outward to the municipal garbage transfer station regularly by the sanitation department for daily dispose.</td>
<td>Environmental Management Plan</td>
<td>Protection, Shifeng District, Zhuzhou City</td>
<td>disposal record; whether specifications are followed</td>
<td>Chapter 9 of Environmental Management Plan</td>
<td>Owner</td>
</tr>
</tbody>
</table>

- Risk Secondary pollution
- Sprinkle water regularly in the surrounding area at the site of excavation, on the transportation road and around the vehicle circulation area to restrain dust raising;
- Strictly limit the activity range of the excavators and transport vehicles to prevent the polluted soil from being brought into other areas or outside the field;
- Provide effective precipitation before excavation of the foundation pit to prevent the disturbed soil from producing groundwater pollution;
- Slow down the speed and reduce the drop height when handling soil as much as possible to reduce man-made secondary spread of contamination;
- Provide cleaning pools at the exit of operation zone and clean and wash away the polluted soil on the tires of construction and transportation vehicles and other parts to reduce passive transfer of the contaminated soil;
- Cover up the polluted soil loaded in the vehicle before transportation to prevent the soil from spilling and scattering;
- Cover the soil in the yard with waterproof cloth to prevent the pollutant from spreading into the air;
<table>
<thead>
<tr>
<th>Element</th>
<th>Potential impacts/problems</th>
<th>Mitigation Measures</th>
<th>Reference to Environmental Management Plan/Resettlement Action Plan</th>
<th>Implementing party</th>
<th>Supervising party</th>
<th>Monitoring index</th>
<th>Monitoring frequency</th>
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<tr>
<td>EMP</td>
<td></td>
<td>Clean the apparatus contacting with the polluted soil directly during the operation at the end of daily operation and collect them together in the designated storage area; In case of no construction in windy or rainy days, cover up excavated soil with waterproof canvas to reduce dust raising or rain washing to prevent secondary pollution;</td>
<td>Chapter 11 of Environmental Management Plan</td>
<td>PMO of Zhuzhou municipal government</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
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<tr>
<td>Social environment</td>
<td>Effectiveness of complaint mechanism</td>
<td>Set up complaint system and provide complaint hotline telephone number displayed on the main entrances at each engineering site. Record each case and send out a written reply within 3 weeks.</td>
<td></td>
<td>Chapter 11 of Environmental Management Plan</td>
<td>PMO of Zhuzhou municipal government</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
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</tr>
<tr>
<td>Cumulative environmental impact</td>
<td>Impacts of the development of the core area of the Qingshuitang eco-industrial new town to the surface water environment, groundwater environment, acoustic environment and ecological environment; Solution of cumulative impacts have been listed in the EIA report of the core area plan of the Qingshuitang eco-industrial new town; Best management practices (BMP) have been adopted in the expansion of the Zhuzhou city; Dialogue mechanism with interested parties has been established to monitor the development and ecological conditions in Zhuzhou city;</td>
<td></td>
<td>Chapter 10 of Environmental Management Plan</td>
<td>PMO of Zhuzhou municipal government</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>EIA report of the core area plan of Qingshuitang eco-industrial new town is approved; various kinds of conferences and meetings are organized</td>
<td>Annually</td>
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</table>
## 5.4 Environmental Protection Measures and Recommendations in Closure Period

### Table 5.4-1 Schedule of Environmental Impacts and Mitigation Measures in Closure Period

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<tbody>
<tr>
<td>Ecological environment</td>
<td>Impacts on landscape</td>
<td>After the service expiration of the landfill, it shall be earthed up for planting grass on condition of safety of the landfill. The landfill shall be earthed up in a planned way and the sequence of earth first and vegetation second shall be followed by leveling the soil in which the vegetation grows and spreading it on the earth-up area.</td>
<td>Chapter 8 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Upon the completion of the project</td>
</tr>
<tr>
<td>Surface water environment</td>
<td>Landfill leachate</td>
<td>The normal operation of leachate monitoring system shall be maintained until the water quality is stable.</td>
<td>Chapter 6 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
</tr>
<tr>
<td>Groundwater environment</td>
<td>Landfill leachate</td>
<td>The normal operation of groundwater monitoring system shall be maintained.</td>
<td>Chapter 6 of Environmental Management Plan</td>
<td>Owner</td>
<td>Bureau of Environmental Protection, Shifeng District, Zhuzhou City</td>
<td>Specifications are followed; environmental monitoring plan has been prepared.</td>
<td>Monthly</td>
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</table>
6 Environmental Management

6.1 Purpose

This project, during both its construction and operation, will affect the ecological, natural, social, and economic environment of its surrounding area. To timely adopt effective measures for protecting the environment and mitigating the adverse effects, we need to make plans for environmental protection management and monitoring during the project’s construction, operation, and site closure.

Primary purposes include: determine the role and duty of environmental management; develop proper mitigation measures; establish supervising and monitoring procedures; and ensure sufficient budgets for effectively implementing the environmental management plan.

6.2 Advice on environmental management

To prevent the project’s construction from producing adverse effects, we need to strengthen environmental management during construction; ensure that the system of “three simultaneities” is implemented and that this project’s environmental protection measures are implemented; establish an environmental management system for this project and improve the system, according to the Technical Guidelines for Site Soil Remediation (HJ 25.4—2014) and Industrial Site Environmental Assessment and Environment Remediation Guidelines (Trial).

6.3 Environmental management objectives

We will develop an environmental management plan in a scientific way to align the construction and operation of the World Bank-China Proposed Zhuzhou Brownfield Remediation Project with the guiding ideology that the main part of a project and environmental protection project should be designed simultaneously, constructed simultaneously, and delivered simultaneously (i.e. three simultaneities), so as to help implement environmental protection measures in a planned way and to help justify the supervision of this project by the local environmental protection agency.

Through the environmental management plan, we will try to minimize the adverse
effects brought about by the planned project on the environment so that this project can bring benefits for the society, economy, and environment in a balanced, sustainable, and stable manner.

6.4 Remediation in environmental management

Remediation will be performed when making plans for construction, when making construction preparations, and during on-site construction. Environmental management when making plans for construction, when making construction preparations, and during on-site construction, should focus on the following.

6.4.1 Remediation plans during construction

Remediation plans during construction should, according to the construction site conditions and specific construction techniques, help update and detail site-specific environmental management plans, including secondary pollution prevention and control measures, emergency plan for environmental accidents, environmental monitoring plan, safe and civilized construction, personal health, and security.

6.4.2 Construction preparations

(1) Make disposal sites seepage-proof; according to construction plans and requirements of environmental management, ensure impermeability of and build drainage for areas that are susceptible to secondary pollution, such as disposal sites;

(2) Prior to construction, use training as tool to raise construction workers’ awareness of construction safety and environmental protection.

6.4.3 On-site construction

We need first to ensure implementation of pollution prevention and control measures, and then increase communications with the local EPA and residents in the project’s surrounding areas, so as to ensure that the interests of residents in the project’s surrounding areas will not suffer. If severe environmental pollutions arise in the remediation, construction undertakers should make remediation according to requirements of the EPA, project owner, and supervision institutions so as to ensure that remediation does not affect the life of residents and environment in the project’s surrounding areas.
6.5 Environmental monitoring and management

6.5.1 Purpose

Environmental monitoring and management is commissioned by the party responsible for the contaminated site, according to the environmental protection laws and regulations, papers regarding the site’s environmental assessment, papers regarding the site’s remediation plan, and environmental monitoring and management contract, to provide professional advice on and technology for environmental protection during site remediation, and to help and guide construction undertakers to implement all environmental protection measures of site remediation, so as to minimize the damages from remediation on the environment and maximize environmental protection.

6.5.2 Focuses

Environmental management focuses on the project’s environmental protection, risk prevention, and protection of the exterior environment affected by the project.

6.5.3 Content

Supervise the remediation project and ensure it meets the requirements of environmental protection; strike a well balanced relationship between the project’s construction and environmental protection as well as between the project owner and other parties.

6.5.4 Work modes

Environmental supervision and management generally involves three modes:

- Mode 1: inclusive type;
- Mode 2: independent type;
- Mode 3: combined type

As remediation is part of the environmental protection project, supervisors need to be knowledgeable in environmental protection. In whichever mode, the accomplishment of environmental supervision and management should be the focus, so as to ensure remediation is implemented as planned.
6.5.5 Procedure

Remediation is divided into three stages: design, construction preparation, and construction. See figure 6.5-1 for the procedure.

Fig 6.5-1 Environmental management procedures
6.5.6  Content of environmental monitoring and management

6.5.6.1  Design stage for the remediation project

Environmental management in the stage of design involves: collect site assessments, remediation plans for contaminated sites, construction design of the remediation project, organization plan for construction, and other basic materials; examine the environmental protection measures and papers regarding the design of environmental protection facilities in the remediation project; pay close attention to the construction location and whereabouts of soil that has been restored with ex-situ methods in the remediation project; examine whether measures for treating secondary pollution of water, atmosphere, noise, and solid wastes during remediation are comprehensive and whether treatment facilities are suitable; and give thoughts to follow-up management measures.

6.5.6.2  Construction preparation stage for the remediation project

Environmental monitoring and management in the construction preparation stage involves: learn about concrete construction processes and environmental protection objectives in various stages; help examine technology in design plan for the remediation project; determine the focus of environmental management; help the project owner and supervisors to improve the accountability system of environmental protection; develop methods for effective communication; develop detailed rules for environmental monitoring and management of sites to be restored.

6.5.6.3  Construction stage for the remediation project

Environmental monitoring and management during the construction stage for the remediation project involves:

Examine whether the remediation project follows the remediation plan, whether environmental protection facilities are put in place, and whether emergency system for accidents and environmental management system have been established; supervise the environmental protection project and measures as well as the progress of the environmental protection project; examine and monitor the wastewater, gas, noise, and wastes produced during construction as well as examine whether the area affected by construction meets the standard of the required environmental quality; undertake environmental monitoring and management for the contaminated soil transported on the site, wind tightness of vehicles
transporting wastewater, and transportation; supervise and manage remediation-related measures (e.g. waterproof curtain and construction precipitation) as well as extraction devices and wastewater treatment; examine whether the excavation of foundation pit and retaining and protecting structures during construction meet the construction requirements;

In ex-situ treatment, implement and monitor seepage-proofing measures for the repository and treatment of ground on the site; examine whether the exhaust gas emissions facilities and monitoring facilities for treatment facilities are sufficient on storage sites for contaminated soil, and verify whether the conditions meet environmental requirements; examine the establishment of long-term monitoring well for final-period management; according to the impacts by construction on the environment, organize for environmental monitoring and exercise environmental monitoring and management right; issue instructions on environmental monitoring and management to construction undertakers, and examine the implementation of the instructions; help construction undertakers handle environmental accidents and serious hidden dangers concerning the environment; compile the monthly report, semi-annual report, annual report, and special report on the environmental monitoring and management.

See figure 6.5-2 for the concrete working procedures of the remediation project during construction.
Fig 6.5-2 environmental monitoring and management procedures for construction of the remediation project on the contaminated site
6.5.7 Key points in environmental monitoring and management

6.5.7.1 Key points in environmental monitoring and management of the remediation project

6.5.7.1.1 Ex-situ soil remediation project

The Ex-situ soil remediation project involves environmental monitoring and management in stages of excavation, restoration, and backfill/transport, shown as follows:

(1) The stage of excavation

Collect samples from the contaminated area’s boundaries, side walls, and pit bottom and examine whether excavation has reached the boundaries according to test data, so as to avoid re-handling problems if problems are identified in stages of restoration and acceptance; distribution of monitoring stations can be based on technical requirements of ex-situ remediation and acceptance; rigorously control the smell of organics during excavation from dispersing, use measures such as spraying smell inhibitor to avoid impacts on the surrounding environment by the contaminated soil, and set up monitoring stations in areas surrounding the excavation site to monitor the atmosphere; supervise the implementation of measures for transporting contaminated soil in a wind tight manner so as to avoid spilling; supervise seepage-proofing effects on the ground where dredged soil is piled up; examine whether facilities for storing odorous organic contaminants are airtight, and set up monitoring stations around the storage facilities. See the Technical Guidelines for Environmental Site Monitoring (HJ 25.2) for methods through which monitoring stations are distributed.

(2) The stage of restoration

Restoration of soil contaminated by heavy metals: supervise seepage-proofing facilities and measures for the site’s ground; supervise implementation of the remediation project to see if it follows technical parameters of the implementation plan; collect soil samples after the soil is restored, roughly determine the restoration effects, supervise storage of restored soil for acceptance, and test samples collected from soil restored in batches under the remediation project; monitor and control the secondary pollution that may be caused by the agents added during the remediation.

(3) The stage of backfill/transport

Monitor and control the backfill of restored soil, and supervise whether the soil is backfilled under the plan for usage of land; supervise whether the foundation pit where soil
is stabilized/solidified is seepage controlled and whether measures for capping the land surface are effective.

6.5.7.1.2 In-situ soil remediation project

Rigorously supervise and regulate the boundaries of the restored area, set up sampling stations in places surrounding the restored area, and prevent the remediation project from affecting the underground water and soil in the project’s surrounding areas.

6.5.8 Environmental monitoring and management methods

Environmental monitoring and management methods include:

1. Examination;
2. Patrolling;
3. Side station;
4. Follow-up inspection;
5. Environmental monitoring;
6. Conference on environmental monitoring and management;
7. Information feedback;
8. Records and reports.

6.5.9 Environmental monitoring and management system

Environmental supervision institutions should establish a series of systems to ensure that environmental monitoring and management is implemented in a standard and orderly way.

Commonly-used systems include:

1. Logging system
2. Document reviewing system
3. Reporting system
4. Correspondence-via-letter system
5. Conference system
6. Emergency reporting and handling system
7. Training, publicity and education system

6.5.10 Environmental monitoring and management documentation

Environmental monitoring and management report includes environmental monitoring and management plans, detailed rules, regular reports, and final report.
6.6 Environmental impact monitoring of remediation works

6.6.1 Monitoring of water & soil loss

According to characteristics of the project and each construction stage, water & soil loss monitoring is detailed in table 6.6-1.

6.6.2 Monitoring of atmosphere, surface water, and noise in contaminated field

See table 6.6-2 for monitoring plan of atmosphere, surface water, and noise in construction stage, operation stage, remediation acceptance, later period and closure period.

6.6.3 Soil and ecological monitoring in remediation acceptance and later period

Environmental monitoring plan in later period at contaminated field shall be determined upon remediation contents of the project. Fixed monitoring station and mobile monitoring spots are both adopted. On-line monitoring devices will be provided by Environmental Information and Demonstration Center according to monitoring needs.

Long-term environmental monitoring shall be carried out to the soil, water, and ecological plants in remediation area after the completion of the project. 10 dynamic monitoring spots shall be arranged within 3 years after acceptance of the project; 3 years later, the number of monitoring spots can be reduced to 1 to 2 for dynamic monitoring over vegetation recovery progress, landscape ecologically recovered vegetation, and vegetation in wetland and ecological sewage intercepting wall. The community diversity of plants in remediation area shall be analyzed. Soil recovery quality and how much vegetation enriches heavy metals shall be comprehensively evaluated.

In addition, long-term inspection shall be conducted on soil around remediation area to make sure that there is no secondary pollution on surrounding area.
### Table 5.4-1 Soil erosion Monitoring Schedule

<table>
<thead>
<tr>
<th>Location of monitoring point</th>
<th>Monitoring content</th>
<th>Monitoring method</th>
<th>Monitoring time</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole area</td>
<td>Observation of rainfall, rain intensity and etc</td>
<td>Use local meteorological data</td>
<td>Construction period, initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Check the area of land occupation and disturbed topsoil</td>
<td>Site investigation, check data</td>
<td>Construction period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Status of heavy-metal pollution in project area</td>
<td>Field sampling survey</td>
<td>Construction period, initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Check the quantity of cut earth and area of land occupation</td>
<td>Site investigation, check data</td>
<td>Construction period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Area of vegetation coverage, survival rate of trees</td>
<td>Field measurement &amp; survey</td>
<td>Initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Hazard of soil erosion and surrounding impact</td>
<td>Site investigation</td>
<td>Construction period, initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Various construction areas</td>
<td>Terrain and relief</td>
<td>Site investigation, topographic survey</td>
<td>Construction period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Quantity and quality of damaged water conservation facilities</td>
<td>Site investigation</td>
<td>Construction period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Runoff erosion of temporary slope (Backfilled slope)</td>
<td>Simple slope measurement method, peg nail method</td>
<td>Construction period</td>
<td>Quarterly, monthly in rainy season; timely additional monitoring in case of rainstorm and strong wind</td>
</tr>
<tr>
<td></td>
<td>Status of construction of water and soil conservation measures</td>
<td>Site investigation</td>
<td>Construction period, initial operation period</td>
<td>Once monitoring and recording for every 10 days</td>
</tr>
<tr>
<td></td>
<td>Quantity and quality of completed water conservation</td>
<td>Site investigation</td>
<td>Construction period, initial operation period</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Status of construction of heavy metal control measures</td>
<td>Field sampling survey</td>
<td>Construction period, initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Earthwork, quantity and quality of completed heavy metal control</td>
<td>Field sampling survey</td>
<td>Construction period, initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td>Survival rate of plants with water and soil conservation measures</td>
<td>Site investigation</td>
<td>Construction period, initial operation period</td>
<td>Annually</td>
</tr>
<tr>
<td></td>
<td>Stability, integrity and operation condition of construction protective measures</td>
<td>Field patrol &amp; observation method</td>
<td>Construction period, initial operation period</td>
<td>Once before and after flood season, respectively</td>
</tr>
</tbody>
</table>
## EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Period</th>
<th>Monitoring Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity of sediment</td>
<td>Grit chamber method</td>
<td>Construction period, initial operation period</td>
<td>Once before and after flood season, respectively, strengthen monitoring in flood season</td>
</tr>
<tr>
<td>Vegetation coverage of forest and grassland</td>
<td>Site investigation</td>
<td>Initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Status of vegetation restoration (Greening rate)</td>
<td>Site investigation</td>
<td>Initial operation period</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Runoff volume and sediment volume</td>
<td>Peg nail method</td>
<td>Construction period, initial operation period</td>
<td>Once before and after flood season, respectively, strengthen monitoring in flood season</td>
</tr>
<tr>
<td>Vegetation coverage of forest and grassland</td>
<td>Method of purposive sample plot</td>
<td>Restoration period</td>
<td>Each May</td>
</tr>
<tr>
<td>Vegetation restoration rate of forest and grassland</td>
<td>Method of purposive sample plot</td>
<td></td>
<td>Each Sep</td>
</tr>
<tr>
<td>Tree resistance to heavy metal (Tree overwintering hazard)</td>
<td>Method of purposive sample plot</td>
<td></td>
<td>In spring and in summer</td>
</tr>
</tbody>
</table>
Table 5.4-2 Implementation of Environment Monitoring Schedule during Construction Period, Operation Period, Remediation Acceptance Period, Subsequent Period & Closing Period

<table>
<thead>
<tr>
<th>Category</th>
<th>Item</th>
<th>Stage monitoring plan</th>
<th>Remediation acceptance period, subsequent period and closing period of landfill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Construction period</td>
<td>Operation period</td>
</tr>
<tr>
<td>Acoustic environment</td>
<td>Monitoring point</td>
<td>Many operation sites of operation equipments and unpaved roads or spaces close to sensitive areas or sensitive environment</td>
<td>Jianshe Village in the east of landfill, Heyeba residential area in the west of Xinqiao dewatering site, New Xiawan Village residential area in the west of Xinqiao solidification/stabilization ground, Xiawan dewatering site</td>
</tr>
<tr>
<td></td>
<td>Monitoring factor</td>
<td>Equivalent continuous sound level (L&lt;sub&gt;Aeq&lt;/sub&gt;)</td>
<td>Equivalent continuous sound level (L&lt;sub&gt;Aeq&lt;/sub&gt;)</td>
</tr>
<tr>
<td></td>
<td>Monitoring frequency</td>
<td>Once/month</td>
<td>Once/month</td>
</tr>
<tr>
<td>surface wastewater</td>
<td>Monitoring point</td>
<td>Discharge outlet of mobile water treatment equipment, discharge outlet of construction camp, construction site and mine seeper treatment equipment</td>
<td>Leaching takeover intake</td>
</tr>
<tr>
<td>environment</td>
<td>Monitoring factor</td>
<td>COD&lt;sub&gt;c&lt;/sub&gt;, BOD&lt;sub&gt;3&lt;/sub&gt;, SS, oils, ammonia-nitrogen, As, Sb, Pb, Zn, Cd</td>
<td>pH, COD&lt;sub&gt;c&lt;/sub&gt;, BOD&lt;sub&gt;3&lt;/sub&gt;, NH&lt;sub&gt;3&lt;/sub&gt;-N, TP, As, Sb, Pb, Zn, Cd</td>
</tr>
<tr>
<td></td>
<td>Monitoring frequency</td>
<td>Monitoring of discharge outlet of mobile water treatment equipment, mine seeper treatment equipment in terms of construction term (At least once/month) ; once/month monitoring at other points</td>
<td>Real-time monitoring of sewage outfall</td>
</tr>
<tr>
<td>groundwater environment</td>
<td>Monitoring point</td>
<td>One monitoring well in the upstream and downstream close to construction site, respectively</td>
<td>One monitoring well in the upstream and downstream close to Xinqiao dewatering site, Xiawan dewatering site, Xinqiao solidification/stabilization ground, landfill, Qingshui Lake constructed wetland, respectively</td>
</tr>
<tr>
<td></td>
<td>Monitoring point</td>
<td>One monitoring well in the upstream and downstream close to Xinqiao dewatering site, Xinqiao solidification/stabilization ground, landfill, Qingshui Lake constructed wetland, respectively</td>
<td>One monitoring well in the upstream and downstream close to landfill, respectively; Use existing monitoring well, for the enterprises in production, set up long-term monitoring well in the downstream of groundwater flow along the boundary of the enterprises</td>
</tr>
<tr>
<td>Monitoring factor</td>
<td>COD&lt;sub&gt;c&lt;/sub&gt;, BOD&lt;sub&gt;5&lt;/sub&gt;, SS, oils, ammonia-nitrogen, As, Sb, Pb, Zn, Cd, Cr, Hg</td>
<td>pH, COD&lt;sub&gt;c&lt;/sub&gt;, BOD&lt;sub&gt;5&lt;/sub&gt;, NH&lt;sub&gt;3&lt;/sub&gt;-N, TP, As, Sb, Pb, Zn, Cd, Cr, Hg, As, Sb, Pb, Zn, Cd, Cr, Hg</td>
<td>pH, COD&lt;sub&gt;c&lt;/sub&gt;, BOD&lt;sub&gt;5&lt;/sub&gt;, NH&lt;sub&gt;3&lt;/sub&gt;-N, TP, As, Sb, Pb, Zn, Cd, Cr, Hg</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Monitoring frequency</td>
<td>Monitoring in terms of construction term (At least once/month)</td>
<td>Once/month</td>
<td>Once/month</td>
</tr>
<tr>
<td>Monitoring point</td>
<td>Many operation sites of operation equipment, operation sites of Zhuzhou Tiancheng Chemical Co., Ltd, organic contaminated soil, and unpaved roads or spaces close to sensitive areas or sensitive environment</td>
<td>Boundary and leeward organic contaminated soil operation sites of Xinqiao dewatering site, Xiawan dewatering site, Xinqiao solidification/stabilization ground, landfill, Zhuzhou Tiancheng Chemical Co., Ltd</td>
<td>Boundary and leeward organic contaminated soil operation sites of Xinqiao dewatering site, Xiawan dewatering site, Xinqiao solidification/stabilization ground, landfill, Zhuzhou Tiancheng Chemical Co., Ltd</td>
</tr>
<tr>
<td>Monitoring factor</td>
<td>Total suspended particles (TSP), PM&lt;sub&gt;10&lt;/sub&gt;, additional measurement of H&lt;sub&gt;2&lt;/sub&gt;S, NH&lt;sub&gt;3&lt;/sub&gt;, odor intensity at construction sites of channels and ponds</td>
<td>TSP, H&lt;sub&gt;2&lt;/sub&gt;S, NH&lt;sub&gt;3&lt;/sub&gt;, odor intensity, organic contaminated soil operation site of Zhuzhou Tiancheng Chemical Co., Ltd, monitoring of benzopyrene and anilin</td>
<td>TSP, H&lt;sub&gt;2&lt;/sub&gt;S, NH&lt;sub&gt;3&lt;/sub&gt;, odor intensity, organic contaminated soil operation site of Zhuzhou Tiancheng Chemical Co., Ltd, monitoring of benzopyrene and anilin</td>
</tr>
<tr>
<td>Monitoring frequency</td>
<td>Random sampling in construction peak</td>
<td>One day per month</td>
<td>One day per month</td>
</tr>
</tbody>
</table>

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EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)
6.6.4 Groundwater monitoring

In light of the risk evaluation regarding the area, it is learnt that the pollution in the area have not extended to groundwater yet, even in the perspective of human health. Therefore, the project will not take groundwater remediation into account for now. However, in order to comprehensively understand the quality of groundwater, a plan has been prepared to conduct systematic and long-term tracking monitoring and research on the groundwater in the area.

6.6.4.1 Objectives and mission of monitoring

The groundwater quality monitoring plan is to fully understand the status quo of groundwater as well as change and pollution in the groundwater under key contaminated sources during and after project construction. Therefore, it can provide scientific basis for whether to conduct detailed groundwater environmental investigation, whether to build a groundwater pollution model to predict the pollution trend, and whether to carry out groundwater remediation (prevention & control).

The main tasks are as follows:

1. Based on the geological and hydrogeological research on the investigation area, gather and use the relevant information and data that have been obtained and screen and analyze the data for reference (or comparison) in the research of the groundwater environment of the area.

2. On the basis of sufficient research into the existing geological, hydrogeological and environmental geological information that have been collected, carry out groundwater quality analysis and water level dynamic observation.

3. Analyze and summarize the results of groundwater investigation and monitoring and provide periodic analysis report annually. Determine the classifications, concentration and special distribution of the contaminants initially; analyze the information obtained from survey targets of the initial sampling, including the groundwater type, hydrogeological conditions, on-site and lab test data; if the contaminants are not covered in the standards, refer to the standard value for assessment based on the protection of water environment in Investigation Report on Environmental Quality of Shallow Groundwater in Qingshuitang Industrial Area (2012) prepared by Institute of Soil Science, Chinese Academy of Sciences. Moreover, the quality assurance and quality control of initial sample analysis need to be evaluated.
6.6.4.2 Monitoring requirements

**Time period:** Based on the implementation of the project, groundwater monitoring will be carried out in three time periods: monitoring in construction phase, monitoring in operation phase and permanent monitoring.

**Monitoring site selection:** Based on the possible impact of the project contents and various project activities on groundwater, with overall consideration of the hydrogeological conditions of the area, current situation of the exploitation and use of groundwater, current situation of land use and the distribution of contamination sources, the monitoring wells should be set mainly at the upstream and downstream of the construction site, nearby environmental sensitive points and groundwater contamination sources. The upstream monitoring wells are comparative wells and the downstream monitoring wells are contamination monitoring wells. Contaminated area and potential contaminated area should be the focus of monitoring. The degree of contamination of the contamination sources on groundwater and its dynamic change should be monitored to reflect the dynamic changes of the water level and water quality of groundwater as well as the temporal-spatial distribution characteristics and contamination features in the area during and after the implementation of the project.

**Monitoring Factors:** Take samples from each drilled wells in the phreatic aquifer and confined groundwater layer and assay the samples respectively. The water quality monitoring factors are: color, smell and taste, turbidity, visible substances, pH, total hardness, total dissolved solids, sulfate, chloride, iron, manganese, copper, zinc, molybdenum, cobalt, volatile phenols, anion synthetic detergent, potassium permanganate index, nitrate, nitrite, ammonia nitrogen, iodide, fluoride, cyanide, mercury, arsenic, selenium, cadmium, chrome (hexavalent), lead, beryllium, barium, nickel, DDT, HCH, total coli-group, total number of bacteria, total α radioactivity, total β radioactivity, total nitrogen, total phosphorus, petroleum and derivatives, sulfide, halohydrocarbon, PAHs, BETX, phenol, alkylbenzene, total lead, total chromium, total vanadium, benzene, phenols, benzoapyrene, aluminum, copper, stibium, molybdenum, silver, thallium, gold, phosphates, organophosphorus pesticides, organochlorine pesticides, alkanes, olefins, nitrobenzoates, and oils. The 68 monitoring factors are used for investigating groundwater contamination.
6.6.4.3 Compilation of report

1. Name and format of report

The report shall include analysis, summarization and assessment of the process and results of stage survey. Specifically the content covers work plans, onsite sampling, lab analysis, quality control, data assessment, result analysis, conclusion and suggestions, and appendixes. For the format of the report, refer to the Appendix I of Guide to Investigation and Assessment of Underground Water (Tentative)

2. Conclusion and suggestions

The conclusion and suggestions shall state whether the subject and surrounding underground water are polluted and focus on the pollutants. The impact of difference between actual investigation and the work plan as well as the limitations on the conclusion shall also be stated

6.6.4.4 Follow-up work based on this survey

Based on the investigation of the above underwater environmental quality, this can provide basic materials for follow-up work and lay a solid foundation for proceeding next work.

(1) If the pollutant concentration surpasses the national and local standards as well as that of the concentration of cleaning control point, and this is confirmed by uncertainty analysis, a detailed sampling plan shall be compiled. Secondary detailed investigation needs to be conducted including sampling and analysis, so as to confirm the type, concentration and spatial distribution of the pollutants. On the other hand, one needs to analyze the necessity of risk assessment or pollution repairing, and when it does not satisfy the above operational demand, third underground water environment survey needs to be conducted, and the survey plan of the third underground water environment shall be compiled.

(2) If the third site environment survey is conducted, it mainly involves supplementary sampling and testing. The property of pollution source, pollution discharge characters, way of pollution, relation between pollution source and potential receptor, migration and transformation of pollutants, the parameters of risk assessment and groundwater remediation shall be satisfied, etc. The major content of the work includes investigation on the parameters of site characteristics and parameters of receptor exposure.

(3) When the toxicity indicator of underground water surpasses the Type III standard of Quality Standard of Underground Water (GB/T 14848) and Sanitary Standard of Domestic
*Drinking Water* (GB 5749), any toxic or harmful materials are detected, the underground water health risk assessment can be initiated.

(4) If the concentration of pollutants in underground water surpasses related standards, or if the concentration remains within standard limits but shows a sign of deterioration, then an underground water pollution conceptual model should be constructed to conduct prediction of pollution trend.

(5) For concentration of pollutants surpasses related standards or acceptable risk level, underground water remediation (control) needs to be considered.

### 6.6.5 Supervision and monitoring of enterprise under production

For enterprises under production, a long-term monitoring well is set in the underwater downstream, and the ZREIDC can conduct long-term monitoring on the quality of the underground water.

Moreover, the Zhouzhou Municipal Environmental Protection Agency carries out regular monitoring on the waste water and exhaust of the operating enterprises, and conducts monitoring of key pollution source once a month and monitoring on common enterprises once a season, in order to supervise the pollution exhaust of the enterprises. Zhouzhou Environmental Inspection Detachment is responsible for the execution of the monitoring by directly supervised units and the implementation of pollution treatment measures, etc. Shifeng District Environmental Protection Agency is responsible for the site inspection and environmental protection of the district area except for the directly supervised units.

There are altogether more than 100 people of the Zhuzhou Environmental Protection Agency, Zhuzhou Shifeng District Environmental Protection Agency, Environmental Monitoring Center as well as the Environmental Inspection Detachment. The Environmental Monitoring Center and Environmental Inspection Detachment both reach the Class II of national construction standard. Currently there are enough and capable personnel of Environmental Protection Agency to meet the environmental inspection requirements. In the future, it is recommended to set up environmental monitoring stations in the district environmental protection agencies to further improve the monitoring capacity and meet the higher monitoring demands proposed by a more developed Zhuzhou City in the future.

According to the *Environmental Protection Law*, the enterprises that violate the law shall be punished, either by day, or be ordered to close up or suspend business, or be taken under administrative detention, etc. Only enterprises that satisfy the related standards and indicators on pollution and environmental protection can continue operation.
6.6.6 Monitoring report

① Environmental monitoring report during construction

The construction takes about 102 months and consists of several stages according to engineering contents. According to Chinese laws and regulations and World Bank Policies, the owner shall compile a Environmental Monitoring Report and submit it to the World Bank and the Shefeng District Environmental Protection Agency. The purpose of the report is to convince the environmental protection agencies that all the environmental protection measures are taken according to the approved Environmental Monitoring Plan, so as to control the adverse environmental impact of the plan.

Environmental monitoring report shall include:

a) Brief introduction of project process;

b) Institutional arrangements and responsibilities;

c) Content and methods of major construction, environmental impact and mitigation and the implementation of measures;

d) Environmental monitoring report;

e) Public complaints and solution

During construction, according to management procedures, the contractor and environmental supervision engineer shall submit environmental report to the owner.

② Environmental monitoring report during operation

According to the monitoring report, during operation, the Project Management Office entrusts qualified environmental monitoring station to conduct environmental monitoring. Meanwhile, the annual environmental report shall be compiled, including: setting of environmental management agencies, operation status of the project, execution of the environmental protection measures as required by the Environmental Protection Agency, environmental monitoring (date, frequency, location of monitoring points, methods, applicable standards, etc.), statistical analysis of monitored data, necessary follow-up. The environmental monitoring report needs to be submitted to Shifeng District Environmental Protection Agency and the World Bank.
6.7 Remediation acceptance

6.7.1 Purpose and content

Contaminated site’s remediation acceptance is a process in which investigation and assessment are conducted for soil on the site after the contaminated site is restored. The site remediation effects will be assessed through document review, site survey, in-situ sampling, and test and analysis to see if the remediation meets the acceptance standard; final-stage management plan should also be assessed to see if it is feasible and to what extent it has been implemented. After the site’s remediation passes the acceptance, the site can be redeveloped and reused; and long-term monitoring and final-stage risk control will be conducted according to the final-stage management plan.

Remediation acceptance involves acceptance of the site’s soil cleanup, acceptance of the site’s soil remediation, and assessment of feasibility of final-stage management plan and its implementation.

6.7.2 Procedures

Acceptance of the contaminated site’s remediation involves document review and site survey, determining acceptance standards, developing sampling stationing plans, in-situ sampling and laboratory testing, assessing the remediation effects, and compiling reports on acceptance. See Fig 6.7-1 for the procedures.

Fig 6.7-1 acceptance procedures
6.7.3 Document review and site survey

6.7.3.1 Document review

(1) Materials to be reviewed

Prior to the acceptance, materials concerning the site’s environmental pollution and remediation should be collected. Such materials include:

(1) Papers concerning environmental assessment and remediation plans: report on the site’s environmental assessment and its documented opinions; the site’s remediation plan and its documented opinions; and other relevant materials.

(2) Materials regarding the site’s remediation project: original records of the remediation process; remediation’s log files (e.g. records of excavation, cleanup, and transport of contaminated soil); records of transport of backfilled soil; records of operation of repaired facilities; records of secondary pollutant emission or discharge; report on the completion of the remediation project.

(3) Papers concerning the project and environmental monitoring and management: records of the project and environmental monitoring and management, and report on the environmental monitoring and management.

(4) Other papers: environmental management contracts and agreements (e.g. commission papers and contracts with regard to contaminated soil treatment).

Relevant maps, charts, and pictures: sketch map of the site’s location, general layout, map of restored areas, pollution remediation process flowchart, pictures of the remediation process, and photo logging.

(2) Content of the review

Systematically list the collected materials and analyze them, and through interviewing the person in charge of the site, staff who implements the remediation, supervisors, and other relevant people, determine the following content:

(1) According to reports on the site’s environmental assessment, remediation plans, and administration-related papers, determine which of the site’s pollutants to target, and the extent and objectives of remediation so as to base the acceptance of remediation on them.

(2) Verify the implementation of the remediation plan and environmental protection measures by examining the monitoring data and supervision records in the site’s remediation process.

(3) Verify the contaminated soil’s amounts and whereabouts by examining the relevant transport list and received letters as well as the supervision records in the remediation process.

(4) By examining the monitoring data and relevant papers, verify the quantity and quality
of the backfilled soil that has been restored with ex-situ treatment; quality of the backfilled soil should reach the remediation’s objective.

6.7.3.2 Site survey

Site survey involves determining the remediation’s extent and identifying the traces of pollution left on the site.

(1) Determine the remediation’s extent

According to the materials concerning grade stakes and geographic coordinates in the site’s environmental assessment report, as well as relevant reports on the project supervision and environmental monitoring and management during the remediation, determine the site’s remediation extent and depth, and verify whether the remediation’s extent meets the requirements of the sites’ remediation plan.

(2) Identify the pollution left on the site

Observe and assess the site’s surface soil and uncovered soil in the area surrounding the site as well as items left behind; use portable test instrument to conduct site tests supplemented by watching and smelling to identify the traces of pollution left on the site.

6.7.4 Acceptance standards and objects tested for acceptance

Under this project, the objects on contaminated sites that will be tested for compliance with remediation standards include the following, along with the standards that shall be met:

(1) Foundation pit remaining after contaminated soil is excavated and cleaned

During testing, collect samples of the soil left in the foundation pit and test them; determine whether the remediated area remains contaminated; the indicators for this test are the levels of the target contaminants; the standard of acceptance for this test is the specified restoration value for the site's soil.

(2) In-situ restored soil

The indicators for this test are the levels of the target contaminants; the standard of acceptance for this test is the specified restoration value for the site's contaminants.

(3) Ex-situ restored soil

The indicator for this test is the leaching threshold for targeted contaminants in areas that have been exposed to toxins through remediation and in areas that, through remediation, have had their terrain solidified/stabilized.

The standard of acceptance for ex-situ remediation is the specified restoration value of the site's soil.
(4) Areas that might be affected by secondary pollution from the remediation
Secondary polluted areas include the area where contaminated soil is temporarily stored and disposed, the area where overspill from facility demolitions rests, and areas that might suffer from the dispersal of pollution due to remediation. The indicators for this test are the pollutants specified by the site survey, and also secondary pollutants; the standard of acceptance for this test is the specified remediation value for the site’s contaminants.

6.7.5 Sampling stationing plan

The sampling stationing plan includes sampling medium, sampling area, sampling depth, sampling quantity, and testing items. According to the target contaminants and the different specified remediation values, partitioned sampling should be conducted within the site’s remediation extent; the location and depth of sampling sites should cover the site’s remediation extent and its border; sampling needs to be conducted in the most severely polluted areas that have been determined by the site’s environmental assessment.

(1) Foundation pit within the site

With regard to the ex-situ remediated site, the in-situ soil in the remediation’s extent and the border should be sampled; sampling sites are the bottom and side walls of the pit; samples of surface soil dominates all soil samples including samples of deep soil; soil samples of volatile organic compounds should be collected at 0.2m below the surface.

Stationing by system will be applied to the surface layer of the pit’s bottom. Generally, the first sampling site is arranged randomly; build grids that go through this sampling site, and collect samples at each junction of the grids. The grid’s size is determined by the sampling area and quantity. See table 6.7-1 for reference with regard to the sampling quantity. In principle, the size of a grid is no bigger than 20m×20m.

<table>
<thead>
<tr>
<th>Sampling area (㎡)</th>
<th>Number of soil sampling sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>3</td>
</tr>
<tr>
<td>100～500</td>
<td>4</td>
</tr>
<tr>
<td>500～1000</td>
<td>5</td>
</tr>
<tr>
<td>1000～1500</td>
<td>6</td>
</tr>
<tr>
<td>1500～2500</td>
<td>7</td>
</tr>
<tr>
<td>2500～3500</td>
<td>8</td>
</tr>
<tr>
<td>3500～5000</td>
<td>9</td>
</tr>
<tr>
<td>&gt;5000</td>
<td>≥10</td>
</tr>
</tbody>
</table>

Within the remediation’s extent, equidistant stationing will be applied to side walls; number of sampling sites will be determined according to the side length. When the remediation’s depth
is $\leq 1\text{m}$, no vertically stratified sampling will be conducted on the side walls. Number of horizontal sampling sites can be determined according to table 6.7-2.

<table>
<thead>
<tr>
<th>Circumference of sampling areas (m)</th>
<th>Number of soil sampling sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>50～100</td>
<td>5</td>
</tr>
<tr>
<td>100～200</td>
<td>6</td>
</tr>
<tr>
<td>200～300</td>
<td>7</td>
</tr>
<tr>
<td>$&gt;300$</td>
<td>$\leq 8$</td>
</tr>
</tbody>
</table>

### 6.7.6 In-situ sampling and laboratory testing

See in-situ sampling at the second stage in the Industrial Site Environmental Assessment and Environment Remediation Guidelines (Trial) for soil sampling methods, field quality control, field quality guarantee, methods for sample storage and transport, methods for sample analysis, laboratory quality control, protection of field force, and emergency treatment for on-site contamination.

Limit of detection for testing the project before it can be accepted should be lower than the specified remediation value. Report on the laboratory testing should include testing conditions, detecting instrument, test methods, testing results, limit of detection, and quality control results.

### 6.7.7 Remediation effects assessment

Efforts that should be made when examining the remediation before accepting it include: carefully collect samples and conduct laboratory testing; analyze test data in a scientifically and reasonable way; and ascertain whether the site’s contaminants meet the acceptance standard to determine if the site reaches the remediation’s effects. If the site fails to reach the remediation’s effects, advice on continuous cleanup or remediation needs to be provided. The feasibility and implementation of the plan for management during this project’s completion acceptance should also be assessed.

#### 6.7.7.1 Assessment methods

A assessment method can be used to evaluate the whole site’s remediation effects.

According to the assessment method, first, we need to determine the difference between sampling sites’ testing results and the remediation’s objectives; second, we need to assess if the site reaches remediation effects;

(1) where the sampling site’s testing results are remarkably lower than the specified remediation value or the difference between the testing results and remediation objectives is not significant, the site is considered having reached the acceptance standard;
6.7.7.2 Advice on continuous cleanup/remediation

If samples collected from somewhere within the foundation pit are tested to be below the standard for acceptance, part of the contaminated soil will be re-cleaned and re-tested based on the grids before it can be accepted; if necessary, samples can be collected from part of the soil with the method that distributing sampling sites through grids.

If samples collected from heaps of restored soil are tested to be below the standard for acceptance, the contaminated soil will be transported to treatment facilities; after the contaminated soil is restored through treatment facilities, samples will again be collected from the soil for acceptance tests.

6.7.8 Compile acceptance report

Acceptance report’s content should be true, comprehensive, and at least includes the following: conclusion of the site’s environmental assessment, implementation of the remediation plan, acceptance’s procedures and methods, paper review and site survey, sampling stationing plan, in-situ sampling and laboratory testing, remediation effects assessment, acceptance conclusion and advice, environmental remediation supervision report and test report.

6.8 Management during the final stage

6.8.1 Content

Final-stage management involves: following the scientific and feasible final-stage management plan as well as the site’s real conditions, adopt systems for equipment’s and project’s long-term operation and maintenance, long-term monitoring, long-term archiving, and reports, and review and examine the work regularly and occasionally. The management objective is to assess the long-term effectiveness of the site’s remediation and to ensure that the site will not affect human health and the environment of the surrounding areas.

Management during the final stage will not be effective until it is combined with development of systems. In other words, it is necessary to develop a series of systems for long-term monitoring, tracking, retrospective examination, assessment, and risk control during the final stage; design and build systems; and determine technical requirements and the
responsibilities of the parties concerned.

Retrospective examination and assessment is at the core of the site's final-stage management and it includes: review site-related materials and site survey, identify and diagnose the site’s potential risks, measures for and advice on optimizing final-stage management, and compile retrospective report. See flowchart 6.8-1 for the procedures.
Fig. 6.8-1 procedures of retrospective examination and assessment

Retrospective examination and assessment involves:

1. Review site-related materials and conduct site surveys: workers who take charge of retrospective examination should first review site-related materials and conduct site surveys, including: collect and read site-related materials, review and analyze site-related data, conduct site surveys, and interview relevant people.

2. Identify and diagnose the site’s potential risks: through site surveys and the review of site-related materials, identify and assess problems that may exist in the existing remediation methods or measures, e.g. system control measures are defective; remediation objectives are difficult to reach; remediation objectives are unclear; implementation of the site’s remediation fails to follow the plan; ways of exposure may be changed; usage of site may be changed, so as to assess if the site’s remediation can protect human health and the environment.

3. Measures for and advice on optimizing the final-stage management: according to the identification and diagnosis of the site’s potential risks, if the site’s remediation is expected to fail to or can hardly protect human health and the environment, further measures and advice should be made and adopted to optimize the plan for implementing remediation, including long-term response, operation and maintenance, implementation of system control, optimization of the remediation plan, and supplemented surveys.

4. Compile retrospective reports: according to the surveys and diagnosis that are mentioned above, provide a retrospective conclusion; decide whether it is necessary to adopt further measures, whether it is necessary to continuously conduct retrospective examination, and how long it will take; compile retrospective report.

With regard to some complicated sites, as retrospective examination covers a long period of time, it is difficult to supervise these sites. Therefore, it is advisable to introduce system control to the final-stage management.
Site’s retrospective examination and assessment will be undertaken by the eligible agencies commissioned by the party responsible for the site’s remediation according to the site’s conditions. The site’s retrospective report should be submitted to the local EPA and be put on record by the EPA; retrospective examination and assessment should be conducted under the supervision and guidance of the EPA.

6.8.2 Schedule

This project’s final-stage management can be implemented when the remediation starts. The first site’s retrospective examination and assessment will be conducted in five years after the site’s remediation passes the test for acceptance, and it will not cease until the site no longer affects human health and the surrounding environment. Schedule for follow-up site’s retrospective examination and assessment will be determined based on the conclusion of the first retrospective examination; according to the situations, reviews can be conducted ahead of schedule and frequency of reviews can be increased.

6.9 Environmental management of solid waste landfills

6.9.1 Operation

(1) Solid waste landfills should operate under the Announcement on Amending the “Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes (GB18599-2001)” and other two pollution control standards.

(2) To ensure that soil is effectively excavated, solidified, and landfilled, the following plans need to be developed: plan for excavating and handling waste heaps; plan for the curing process in workshops; plan for safe landfilling in newly-built landfills; operating instructions and progress plan. In the solidification process, attention should be paid to the following:

A. Blocks formed from solidified waste must be sampled for testing.

B. Blocks whose harmful leachate concentrations fall under the control thresholds of the landfill area can be taken to the landfill, otherwise the blocks will be broken up and re-disposed of as waste.

In the landfilling process, attention needs to be paid to the following:

A. Waste heap should be compacted to the greatest extent so as to ensure the maximum landfilling capacity.

B. Blocks of solid wastes should be piled up on the site according to the design; the blocks are prohibited from being randomly dumped in the site.
C. The area of the landfill in which blocks are disposed needs to be minimized; exposure of blocks of solid waste needs to be minimized; as the blocks fill the landfill, the landfill needs to be closed.

(3) To ensure newly-built landfills operate safely and effectively, the landfills should be partitioned for waste heaps to be disposed; ensure single landfill area is covered eventually in as short period of time as possible.

(4) In excavating the soil contaminated by heavy metals, test for leaching toxicity of the contaminated soil should be conducted in a timely manner according to the excavation depth and solidification should be minimized.

(5) The landfill area, existing excavation area for waste heaps, and roads for transportation should be regularly watered so as to reduce dust pollution.

(6) In the landfilling process, efforts should be paid to protect the impermeable layer, to prevent pipelines from being blocked, to ensure that leachate is collected unimpeded, and to prevent risks and accidents.

(7) Strength environmental monitoring and management; make a record of environmental monitoring data and make a record of environmental management work, and in a timely manner gain an understanding of the environment and pollution discharge in the site area and in waste heaps.

6.9.2 Site closure

(1) Construction undertakers should collect basic information about the weather, hydrology, soil, and vegetation on the newly-built landfill and in its surrounding areas; according to the plan of land usage, determine the forms for greening the closed landfill sites and the remediation project for existing waste heaps, e.g. greenbelts for relaxation, woodland, and land for tree nursery; select and allocate plant species in an ecological, safe, and economical way; make designs for the greening of areas surrounding buildings, roads, greenbelts, and creations in various regions that have been partitioned according to the functions of the sites’ areas.

(2) Conservation of water and soil is the primary function of site closure. Therefore, it is necessary to use the covering materials that can better conserve water and soil, and to make good designs for the site’s drainage and construct the drainage, so as to prevent water erosion after greening is complete.

(3) To keep the closed site’s cover system intact, reshaping the terrain in a large scale when the site is closed should be avoided. Therefore, when making designs for closure of the site,
waste heaps must be reshaped according to the landscape plan; cover system will not be constructed until it meets the design requirements.

(4) Growing drought-enduring plants on the closed site helps reduce water bill; growing vegetation that have low maintenance costs helps reduce follow-up management and maintenance costs; growing plants that absorb heavy metals helps improve the quality of the area’s soil and underground water environment.

(5) Regularly monitor the closed landfill site, monitor and control ecological restoration in real time, and adjust the remediation plan according to the monitoring results.

6.10 Measures for Pollution prevention and control and Personnel Safety Guard in the Remediation Process

6.10.1 Pollution prevention and control in the Remediation Process

6.10.1.1 Cleaning of Equipment

All equipment, machines and tools into the non-contamination area from the contamination area shall be cleaned, including excavators, transport vehicles and personal protective equipment. Collect and place the cleaning water in the water treatment equipment and recycle it for reuse to reduce the amount of it. For cleaning of large machinery, provide cleaning pools and sedimentation basins on the floor. When the equipment is placed on the cleaning platform, the washing water can flow into the cleaning pools and sedimentation basins. The water therein can be recycled for reuse as washing water while the sediment can be collected for disposal.

6.10.1.2 Prevention and Control of Flying Dust

Establish no lower than 2 meters of enclosed facilities that conforms to the specification surrounding the construction; provide special sites for piling up earthwork at the construction site; strengthen management and civilized construction; prevent generation of flying dust by spraying water on the construction sites and roads; restore the vegetation after the completion of temporary land use.

6.10.1.3 Prevention and Control of Noise

Select low noise machinery and equipment; implement strictly the relevant regulations of Emission Standards of Environment Noise for Boundary of Construction Site (GB12523—2011), control the time for operation producing noise contamination and prohibit from construction of high noise equipment at night (between 22:00 and 6:00); avoid construction activities generating
noise at noon (between 12:00 and 14:00) and at night (between 19:00 and 22:00); sensitive points shall be far away from vehicle access points as much as possible and keep low speed and do not honk when drive soil transportation vehicles in and out of the soil solidification sites and other construction sites; arrange the construction machinery and strength in a reasonable manner.

6.10.1.4 Solid wastes

1) During the process of site cleaning or excavating, the following instructions need to be followed to dispose of any solid wastes:

2) For locations that need to remain at status quo and to be confirmed by the Party A, identify the exact position and direction by excavating exploratory holes manually and conduct the excavation construction after clearly making painted marks on the roads where the solid wastes are located. Conduct manually the excavation construction supplemented with a backhoe excavator, where conduct manual excavation and removal around buried things and backhoe excavation at other areas;

3) For relocation that needs to confirmed by the Party A, conduct the excavation by following the same procedures above and determine a migration plan until all the buried things are uncovered;

4) For abandonment or unknown conditions, when the buried things are general solid wastes, as long as they have been abandoned and in no longer use upon further confirmation, and remove them directly for external disposal. In case that the buried things belong to hazardous wastes, declare it to the supervisor and hand it over to the institutions with qualification of disposing hazardous substances and wastes for disposal in the end.

6.10.1.5 Waterproof Measures and Surface Runoff Control

1) As there is contaminated soil in large quantity at the site, prevent it from being washed by rain and conduct effective control to the surface runoff by following the specific ways below:

2) Design the direction and volume of the drainage trenches and water collecting basins in a reasonable way to ensure that the contaminated rain water will not overflow;

3) Cover the surface of the extracting soil immediately on the contaminated soil stored temporarily in the designated area and build drainage trenches and water collecting basins around all stockyards;

4) According to the progress of the excavation of the contaminated soil, build temporary drainage trenches timely to collect the rain into the water collecting basin;

5) All the collected contaminated rain water shall be transferred into the water treatment and drained after up to standards.
6.10.1.6 Secondary Contamination Prevention

1) Must give full consideration on the prevention and control measures of the secondary contamination during the excavation, cleaning, transporting and disposal of the contaminated soil;

2) Attend to spray water at regular time around the excavation sites, on the transport roads and surrounding the vehicle circulation area to prevent from flying dust;

3) Limit strictly the activity range of the excavators and transport vehicles to prevent the contaminated soil from being brought into other areas at the sites or outside.

6.10.2 Measures for Personnel Safety Guard

(1) Strengthen the education to the management and construction personnel;

(2) Workers shall conduct security check to the used machinery and tools, equipment, protecting appliance and working environment before operation;

(3) Personnel operating at the excavating and loading area, must wear work clothes, rubber shoes, gloves, safety caps and respirators;

(4) Operating personnel shall wear protective respirators and take spraying and other measures to reduce the dust concentration when excavating, clearing and transporting dry contaminated soil;

(5) Prohibit irrelevant personnel to enter in the rotating radius area of the excavator during the construction operation of the excavating machinery;

(6) Prohibit irrelevant personnel to enter in the circulation area of transport vehicles;

(7) Staff shall not carry out any violation operation or illegal command;

(8) Construction personnel shall not move around and machinery shall not be driven at random; concentrate the household garbage and construction wastes to collect and dispose and do not scatter them arbitrarily. Provide closed containers in living area for classified storage of the garbage and wastes which shall be disinfected regularly and cleaned and transported without delay.
7 Environmental Specifications for Contractors

A series of guidelines, processes and procedures shall be provided in the Environmental Specifications for Contractors to ensure that the ecological environment shall be not effected by the contractors’ activities during the implementation of the project. Contractors shall follow the guidelines determined in this document. General environmental problems related to the contractors’ activities include:

- Field management
- Storage and treatment of fuels and materials
- Waste gas and noise hazard control
- Sewage management
- Waste management

See the latter chapters for details of the environmental problems related to the specific activities of the project (such as water and soil conservation program, contingency plan, etc.)

7.1 Environmental Protection Plan for Contractors

Contractors shall hold copies of Environmental Management Plan and incorporate it in the bidding documents. Before commence of construction, contractors shall submit an Environmental Management Plan of construction site for their operation to environmental supervision engineers, external environmental management consultants and owners for view. The Environmental Management Plan shall cover mitigation measures for generic environmental impacts (and special mitigation measures for emergency respond for security events), mainly including the following:

- The operation area, fuel storage and supply area, parking lot, equipment maintenance area, material storage area and compound area shall be marked in the overall construction site plan;
- Waste management plan;
- Waste gas control plan;
- Noise control plan;

### 7.2 On-site facilities

Ensure that there is a certain distance interval between the construction compound and the supporting industries. The environmental supervision engineer shall be responsible for the production, examination and approval of the construction activity plan.

#### 7.2.1 Employment of labor

- If appropriate, priority shall be given to the local workers.
- Contractors shall publish the operation location to the villages and towns in the Qingshuitang industrial area.
- Construction personnel and other staff shall have legal employment contract.
- Contractors shall provide education and training on the environmental protection and occupational health and safety to the construction workers.

#### 7.2.2 Requirements of Construction Compounds

- Contractors shall provide suitable and safe residence for the construction workers.
- Independent and perfect bathing facilities (including toilets and bathrooms) shall be equipped respectively for men and women workers at construction compounds. Soap, toilet paper, sufficient water supply, etc. shall be provided in the toilets. All these facilities shall be clean and sanitary for use. Identification of “Men” and “Women” shall be marked outside the toilets.
- Clean water supply and good sanitary conditions shall be provided in the kitchen at the construction compounds.
- Life waste water at the compounds shall not be drained into any waters directly unless it has been undergone the septic tank treatment.
Emergency medical facilities shall be provided at the construction compounds. First-aid equipment under management by special personnel shall be provided at the compounds. First-aid personnel shall receive complete first aid training and acquire corresponding qualifications and are able to transfer the injury or patients timely and properly to the local hospital. All the health facilities above shall be supplemented timely upon use.

7.3 Codes of Conduct

Codes of Conduct shall be set up for construction workers, which shall emphasize appropriate behavior, forbid workers from drug and alcoholic abuse and instruct them to obey the law and regulations in order to reduce influences on society. Each worker shall be ensured to know the propaganda and announcement of the Codes of Conduct, which shall also be notified to the local community nearby. Anyone who fails to obey the Codes of Conduct shall receive disciplinary action. The Codes of Conduct includes but not limiting to the following measures:

- All staff shall abide by the national laws and regulations;
- Forbid hazardous substances and dangerous weapons at construction sites;
- Forbid pornographic materials and gambling activities at construction sites;
- Forbid fighting and brawling;
- Shall not hinder the production and life of the local people in the immediate vicinity;
- Respect the local traditional cultures, customs and activities;
- Smoke at the designated area;
- Appropriate dresses and personal hygiene standards;
- Appropriate accommodation and health conditions;
- Obey the related Codes of Conduct when visiting the vicinity and the local people.

Forbid the following behaviors at the construction sites and surrounding area;

- Harm wild animals and villagers’ livestock in the vicinity region;
- Capture protected animals or pick protected plants;
• Purchase and eat protected animals;
• Affect or destruct objects with historical or architectural values;
• Light fire outdoor;
• Drink during working time;
• Conduct mechanical maintenance (oil and lubricant supplementation) beyond the designated area;
  • Dump garbage beyond the designated area;
  • Drive dangerously on the local roads;
  • Fail to wear safe dresses (such as safety boots and helmets) during construction.
• Affect the people nearby;
• Leak of pollutants, such as fuel leak;
• Incinerate garbage.

In case of violation of the rules above, any contractors, office workers or other staff shall be given disciplinary punishment from oral criticism to termination of labor contract depending on the degree of severity.

### 7.4 Health and Safety

• Contractors shall ensure that the project conforms to all the national and local safety procedures and other measures for damage prevention;
  • Before construction, contractors shall organize safety training of the workers;
  • There shall be sufficient daylight and night lighting;
  • Build enclosing walls surrounding the construction site to prevent from interference and conduct inspection and maintenance on it during construction;
  • Without approval of the management personnel from the contractor, unauthorized persons shall not enter the construction compounds;
  • Fire extinguishers and other fire safety equipment shall be equipped at the construction compounds;
  • Contractors shall provide enough personal safety protection devices (such as goggles, protective gloves, protective masks, dust covers, safety caps, ear protectors,
helmets, etc.) for the construction workers and ensure the devices shall be used at the construction sites.

- The safety procedures, contingency plan and emergency contact information shall be marked clearly on the bulletin board at the construction sites;
- Clearly mark warnings at all possible dangerous places;
- Safety protection distances shall be determined according to the related regulations;
- Contractors shall take all reasonable measures to prevent from risks and ensure to provide fire safety equipment at all construction sites and compounds;
- Any project requiring open fire shall only be conducted by the supervisor under the approval of the environmental supervision engineer. Meanwhile, the corresponding fire safety equipment shall also be arranged in place;
- Contractors shall provide physical examination for construction workers annually.
- Contractors shall also provide the training on basic personal hygiene and epidemic prevention, including respiratory diseases and infectious diseases;
- Contractors shall carry out educational activities on diseases prevention and treatment (especially on the AIDS and STD protection), including propaganda in the form of notice and training at construction sites and in the vicinity areas;
- Contractors shall provide basic first-aid services and emergency measures for construction workers;
- Contractors shall set up necessary warnings and road surface decelerating devices at construction roads (if any) in the local community nearby to ensure traffic safety of the residents nearby.

7.5 Storage of Fuels, Oils and Hazardous and Noxious Substances

- All fuels at construction sites shall be stored in a region with fences; the volume of the storage space shall be 110% that of the fuel storage container. The fuel
storage area shall not be close to any water source (that is far away from the water source within 100 meters);

- Hazardous substances shall be stored in the specially designated storage devices. Temporary storage regulations shall be made for hazardous substances such as fuels, oils and paints.
- Access to the storage area shall be only limit to the concerned parties;
- The storage site shall also be protected from vehicle damage and inspection of leakage, damage and contamination shall be undertaken regularly;
- Machinery and equipment maintenance shall be only limit to the contractor compounds. Operation panel shall be designed (i.e. concrete floor in a regions with fences) properly to ensure that fuels and oils can be concentrated in a proper container. In case of any oil/fuel leak, the contaminated soil to the location shall be transferred with proper license for treatment;
- In order to prevent water and soil contamination or erosion by greases, oils, fuels, solution and chemicals, prevention measures must always be taken;

7.6 Management of solid wastes

- During construction, contractor shall timely transport the site wastes to approved waste disposal devices for cleanup. The stacking-up of construction waste on site shall be minimized as much as possible.
- All the domestic sewage produced on site by the contractor must be put into dustbins (210L steel or plastic bucket) or garbage trolleys. The contractor shall guarantee cleaning-up of such waste containers once a week or when it is necessary.
- All the wastes shall be put into dustbins or trolleys immediately. Littering is not allowed on the working area or the site of the contractor.
- Construction wastes need to be stored on the contractor’s site, and they shall be disposed by contractor. Contaminated construction wastes need to be disposed separately.
- Incineration of garbage is forbidden on construction site.
7.7 Waste-water and storm water management

- Waste at construction site and compound mustn’t directly be discharged into surface water;
- Domestic sewage shouldn’t be discharged until it is properly handled (such as septic tanks).
- Storm water shouldn’t be discharged into the river until it has undergone energy dissipation determination;
- Storm water run-off from the construction site (temporary drainage facilities) should be as evenly distributed as possible; use gabion box, ripple bed and low-lying land to reduce the flow of water.

7.8 Waste gas management

(1) Dusts

①Fencing facilities with height of no less than 2m that conform to requirements should be built surrounding the construction site; Special storage yards should be provided at the construction site for earthwork and the like.

②Strength construction management and advocate civilized construction. Load and unload building materials carefully to avoid making too much noises; the mud attached on the surface of the trucks should be cleaned up as much as possible before leaving the construction site; Trucks transporting remediating soils, lime, sand and rocks, cement, flyash and other materials that may produce dusts should be covered with tarpaulin.

③Water and clean the construction site and construction roads regularly.

Storage yard for excavated soil, lime, yellow sand and the like should not be exposed to the open air if possible; if the storage yard has to be exposed, it should be watered.

④After temporary use of land, the vegetation on the land should be restored to avoid dusts flying in heavy winds.

(2) Waste gas from excavation of organically contaminated soil

Transport vehicles shall be enclosed; foundation pit that has been excavated shall
be covered with film for separation; contaminated soil that produces organic waste gas after excavation can be treated by spraying smell inhibitor and should be put into ton bags uniformly which should be sealed.

(3) Exhaust gas of fuel-consuming machines and construction vehicles

Strengthen management of large construction machines and vehicles. Machines shall be equipped with appropriate smoke and dust elimination devices and shall be checked and maintained regularly.

(4) Stink produced in sediment dredging

Dredge sediment with machines and do not store sediment on site.

Pay attention to the personal protection of the construction workers; provide protection articles to the workers; conduct inspections and be ready for first aid at any time.

Enclosed-tank truck should be used to transport sediment to prevent the sediment from falling on the road; sediment should not be transported via downtown area and crowded residential area.

7.9 Noise control

- Limit the construction time during the daytime;
- Ensure noise-free activities at weekend when the construction is close to local communities;
- Staffs of the construction site, visitors and construction workers must be equipped with appropriate hearing protection measures to avoid hearing damage by noise;
- Environmental supervising engineer must regularly check the site to guarantee its compliance with Occupational Health and Safety.

7.10 Soil-taken management

Some repaired sites of the project need to be backfilled with clean soil. This soil shall be got from the spoil of Tianyuan District, Zhuzhou City. However, implementation of the project will take 6 years and at the present, we are unable to identify the specific location of the clean soil and its source, and are unable to confirm
if we need new a borrow site. For this part of the clean soil, whether it comes from the
spoil area or the newly established soil-taken field, need to meet the domestic laws and
regulations, as well as the legal sampling procedures. And relevant measures shall be
taken for environmental protection and water and soil conservation.

- Use waste soil from other construction projects as much as possible;
- Make construction plan reasonably and reduce disturbance to the surface;
- Conduct heavy metal detection for clean soil transported to Qingshuitang area before backfilling; the heavy metal content of such soil shall be consistent with the risk control range of the area with planned land use;
- Design of drainage in soil borrowing area shall conform to the general requirements of relevant technical specifications on water and soil conservation and eco environment protection; after soil borrowing, the side slopes of the soil borrowing area shall be renovated and drainage system shall be built;
- When transferring soil, the soil shall be covered tightly with tarpaulin; soil-carrying vehicle shall be moderately loaded and must not be overloaded so as to reduce production and falling of dust;
- Special sprinklers shall be equipped to regularly water and wet the construction site and transport roads so as to reduce dust;
- Fences shall be set at the periphery of the soil borrowing area to prevent spreading of dust;
- Soil borrowing shall be conducted layer by layer. The surface soil shall be taken off before excavation and shall be collected and kept properly to be used for backfilling or vegetation restoration; after soil borrowing, renovate the side slopes of the area; in the end, backfill the area with the original surface soil and level the area. After soil borrowing is finished, restore the vegetation in the soil borrowing area to an extent that conforms to the requirement of water and soil conservation so as to reduce water and soil loss.
7.11 Public communication during the construction phase

Public participation and registration of complaints:

- During the construction phrase, the contractor shall maintain open communication with the local government and the community;
  a. Before construction, the contractor shall publish project information to affected parties (for example, local governments, businesses and residents) in form of community meetings;
  b. Each construction site should mark out project information, including but not limited to:
    c. Project overview;
    d. Construction plan;
    e. Main construction activities;
    f. Main environmental problems and mitigation measures;
    g. Project manager, supervising engineer and environmental protection staff's name, telephone numbers and so on;
  - Contractors and the supervising engineer should communicate regularly with key sensitive receivers to minimize its negative impacts;
  - All contractors should provide workers with relevant training on neighboring relationship maintaining, local customs and codes of conduct;
  - Related information about complaints channels shall be published at the entrance to the construction site;
  - The main office of the construction site should prepare registered complaints. All complaints, problems and related issues should be included in the feedback report and be handed to environment supervising engineer and ZREIDC for review;
  - Complaints requiring correction must be communicated to the disputing party to guarantee the satisfaction of the complainant.

7.12 Physical cultural resources

- It aims at providing workers with education on historical relics and training on the discovery and protection of historical relics.
• If any relevant resource is found;
  a The contractor shall immediately halt construction and keep the scene intact;
  b Report to the environment supervising engineer, the proprietor and local cultural
    resource authorities;
  c During the investigation of local authorities, the contractor shall take appropriate
    measures to protect the historical site and implement weather precautions;
    Only after consent of the authorities concerned can contractors resume
    construction.
8 Soil and water conservation scheme

To ensure the smooth implementation of soil and water conservation measures, and the implementation of legal requirements “soil and water conservation facilities of the construction project should be simultaneously designed, constructed and put into use with the main project”, the soil and water conservation project should adopt organizational management and technical measures and be implemented through administrative and legal means.

Safeguard measures of the plan include the setting of appropriate organization, and during the construction of the project, the management should adhere to project legal person system, bidding system and supervision system to ensure source of fund and to strengthen supervision.

After approval of the water conservancy administrative departments, contents and investment of measures of control of the soil and water conservation plan should be included in the main project preliminary design documents, and separately come out as an article. Significant design change should have the approval of the approving authority, and the scrutiny of project preliminary design should have the attendance of water administration departments, so as to smooth the implementation of the soil and water conservation measures in the light of detailed design requirements.

8.1 Construction bidding

The soil and water conservation project implements bidding system, bearer of main project construction and soil and water conservation project must be equipped with technicians familiar with soil and water conservation as well as the technical requirements of soil and water conservation measures; training on soil and water conservation need to be enhanced, soil and water conservation awareness be strengthened, and the work of prevention of soil and water be prioritized. The construction should strictly adhere to the approved scheme of soil and water conservation plan, and strictly implement relevant technical specifications and specifications for soil and water conservation and Technical Specifications for Soil
and Water Conservation in Development Project.

**8.2 Construction supervision of soil and water conservation project**

Supervision of soil and water conservation is an important measure for the implementation of this soil and water conservation scheme. By supervision of soil and water conservation, technical support and protection for effective soil erosion control can be provided to construction undertakers, so as to ensure the achieving of goals of soil and water conservation, and meet the requirements of special acceptance of soil and water conservation. Based on concrete conditions of the project, supervision of soil and water conservation shall be included into supervision of main projects, so as to strengthen the construction management. During the acceptance of soil and water conservation facilities, the main supervision institution should submit supervision documents, including image data, and more which is in relevant with the soil and water conservation project.

**8.3 Monitoring of soil and water conservation**

During the service period of the plan, work for monitoring of soil and water conservation will be strengthened and dynamic change of soil and water erosion and effect of soil and water conservation measures will be monitored during the project construction phase. For places requiring soil and water conservation measure, relevant complementary measures will be implemented. The construction undertaker will entrust a qualified monitoring institution of soil and water conservation to report to the construction undertaker on time on monitoring contents, methods, time interval and monitoring results. The annual monitoring report should be capable of guiding construction of next year. When designing the target year, the monitoring institution should submit monitoring reports for soil and water conservation, report the implementation and effect of soil and water conservation measures, and make analysis of the accomplishments of soil and water conservation goals. Monitoring reports should meet acceptance requirements for soil and water conservation.
8.4 Construction management

Water administration department shall supervise and manage by law the implementation of soil and water conservation scheme. In the course of project implementation, the construction undertaker should strengthen cooperation with the water administrative department, and consciously accept the supervision and management of local water administration department. The construction should record inspection results of water administration department, and settle in time problems found in the supervision. During the construction of the project, the construction quality should be checked in real time, and for a project which does not meet the design requirements or the quality requirements, reconstruction command shall be ordered until the requirement is met. For construction of vegetation measures, attention should be devoted to works which nurture the vegetation measures. Adequate attention should be paid to the nurturing and protection of young wood and weeding, so as to guarantee the survival rate of various plants and bring the soil and water conservation benefits into play.

8.5 Final inspection and acceptance for soil and water conservation

According to the requirements of three-simultaneous rules for soil and water conservation, in the final acceptance of the main project, the acceptance of soil and water conservation facilities should be done simultaneously. The main project can be put into use until the acceptance of soil and water conservation facilities; otherwise, it shall not be put into operation.

During the acceptance process, acceptance report shall be submitted, which evaluates the quantity and quality of soil and water conservation, summarizes evaluation, and summarizes the successful experience and defective portion during the implementation of soil and water conservation. For projects not completed in full or having defects, order of redesign and supplement shall be commanded till the soil and water conservation measures can achieve acceptance indicators in accordance with
A-level Soil and Water Conservation Standards.

- Fund sources and management

According to the principle of “who develops, who protects; who causes soil erosion, who pays” and the provision of Article 32 of the *Law of The People's Republic of China on Water and Soil Conservation*, the construction undertaker which causes water and soil erosion in production and construction project or other activities shall bear responsibility. Water administration departments are responsible for organization and implementation of special soil and water prevention and management. Collection and use of compensation cost for soil and water conservation shall be drafted by the financial sector of the State Council, and competent pricing department of the State Council, in conjunction with the Water Administration Department. The soil and water conservation cost incurred in the construction and production process shall be charged in accordance with the uniform financial and accounting system of the nation.
9 Measures to prevent accidents and environmental emergency safety plan

As a pollution controlling project, the project won’t have harmful impact on environment in case of normal operation, but if the construction is in rainy season, or the leachate of landfill site is in abnormal state (i.e. emergency state), it may have certain impact on the external environment, especially water environment.

9.1 Precautionary measures and countermeasures to leachate of landfill site

(1) Precautionary and emergency measures to dam collapse

The project shall ensure the quality of paving uniformity and the times of rolling compaction of the waste residue in the site; the landfill of the waste residue will adopt the method of zoning landfill, and temporary drainage ditches will be set in the site to drain away the surface runoff created in the closed area or area without landfill, to prevent them from entering the landfill area to add the weight of garbage; improve the construction management level, dispose the landfill in strict accordance with norms.

The environmental evaluation requires to build retaining wall and design the wall type and wall body reasonably, not only pay attention to the reason of wall collapse, but also check and calculate carefully the stability of side slope of the wall, the stability of resistance to sliding of the wall, the stability of the wall base, etc. to ensure the scientific rationality of the design of retaining wall. In operation period of the landfill site, maintain the wall regularly, drain the rain and leachate timely, avoid large amount of rain to lash against the wall, and the accumulation of rain and leachate to steep the wall base, ensuring the stable operation of retaining wall. Once accident of retaining wall collapse occurs, remedial measures should be taken as quickly as possible, to minimum the contamination and loss.

Thus, if the drainage within stack body can be done well, the technological quality of landfill is ensured, and the construction of retaining wall is strengthened, according to introduction of relevant materials and implementing experience of the established projects, the risk of collapse of engineering waste residue stack is low, and the security can be guaranteed to a certain degree.
(2) Precautionary and emergency measures of overflow and leakage accident of leachate collecting system and adjustment pool

In case of rainy season and heavy rains, the amount of leachate will increase dramatically. Without taking any measures, the leachate may drain directly and pollute the surface water. Aiming at this case, the engineering design takes the following measures:

(1) The landfill of garbage adopts the method of zoning landfill and temporary drainage ditch will be set in the site to drain away the surface runoff created in the closed area or area without landfill, to prevent them from entering leachate collecting system, so as to lower the amount of leachate;

(2) Set flood drainage ditch in the periphery of the landfill area, to intercept the stormwater outside of the landfill area;

(3) For the capped landfill area, cover soil and greenling the surface timely, make the surface to form a slope surface of 20%; drain the stormwater outside, avoid the rain from seeping into stack, reduce the output of leachate.

(4) In heavy rains, the operation should be stopped, and waterproof materials should be covered on the exposed working face.

(5) Strict anti-seepage measures should be taken in the landfill site;

(6) In rainstorm season, evaporate the leachate in the adjustment pool completely and clear and maintain flood intercepting trench regularly, to reduce the output of leachate.

To sum up, as long as anti-seepage measures are attached importance to, anti-seepage design and construction are conducted strictly, the operation of landfill is normalized, the output of leachate is reduced effectively, the normal operation of sewage collecting facilities is guaranteed and the flood drainage system is kept clear, while the risk of leachate leakage causing pollution to the surface water nearby is low. Meanwhile, the environment evaluation requires that, the daily management should be strengthened and patrol and maintenance should be conducted regularly.

(3) Precautionary and emergency measures of accident from improper site-bottom anti-seepage measures and anti-seepage layer destroying

Once the anti-seepage layer of waste residue is broken, it’s hard to examine and repair through leaking stoppage and perfusion. The precautionary measures of anti-seepage layer breakage include: strengthen construction quality monitoring in
construction period, choose anti-seepage materials as well as cement and steel bar which meet the requirements of design code, choose construction team with high construction skill, formulate strict anti-seepage layer construction plan, conduct the construction according to design requirements strictly, ensure the quality of anti-seepage layer when it’s paved.

When the anti-seepage layer film is paved, attention should be paid to:

1. The paving of film should be flat without fold.
2. The amount of weld joints should be made as small as possible in lap joint of film;
3. Anti-seepage layer should be paved on slope, and the joint should be from top to bottom. Joint in the horizontal direction is not permitted on the slope, to avoid concentration of stress in the joint.
4. The stability of slope should be calculated when the slope is paved, to prevent the slipping of the film;
5. Weld joint shall not be set in the junction of slope and undersurface, but set cross over the junction.
6. The direction of weld joint of basic film had better be consistent with the flow direction of leachate.
7. The film can’t be paved on general natural ground base, but on level and stable finished layer. That’s to say, under the anti-seepage film, there should be a scientific underlying base, which is generally an artificial anti-seepage layer mainly made of natural anti-seepage material.

Through supervision of the construction of paving anti-seepage layer, improve the paving quality and prevent breakage to occur later.

9.2 Environmental emergency and security plan

The emergency measures of the project are mainly related to personal injury, secondary pollution, and rainfall during construction period.

9.2.1 Personal injury

In the construction site, first-aid case should be equipped based on the principle of simple and practical, ensuring to meet the basic demands of field first aid. It can be added or reduced depending on different cases, and should be examined and
replenished regularly, to ensure the availability at any time.

**1) Treatment of cadmium poisoning:**

For acute poisoning caused by breathing in large amount of smoke of cadmium oxide, the treatment is the same as poisoning of general irritant gas. The key is to prevent pulmonary edema.

People should withdraw from the accident field, keep silent, breathe in oxygen, keep respiratory tract clear. 10% silicone atomizing inhalation can be used to eliminate foam, and adrenocortical hormone should be used as early as possible, which can lower permeability of capillaries. Limit the input of liquid, use antibiotic to prevent secondary infection. In case of acute eating cadmium poisoning, symptomatic treatment can be mainly used, and large amount of fluid infusion and atropine injection can be used to stop vomiting and eliminate stomachache.

In case of chronic cadmium poisoning causing renal damage, the intake of calcium and phosphate should be added in meals, and sufficient zinc and protein should be supplied. CaNa₂EDTA can facilitate elimination of cadmium, but can worsen kidney damage, so it’s not suggested to be used in either acute or chronic cadmium poisoning. It’s reported that, taking NTA orally can facilitate elimination of cadmium (mainly through faeces), so as to lower the accumulation in the body, and reduce damage to renal function.

To prevent cadmium poisoning, the operation site should be equipped with good ventilation device and hermetic device. Eating and smoking shall not be permitted in production site. The highest allowable concentration of cadmium oxide in production site stipulated in China is 0.1mg/m³.

**2) Treatment of As poisoning**

In case of unexpected poisoning through mouth, gastric lavage should be conducted with warm water, normal saline or 1% sodium bicarbonate as early as possible, then give by gavage 30g of activated carbon, 20～40g of magnesium oxide or egg white. Or take newly prepared ferric hydroxide orally, which together with arsenic will form insoluble arsenic acid, then give sodium sulfate for catharsis.

For acute arsenic poisoning, there are antidotes with special effect, for example, sodium dimercaptosulphonate and sodium dimercaptosuccinate both have good effect in facilitating arsenic elimination. Penicillamine also have such effect to a certain degree, which should be used as early as possible (the dose, methods, etc. need to
follow the doctor's advice. Pay attention to preventing and remedying dewatering, shock and electrolyte imbalance. For critical patients, hematodialysis should be conducted as early as possible, which can effectively eliminate the arsenic in blood and prevent acute renal failure.

As for chronic arsenic poisoning, 10% sodium thiosulfate can be used through mainline, to assist renal excretion. Damage of skin or mucous membrane can be treated by externally applying 2.5% dimercapto propanol ointment or dexamethasone ointment. In case of tardive multiple peripheral neuropathy, expectant treatment should be conducted.

To prevent arsenic poisoning, firstly, the rise of dust with arsenide should be controlled. The dust producing device should be hermetic, the dust should be recycled, and ventilation device should be installed, to prevent the gas from effusion. Secondly, personal protection should be strengthened, and anti-poison respirator, protective garment, and work shoes, etc. should be used. It’s prohibited to eat and drink in the working site, and required to wash carefully after work. The waste water or waste gas containing arsenic must be treated before discharge.

For the workers involved in operation of arsenic, periodic physical examination should be conducted. Those who has diseases of respiratory tract, liver and kidney, blood or skin, should be transferred to other posts.

(3) Treatment of Pb poisoning

Skin exposure: take off the polluted clothes, wash with soapy water and flush with flowing water completely.

Eye contact: open the up and down eyelids, flushing with flowing clean water or normal saline. Go to a doctor.

Breathe in: Leave away the field quickly to fresh air. Keep the respiratory tract clear. Conduct oxygen therapy when breathe hard. Conduct artificial respiration immediately when breath stops. Go to a doctor.

Eat in: Give sufficient warm water to drink, promote emesis, go to a doctor.

Prevention measures:

Respiratory protection: the operating workers should wear anti-dust respirator; Eye protection: use safety face shield when necessary. Protective garment: wear work clothes. Mouth and hand protection: wear protective gloves when necessary. Others: it’s prohibited to smoke, eat or drink in working field. Take a shower and
change clothes after work. Physical examination should be conducted before employment and regularly. Maintain a good hygienic habit.

(4) Treatment of aniline poisoning

Skin exposure: take off the polluted clothes, wash with soapy water and flush with flowing water completely. Go to a doctor.

Eye contact: Open the eyelid immediately, and flush with large amount of flowing clean water or normal saline for at least 15 minutes. Go to a doctor.

Breathe in: Leave away the field quickly to fresh air. Keep the respiratory tract clear. Conduct oxygen therapy when breathe hard. Conduct artificial respiration immediately when breath stops. Go to a doctor.

Eat in: drink sufficient warm water, promote emesis. Go to a doctor.

(5) Treatment of benzopyrene poisoning

Protective measures:

Respiratory system protection: generally, special protection is not needed, but in special cases, it's suggested to wear self-contained breathing apparatus.

Eye protection: wear protective safety glasses.

Protective garment: wear protective clothing made of polyethylene film.

Hand protection: wear chemicals-proof gloves when necessary.

Others: Take a shower and change clothes after work. Avoid contact it over and over again for a long time. Be cautious to its carcinogenicity.

Emergency treatment:

Skin exposure: take off the polluted clothes, wash with soapy water and flush with flowing water completely.

Eye contact: Open the up and down eyelids immediately, and flush with flowing clean water for 15 minutes. Go to a doctor.

Breathe in: Leave the environment of pollution, wash the dust in nasopharynx. Go to a doctor.

Eat in: in case of taking it by mistake, gargle fully, drink water, promote emesis. Go to a doctor.

Extinguishing method: with carbon dioxide, dry powder, 1211 fire extinguishing agent, sand and soil. Using water may cause boiling and splashing.

(6) First-aid treatment of trauma

In the implementing process of the project, when trauma occurs, transfer the
injured immediately to leave the dangerous area, wash and bandage the wound. In case of severe wound, use standby emergency facilities to control the state of injury, and go to a doctor immediately.

(7) First-aid treatment of electric shock:
Cut off power immediately. Use dry wood stick, bamboo and other insulating tools to cut off the power wire or power source. Observe the wounded person’s condition. If the heartbeat and breath of the person who get an electric shock is weak, even stopped, the salvager should conduct external chest compression and artificial respiration for him. Don’t stop or give up salvage until doctors come.

(8) First-aid measures of collapse accident:
When collapse occurs in slope of excavation pit, the first thing to do is salvaging wounded person by location. Others should take effective measures to monitor the condition of slope, and clear the materials stocked on the slope, to prevent secondary accident to occur.

(9) Go to a doctor:
After first-aid treatment, the wounded person should be send to hospital for further examination. Special vehicles should be equipped for personal first aid.

### 9.2.2 Secondary pollution

In the process of excavation, clearance and delivery of polluted soil, emphasis should be put on emergency measures of secondary pollution. Clearing and delivering team is the implementing subject in charge of the preparation and execution of the emergency work.

All the staffs in the field of emergency measures must conduct well personal safety protection.

When the polluted soil is delivered out of the construction site, the soil should be sealed to upload, and the transportation staffs should take safety protection measures.

Large amount of leakage in transit must be notified to head of clearing and delivering field to seek for aid, and isolation mark should be set on the road. At the same time, use standby tools as quickly as possible to prevent the diffusion of secondary pollution.

In case of strong wind weather, the constructions that may cause raising dust pollution are prohibited, such as earthworks excavation, backfill, transfer, etc.
9.2.3 Rainfall during construction period

(1) The construction undertaker should conduct all-around environmental supervision in the process of construction; implement the pollution prevention measures raised in environmental evaluation report and construction plan;

(2) Construct by area, equip with caustic soda flakes, sodium sulphide, PAM and other wastewater emergency treatment agent, for emergency use when accident occurs. Arrange people to be on duty for 24 hours during construction period.

(3) Strengthen connection with all construction undertakers of heavy mental treatment project simultaneously, establish linkage mechanism. In case that waste water treatment device of one treatment project loses efficacy, all the project should be stopped, to avoid that the cumulated influence overload.

(4) In rainy season, equip with a vehicular mobile waste water treatment device; once accident occurs, use the vehicular mobile waste water treatment device to draw off waste water and discharge into Xiawangang or Qingshuitang Industrial Waste Water Treatment Plant after treatment.

(6) The water pump and other devices used for intercepting stormwater should be prepared with one backup for one pump, to prevent failure of the devices to cause stormwater to enter pool directly.

(7) Strengthen equipment maintenance, avoid failure.

9.2.4 Emergency contact information

In case of sudden emergence, the contact information of relevant contacts and authorities are listed as following:

<table>
<thead>
<tr>
<th>Unit/staff</th>
<th>Address</th>
<th>Tel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Police</td>
<td>—</td>
<td>110</td>
</tr>
<tr>
<td>Fire</td>
<td>—</td>
<td>119</td>
</tr>
<tr>
<td>Emergency center</td>
<td>—</td>
<td>120</td>
</tr>
<tr>
<td>Power supply bureau</td>
<td>—</td>
<td>95598</td>
</tr>
<tr>
<td>Environmental Protection Department of Hunan Province</td>
<td>No. 118 Section 3 of Wanjiali Middle Road, Changsha City.</td>
<td>12369 (Report and complaint hotline)</td>
</tr>
<tr>
<td>Environmental Protection Bureau of Zhuzhou City</td>
<td>No.137, Lujiang Road, Tianyuan District, Zhuzhou City</td>
<td></td>
</tr>
<tr>
<td>Environmental Protection Bureau of Shifeng District</td>
<td>1st Floor of Building 4, Shanmutang First Road, Zhuzhou City</td>
<td>0731-28682795</td>
</tr>
<tr>
<td>People’s Hospital of Zhuzhou City</td>
<td>No. Te 1, Xinwu Street, Xinhua West Road, Zhuzhou City.</td>
<td>0731-22681058</td>
</tr>
</tbody>
</table>
9.3 Countermeasures and emergency plan of sudden accident

9.3.1 General emergency plan system

(1) Accident rescue commanding and decision-making system: Accident rescue commanding system is the system of conducting accident rescue and handling after emergency accident occurs. The system is necessary for responding quickly after accident occurs, handling the accident timely and making decisive decisions to reduce the loss caused by the accident. The system includes organizational system, communication, personal rescue, etc. Thus, an emergency plan of the system should be made in the implementing process of the project.

   a) Organizational system: establish an emergency rescue headquarter and emergency rescue group, arrange special staff to be in charge of supplying and allocating protective equipment and on-the-spot rescue. All functional departments take charge of chemical poison management and first-aid in the accident with clear division of each.

   b) Communication: The communication information should be ensured to be unblocked. In the emergency plan, all persons in charge and their telephone numbers should be made clear, so are the telephone numbers of external liaison center and each social rescuing organization, such as ambulance station, fire station, etc. Communication determines the ability to respond quickly when accident occurs. Communications should not only keep unblocked and be able to contact quickly at day, but also in deep night and holidays and festivals.

(2) Emergency plan generally includes the following contents:

Project overview; major hazards screening and hazard assessment; emergency rescue commanding organization; emergency rescuing team; emergency rescuing procedure; after-accident site disposal; emergency rescuing equipment and facilities; social rescue; communication network; simulating exercise of emergency plan, etc.

9.3.2 Emergency plan of sudden accident

As the project has a certain environmental risk, and once accident of pollution occurs, the first influence scope is the downstream cities, Changsha and Xiangtan. To
prevent the waste water exceeding standards cause contamination accident in Xiang River, it’s suggested to establish an emergency leading group with Environmental Protection Department of Hunan Province taking the lead, and make clear the emergency scope, principle and procedure, as well as work tasks, disposal method and countermeasures after contamination accident. Before construction, an emergency plan of environmental contamination accident should be compiled and submitted to relevant authorities for approval before execution. In the implementing process, construction undertaker should execute the measures of the construction plan and emergency plan strictly, to ensure the safety of the environment.

According to the results of this environmental risk analysis, referring to sudden accident emergency plan made by Environmental Protection Bureau of Zhuzhou City specially for Qingshuitang Cadmium Pollution Comprehensive Treatment Project, the outline of emergency plan of sudden accident that may cause environmental risk are formulated as following, which is for decision-makers’ reference.

Outline of emergency plan:
I. Organizations
The Environmental Protection Bureau of the city takes the lead to establish environmental contamination accident emergency treatment leading group, to take charge of organizing and commanding the work of environmental contamination accident emergency treatment. Under the leading group, it sets environmental supervision emergency group environmental monitoring emergency group, which are led by Environmental Protection Bureau of Zhuzhou City.

II. Work tasks
(1) Organize and command uniformly the environmental supervision and monitoring of the environmental contamination accident.

(2) Accept and handle report on environmental contamination sudden accident, investigate quickly to get to know the cause of the accident, the nature of contamination source, and the developing process of the accident.

(3) Report timely to government of Zhuzhou City, Environmental Protection Bureau of Changsha City, Environmental Protection Bureau of Xiangtan City and Environmental Protection Department of the province about sudden environmental contamination accident in the project scope.

(4) Participate in relevant rescue work organized by Environmental Protection
Department of the province.

(5) Guide public to conduct prevention and protection, assist relevant departments to take effective measures to eliminate contamination.

(6) Upon approval of superior, take responsibility to publish information about sudden environmental contamination accident in the project scope.

III. Emergency procedure

a. Emergency response

1. Release notification quickly, send out emergency groups.

When receive relevant emergency notification

(1) Emergency leading group will be transferred into emergency headquarters, the group leader become the commander in chief, and the deputy leader of the group become the deputy commander-in-chief.

(2) Start the emergency system, the leading group notify supervision emergency group and monitoring emergency group to rush to the spot.

(3) All emergency staff should rush to emergency disposal location in 20 minutes after receiving emergence notification, and engage in emergency work as quickly as possible.

2. Analyze the situation, define tasks, and establish organizational guarantee

(1) Listen to report and suggestion. The emergency groups should raise emergency recommendations to emergency headquarters actively based on each person’s responsibilities, provide reference to decision making of emergency headquarters.

(2) Define tasks. Emergency leading group should define emergency tasks, emergency general goal, and emergency purpose after comprehensive analysis and judgment based on hearing relevant suggestions.

b. Resolution of emergency

1. In the process of construction, Environmental Monitoring Central Station will conduct tracking monitoring to the water quality of all sections of Xiang River, and notify monitoring results at any time.

2. Emergency leading group and all emergency groups should record the emergency process accurately and timely, to provide basis for summarizing emergency experience and lessons, and modifying and improving emergency plan. Arrange special person to record, and the content that must be recorded includes: 1)
The start, development and end of the accident. 2) Commanding procedure, the scale and nature of arranged forces. 3) Task division and the completion of tasks. 4) Adaptability and the ability to complete tasks of emergency organization, staffs, and equipment and facilities. 5) Major prevention and protection measures taken by public and the effect. 6) The influence of terrain, weather on the accident area and emergency activities.

All announcements, public reports, notifications, orders, notices and important instructions should be collected and classified. The record of all situations must include time, location, execution organizations and the persons in charge. These materials should be submitted to emergency leading group, and be filed by special person after emergency termination.

c. Termination of emergency

1. Conditions of emergency termination

(1) The accident spot has been under control, and the conditions of accident have been eliminated.

(2) The discharge of cadmium in the contamination source has been reduced to lower than limited values;

(3) The damage of accident has been eliminated completely, and is impossible to occur again;

(4) All the professional disposal activities on the accident spot is not necessary to go on.

(5) Necessary prevention and protection measures have been taken to make the potential long-term results of the accident to tend to a level that is reasonable and as low as possible.

2. Steps of emergency termination

Emergency leading group determines the timing of termination based on the situation of treatment on the spot and monitoring results, and releases notification of emergency termination. Then all the staffs on the spot withdraw step by step.

3. Activities after emergency termination

(1) Evaluation on emergency results

Emergency leading group organize to implement the evaluation, and the basic basis of evaluation includes: 1) Record of the emergency process; 2) Final reports of all emergency groups; 3) Other emergency situations the emergency leading group of
the Bureau masters. 4) The actual effect and social influence of the emergency activities. 5) Reflection of public, etc.

The main conclusion includes: 1) Grade of the accident; 2) The completion situation of the general emergency task and local task. 3) Whether or not comply with the general requirements of protecting public and environment; 4) Whether the major prevention and protection measures are proper. 5) Whether the scale of starting off forces, the use of instruments and equipment and the degree and speed to meet the emergency are suitable for the task; 6) Whether the disposal of interest and cost, risk and difficulties are scientific and reasonable; 7) Whether the content of bulletin and public information are authentic, and the timing is proper, what’s the influence of them on public psychology; 8) Typical cases about success and failure; 9) Other necessary conclusion.

(2) Guide relevant departments and accident-affected organization to investigate cause of the accident, prevent similar problems to occur again.

(3) Compile emergency summary report, and submit it for filing in two weeks after emergency termination.

(4) Go on the environmental supervision and monitoring.

(5) Modify emergency plan based on actual experience, and submit it to superior for approval.

(6) Guide emergency groups to maintain instruments and equipment, to keep them in good technological state.

IV. Logistical support

a. Material guarantee

Prepare enough Na2S, sodium hydroxide and other agents, dose in time when accidents occur.

b. Communication guarantee

(1) Communication guarantee when emergency system starts

Use wire communication mainly and combined with wireless communication and network transmission. Release and receive emergency notification through wire communication mainly with office phone; contact outside emergency staffs mainly through wireless communication, ensuring to release the notifications fast.

(2) Communication guarantee when marching

Releasing and receiving emergency orders as well as report and feedback of
emergency information on the spot of accident are mainly achieved through wireless communication.

(3) Communication guarantee in emergency disposal

Take wireless communication as the principal way, and combine with wire communication and moving communication.

c. Traffic guarantee

Emergency leading group organizes to execute the confirmation and allocation of transport capacity. At ordinary times, all the emergency vehicles should ensure to be with oil enough for driving over 100 kilometers.

d. Medical support

In case of personal poisoning and injury, send the wounded person to the nearest hospital to treat and cure, or contact hospitals to organize on-the-spot treatment, or send the wounded person to the hospitals or medical institutions to treat and cure. Transfer the wounded person to another hospital or go on the treatment in the hospital depending on actual situation after emergency termination.

e. Life guarantee

Emergency leading group makes a plan and organizes to implement uniformly. Before activity, all emergency groups should prepare enough food and water for one day, and prepare a certain amount of cashes.

f. Organizational discipline guarantee

Once sudden accident occurs and emergency plan is started, all relevant staffs should obey the uniform commanding. Whether it’s festival and holiday or not, whether take a vacation or not, all staffs should engage in immediately, offenders will be treated strictly.
10 Task outline for mitigations of accumulated environmental impacts

The characteristic of accumulated impact lies in considering the environmental change caused by multiple projects, complex causal relationships, induced impact, interaction process, temporary space covering and other factors. This report analyzes the accumulated impact, through reviewing the construction history of Qingshuitang Industrial Zone and integrating all the impacts of the project and development plan of future.

10.1 Mitigation measures of accumulated environmental impact

10.1.1 Mitigation measures of impact on green land of this area

(1) In construction of the road project, design road greening project, build a linear landscape belt; in construction of factory, take greening project construction as a rigid regulation. They can both make up the loss of amount and area of living beings caused by construction of the industrial zone and beautify the landscape of the city.

(2) In formulation of the plan, green land system plan should be taken into account. Regulatory Detailed Plan of Core Area of Zhuzhou Qingshuitang Ecological Industrial City makes clear that:

Based on the good conditions of mountains around the plan area, green land plan emphasizes connecting with the peripheral Fahua Mountain and Shifeng Park to form the green land system structure of “One belt, two parks, seven corridors, and multiple blocks”.

“One belt” refers to green belt on the bank of Xiang River. On some parcels from bank of Xiang River to Shugang Road and Xiangwan Road, the width of green belt is limited to 10m-120m.

“Two parks” refers to Qingshui Lake Ecological Sport and Leisure Park as well as Xiawan Park.

“Seven corridors” refers to seven galleries in greening space, with the ecological background of Fahua Mountain and Shifeng Park around the plan area, and
combining with the canals, face-shape protection green land and belt-like parks in the area.

“Multiple blocks” refers that the area gathers large area of major green land parks, ecological forest lands and protection green lands.

The construction of green system can also make up the loss of area and amount of vegetation caused by the construction of the development zone to a certain degree. Thus, these measures are very necessary.

(3) Plan to set urban slow-moving green road system, including independent green road and accompanying green road.

Independent green roads are mainly special passageways located in Qingshui Lake Ecological Sport and Leisure Park, Xiawan Park-Xiawan Park, on the two sides of the river and in protection green road, for citizens to walk or ride on a bicycle slowly.

Accompanying green roads are mainly walking passageways of citizens set based on sidewalks on two sides of main road, secondary road and minor roads. Among them, the accompanying green roads on two sides of secondary roads, minor roads and other living roads should put emphasis on user-friendly of the space of street and add seats for rest, street furniture and other facilities. For control of architectural interface, emphasis should be put on the interaction between function of underlying buildings and passengers. As for the accompanying green road on two sides of main road, the layout should lay emphasis on connection with public traffic. Meanwhile, the ground mark should be set on the ground, and the speed of vehicles on minor roads should be limited less than 20km/h.

Slow-moving traffic system is green, environmentally friendly and healthy, which has no contamination to environment, and has the function of physical exercise. Meanwhile, slow-moving traffic system has the implicit concept of fair, harmony, caring for people, and sustainable development. It coordinates with private motorized traffic and public traffic to form the traffic system of the city.

10.1.2 Mitigation measures of impact on the environment of the area

- Mitigation measures of impact on air environment
  
  (1) Conduct rational distribution of projects entering the industrial zone in strict
accordance with the planned leading industries and the layout of industrial land.

(2) Strengthen control of contamination of industrial waste gas from the following 5 aspects: (1) Promote clean production; (2) Optimize the structure of energy use, use natural gas in preference; (3) Ensure all the process waste gases are treated effectively; (4) Improve environmental management and supervision; (5) Improve emergency mechanism of accidental discharge.

(3) Conduct regular monitoring to the enterprises in the development zone that may produce air contamination, to ensure the waste gas treatment measures of the enterprises are in normal operation, and the waste gas are discharged meeting standards.

(4) Strengthen atmospheric environmental management, limit and examine strictly for approval of construction of industrial projects with high energy consumption and high contamination. Bring down continuously the energy consumption of unit output value and the discharge of contamination indexes, encourage to develop and use clean energy.

(5) Ban the small enterprises with air contamination exceeding standard as well as projects which are in the list of out-dated productivity, technology and products. Promote vigorously clean production and ISO14000 environmental management system certification in enterprises, facilitate the resource use to transform from extensive pattern to intensive pattern.

(6) Strengthen management of civilized construction. In the construction of urban buildings, take the measures of commercialization of concrete, as well as dust reduction measures such as operation in enclosed space, cleaning vehicles before driving on road, dust suppression by water spraying, etc. to control the blowing dust in the construction site.

- Mitigation measures of impact on surface water environment
  (1) Divert waste water from clean water and stormwater from sewage.
  (2) Promote clean production technology;
  (3) Promote comprehensively contamination discharge declaration and licensing system;
  (4) The sewage from the enterprises in the area must meet grade-3 standard of Integrated Wastewater Discharge Standard before discharging to sewage treatment plant for treatment, that’s to say, discharge in compliance with the standard;
(5) Strengthen protection of water environment of rivers and channels in the area;

(6) Draft an emergency plan of accidental discharge of sewage treatment plant;

(7) The long-term treatment scale of the sewage treatment plant can be adjusted based on the actual situation of enterprises entering the development zone, to ensure that the sewage treatment plant can receive all the discharge of production waste water and domestic waste water, and avoid contamination to water quality of water body of Xiang River.

(8) Complete the construction of the supporting project of sewage intercepting network of the sewage treatment plant, speed up the construction of sewage treatment and supporting facilities, transform the urban sewage treatment system, implement separating stormwater from sewage, increase the collecting rate of urban sewage; establish sewage treatment plant by area, and establish regional sewage collecting, treatment, and discharge system.

Mitigation measures of impact on environment of underground water.

(1) The enterprises in the development area should take surface seepage control measures depending on related contamination in production. The overall principles are: for the area with serious contamination and higher probability of accidents, the grade of seepage control will be higher, and the surface permeability coefficient will be lower.

(2) The waste water created by all enterprises should be treated firstly through self-built sewage treatment facilities to meet requirements of flowing into sewage treatment plant before flowing into sewage treatment plant, and be treated to meet standards in sewage treatment plant before discharging. Indiscriminate discharge is prohibited. The waste water of accidental discharge and fire-fighting waste water should be discharged into waste water emergency pool before being leaded into self-built sewage treatment facilities of enterprises by for treatment in batches; and after being treated to meet requirements of flowing into sewage treatment plant, they can enter sewage treatment plant for treatment to meet standard and discharge.

(3) Strengthen the management and maintenance of sewage treatment plant, ensure long-term and stable up-to-standard discharge of the centralized-treated waste water, and avoid accidental discharge of waste water to cause serious impact on surface water and underground water;
(4) Control quality strictly during the construction period of the planned area, strengthen anti-seepage treatment of pipes and structures, ensure the construction of project and pipe network is completed according to requirements of design with the required quality and quantity.

- Control measures of noise
  (1) Control measures of industrial noise: arrange reasonably, meet standards at boundary.
  (2) Control measures of construction noise: arrange construction time reasonably.
  (3) Control measures of traffic noise: on two sides of main road in the area, and in 30m from main traffic artery, the buildings that are sensitive to noise are not suitable to be planned, such as residence and schools. Instead, a greenbelt with a width of 20〜50m should be set to reduce the impact of traffic noise through distance attenuation and greening lowering noise.
  (4) Control measures of social life noise.

- Management and disposal measures of solid waste.
  (1) Strengthen management of general industrial solid waste, transform the waste and old materials into resources, expand the comprehensive utilization approach, reinforce management of exchange and disposal of industrial solid waste, establish an information system of output, flow direction, storage, disposal and transaction of industrial solid waste, and encourage waste recycling and reuse among production enterprises in the development zone.
  (2) Implement a system of hazardous waste creation, report and registration and business license system of hazardous waste storage, collection, disposal and utilization facilities. Conduct whole-process management of hazardous waste from the aspects of collection, transportation, storage, utilization, treatment and disposal, etc..
  (3) Establish garbage collection system, garbage storage system, garbage transportation system, garbage treatment system, and achieve harmless treatment of domestic garbage.
10.1.3 Mitigation measures of impact on natural drainage of the area

As the natural soil is transformed into cement pavement, bituminous pavement that is impermeable, the ground hardening reduce the permeability of the natural soil layer, cause obstruction to a certain degree to the rainfall from supplying the underground aquifer. Thus, in the actual process of construction and development, it should be taken fully into account that the connection between infrastructure construction and natural drainage as well as underground water supply.

Thus, in the construction of the development zone, it can be considered to increase the urban natural drainage rate from the aspects of permeable green land, permeable ground, urban drainage ability, etc.

Permeable green land: in the process of urban construction, make the level of green land near factory and road lower than factory and road, which will enable the rainfall runoff on the surrounding hard ground to flow naturally into green land and supply the underground water.

Permeable ground: consider to use permeable bituminous pavement in construction of road, and use color permeable pavement brick on sidewalk. Transform the impermeable pavement in water collecting area, replace the completely hardening pavement (such as the pavement of parking lot, ball park and surrounding area) with porous material, to increase the infiltration capacity of rain water, and supplement the water yield of underground water.

Urban drainage: based on the actual situation of the area, the plan suggests that the rainfall reappearing period is designed as following: general residential area, road, the designed rainfall reappearing period \( P = 2-3 \) years; central area, main road, plaza, the designed rainfall reappearing period \( P = 3-5 \) years; particularly important areas, the designed rainfall reappearing period \( P = 10 \) years. In design of plan, the influence of rainstorm on the city has to be taken fully into account, to ensure the drainage ability of the city.
10.1.4 Mitigation measures of impact on regional ecology of the area

Qingshui Lake Ecological Wetland has established good ecological system, which not only can reduce the contamination in the area, but also has good ecological effect: the construction of Qingshui Lake Ecological Wetland changes the structure of the existing vegetation, enrich the species and quantity of plants, and has positive impact on terrestrial vegetation; most of the birds can find suitable space for living and activity here, other animals will migrate to the wetland to live and multiply; as the wetland is established, some fishes will be introduced, and zooplankter, crustacean, aquatic insect, etc. will gradually live and multiply here. All of these constitute the aquatic ecosystem. The diversity of landscape will increase; the construction of ecological wetland can further improve the quality of water from Qingshuitang area flowing into Xiang River, which will have positive impact on water quality of Xiang River.

Mitigation measures mainly include: maintain the landscape project of the ecological wetland, renovate regularly the greening, ecological island, etc. ensure the landscape project to meet the designed effect.

10.1.5 Mitigation measures of loss of farmland

Provide economic compensation to the occupied houses and farmland. The construction of local enterprises will create employment opportunities; add the income of local workers. Meanwhile, after the transformation of the infrastructure, more enterprises will be attracted to enter the development zone; the development of the enterprises demands to recruit local workers, so large amount of employment opportunities will be created, and the local low-income group, vulnerable group, and women will have employment opportunities. Provide land-expropriated farmers with employment opportunities to increase their income, and improve their living standard.
10.2 Implementation of mitigation measures of accumulated environmental impact

10.2.1 Contamination control of enterprises in production recently

According to “Zhuzhou Environmental Remediation and Protection Development Plan for the Twelfth Five-year”, during the twelfth five-year, the key projects including replacement of sintering-blast furnace lead smelting with Kivcet direct lead smelting for Zhuzhou Smelter Group; remediation of gaseous heavy metal pollution; remediation of heavy metal sedimentation in Qingshuitang, etc. will be implemented, to eliminate gradually the hidden danger of heavy metal contamination and ensure the safety of environment. “Zhuzhou Total Emission Reduction Plan for Main Pollutants for the Twelfth Five-year”

According to “Zhuzhou Total Emission Reduction Plan for Main Pollutants for the Twelfth Five-year”, during the eleventh five-year, some key industrial enterprises of Zhuzhou Municipality had undertaken some notable environmental protection projects, such as Treatment of 1-3 # volatile kiln flue gas sulfur dioxide of Zhuzhou Smelter Group, zero discharge of heavy metal waste water and treatment of heavy metal exhaust gas, waste water treatment and recycled water reuse of Hunan Zhicheng Chemical Industry, treatment of waste water with ferrous ion of Zhuhua Group, treatment of ammonia-nitrogen waste water of Zhicheng Chemical Industry, treatment of total waste water of Haida Chemical Industry. The key sources of contamination had been reduced to acceptable levels, and the total amount of discharge of main contamination had been reduced. During the twelfth five-year, kiln waste gas treatment will be conducted, including that, Zhuzhou Smelter Group will conduct flue gas desulfurization for No.4 and No.5 volatile kiln, which is expected to reduce sulfur dioxide by 4160 tons; Hunan Zhicheng Chemical Industry will conduct unit desulfurization, which is expected to reduce sulfur dioxide by 467 tons.

According to bulletin of Zhuzhou Smelter Group in 2013, it had conducted upgrading and reconstruction to some waster gas facilities, total waste water treatment system, and residue sites in 2013.

In summary, Zhuzhou Municipality has taken measures to strengthen the
contamination discharge control of main polluting enterprises in the area, and reduce the output amount and accumulated amount of contamination in the area.

10.2.2 Long-term relocation measures

According to Regulatory Detailed Plan of Core Area of Zhuzhou Qingshuitang Ecological Industrial City (2012):

For treatment of polluting enterprises in the area, in short term, the planned treatment project can be implemented according to the guideline that, core enterprises conducts industrial transformation, key enterprises conducts relocation and upgrading, and middle and small-sized enterprises will be closed down or moved to other areas.

There is one core enterprise, which is Zhuzhou Smelter Group. It will close the polluting production line, weed out high-contamination and high discharge rough machining smelting production line, to achieve the goal of transformation to meticulous smelting.

There are seven backbone enterprises including Mingzhu Flotation, Zhuzhou Iron and Steel Company, Hunan Haohua Chemical Group, Hunan Haili Chemical, Hunan Zhuzhou Chemical Industry Group, Liuzhou Chemical-National Complete, and Liuzhou Chemical-Zhicheng. Recently, for the backbone enterprises that has important supporting function to the industrial development of the industrial zone, the following measures had been taken: maintain the headquarters of the enterprises, develop the economy and facilitate industrial transformation of headquarter, and relocate the production line of the key enterprises to other places gradually.

As for the medium and small-sized enterprises, based on government leading, social supervision, self-directed development, and policy supporting, etc, conduct closure, merger or transfer to the 175 medium and small-sized enterprises, to reduce the pollution source effectively.

The land after relocation will be replanned after remediation, to resolve the problem of accumulated impact of the regional pollution at the source.

10.2.3 Environmental management measures

Controlling the impact of regional development on environment of the area, is also an important step of control at the source. All the environmental supervision and monitoring measures can hardly be taken without the support of local environmental
protection department, for example, limit and examine strictly for approval of construction of industrial projects with high energy consumption, high contamination, and heavy mental contamination, ban comprehensively small-sized enterprises with air contamination discharge exceeding standards as well as projects which are in the list of out-dated productivity, technology and products; for the enterprises in the development zone, the sewage should be pre-treated to meet standards before discharge, air contamination should meet standard to discharge, and industrial waste should be disposed properly; strengthen civilized construction management, etc.

The staffs in Zhuzhou Environmental Protection Bureau and Environmental Protection Bureau of Shifeng District, Zhuzhou City including Environmental Monitoring Central Station, and Environmental Supervision Group, are amount to over 100. The construction of Environmental Monitoring Central Station meets level-2 standard of standard construction of the nation; and the Environmental Supervision Group meets level-2 standard of standard construction of the nation.

Zhuzhou City is with a vast territory. The personnel construction of Environmental Protection Bureau can meet the demand at present, but, as the development of Zhuzhou City, to adapt to the demand of environmental work in new situation, improve ability of environmental supervision, facilitate the healthy development of environmental work of Zhuzhou City, it’s considered to set environmental monitoring stations in all districts’ environmental protection bureaus in the administrative area.

10.2.4 Implementation of environmental protection measures

In the development process of cities, to control the impact on environment, specific implementation and management of all environmental protection measures is necessary.

(1) The plan department should consider fully the percentage of green land in the whole plan, when conduct plan and adjust plan of the city. When plan the land use, it should be avoided to classify the high yield farmland into the plan scope as far as possible; in the process of construction and development of Zhuzhou City, Housing and Construction Bureau of Zhuzhou City can implement the construction of green land according to the plan of green land by plan department.
(2) Water Supplies Bureau should adjust the treatment scale of the sewage treatment plant timely according to the circumstance of enterprises entering the development zone, to conduct effective collection and treatment of sewage in the development zone;

(3) The Housing and Construction Bureau of Zhuzhou City should pay attention to the construction situation of the pipeline projects of sewage, stormwater, and water supply, to enable the sewage of all areas of Zhuzhou City to be effectively collected to deliver to sewage treatment plant for further treatment; the rainfall reappearing period of Zhuzhou City should be taken into account, to make the stormwater pipe network has sufficient drainage capacity and reduce the impact of rainstorm on the city.

(4) In implementation of road projects by Housing and Construction Bureau of Zhuzhou City, it can be set as regulatory condition of road project construction to use new type materials such as permeable green land, permeable bituminous pavement, color porous pavement, etc., to reduce the impact of ground hardening on natural drainage.

(5) Environmental Sanitation Bureau of Zhuzhou City establishes garbage collection system, storage system, transportation system and treatment system, and pays attention on the capacities of garbage landfill sites, to ensure the harmless disposal of general industrial garbage and domestic garbage. The fund resources are mainly self-raised funds and loan.

10.3 Task outline for detailed accumulated environmental impacts/strategic environmental and social impacts

The evaluation is planned to adopt fast evaluation method. The evaluation of induced and accumulated impact should be combined with other elements of technological assistance projects, especially the compilation of strategic urban plan. The evaluation will be conducted according to the steps as follows:
## Key points in the preparation of the strategic environmental and social impact assessment task outline

The evaluation is planned to adopt fast evaluation method. The evaluation of induced and accumulated impact should be combined with other elements of technological assistance projects, especially the compilation of strategic urban plan. The evaluation will be conducted according to the steps as follows:

1. **Project introduction and background:**

   Introduce the planned projects, their background, and other projects and activities that may have accumulated effect; the consultants will use environmental evaluation reports and others such as Urban Master Plan of Zhuzhou City (Plan of Shifeng District), Master Plan and Regulatory Detailed Plan of Qingshuitang Industrial Area, plan of relevant environmental functional areas, resource utilization, and historic and cultural features and relic protection. The evaluation of induced and accumulated impact (CIA) needs to determine the sequence of construction of planned projects and auxiliary and local infrastructures, and determine the industrial type that may develop and the circumstance of development.

   For identification of potential impact of important environmental factors, consultants should suggest the geographic information of accumulated impact evaluation (including administrative boundary and watershed), and the boundary of space and time of the evaluation.

   The project introduction needs to include the following aspects:

   **(1) Known projects**

   The projects that have been implemented in the World Bank financed evaluation area and other areas. Introduce the scale and overview at the stage as well as time to implement; introduce the projects supported by World Bank funds, and the overview of the area to be constructed during the period; introduce the urban infrastructure related to the project, including the road planned to build, electric transmission line, gas transmission line, etc.; identify the environmental sensitive areas, main stakeholders and impacted residents.

   **(2) Projects of past, now and future**

   After the evaluation scope, and environmental impact has been determined, analyze the projects of past, now and future, and activities in special time and space framework. Other projects and activities should consider the following aspects:

   - Evaluate all the projects to be implemented and planned to be implemented in the evaluation area;
### Key points in the preparation of the strategic environmental and social impact assessment task outline

- Determine the time phasing of projects of past to now, as well as projects to be implemented and planned to be implemented in the future.
- The evaluation content should include all the projects that has been approved, to be approved, planned to be constructed or are designing in the evaluation area of accumulated impact.
- Evaluate the potential industrial development type in the evaluation area of accumulated impact, and the potential pollution load of the industrial type;
- Evaluate the environmental factors of environmental and social accumulated impact that can be reasonably predicted, especially the projects which have direct impact on water resource, land resource, and biological diversity, and make a basic map of projects of past and now ,as well as the future development of the expansion area.

#### (3) Definition of important environmental and social problems

Identify the accumulated impact of the urban expansion on important resource, for example, impact on underground water, biological diversity and on life of local people, which are usually called valuable ecological components (VECs). These items should be determined after consultation with potential impacted group, local authorities, NGO, specialist and scholars. The determined valuable ecological components should be able to measured with relevant indexes. Potential valuable ecological components and indexes can include:

- Destruction of the green belts, green spaces and natural habitats of the city brought by city expansion;
- Impact brought by urban road construction, exhaust emissions of increasing vehicles and noises caused by driving vehicles; Impact on ambient air quality and sound quality brought by plants construction in industrial area;
- The surface of the zone before development and construction is natural soils of strong permeability. However, urban construction hardens surface, which reduces the permeability of natural soil. The permeability of the concrete is poor, which hinders in some degree the direct atmospheric precipitation to underground aquifers;
- Urban expansion results in the loss of land of farmers, which may bring some degree of impact on farmers' income and livelihoods.
- The impact on material culture resources brought by infrastructure construction and urban expansion.

#### (4) Baseline map

Mark the selected valuable ecological factors from the map by using the geographic information system or other tools. Draw up indicators, environmental carrying capacity, urban historical development trend, and urban expansion plan required in the status of each valuable ecological factor within the time frame.

2 Impact assessment

Assessment of induction and cumulative effects. The assessment of induction and cumulative effects adopts a method similar to the environmental assessment. The difference lies in that the assessment of induction and cumulative effects includes not only projects within a specific time and space frame but also other projects and activities.
**Key points in the preparation of the strategic environmental and social impact assessment task outline**

- The assessment includes the impact during the implementation phase and plan and development phase of the project. Assessment of each environmental factor and cumulative effects should consider the typical components in environmental assessment, namely: degree, frequency, duration, magnitude, uncertainties, and possibilities. The assessment method needs qualitative analysis and quantitative data analysis, and the quantitative data can be completed by information-gathering and analogy; in evaluation, the map overlay method can be used for analysis of future industrial development, and additional loads of environmental systems (such as sewage treatment plant.)

3 Determine the degree of influence or scope

Determine the level and scope of the cumulative effect. The impact should be identified according to pre-set value of threshold limit. Legal guidelines or policies, qualitative assessments based on professional judgement and consultation, and the extent or scope of cumulative effects must bear closer analysis.

The assessment consultant is required to define the scope and degree of impact, and put it into the use of the past, present and planned projects. The scope and degree of influence brought by each of the three phases of the project in the past, present and future should be assessed, as well as the cumulative effects of induced development.

4 Mitigation measures

Analysis of reasonable and feasible methods reducing or avoiding significant induction and cumulative effects. Set out a corresponding action plan based on analysis conclusion (including time, institutional responsibilities and budgets), and specify mitigation measures and the mitigation measures incorporated into the environmental management program. For instance, as for urban regional development or development and construction of industrial zone, the mitigation measures for environmental impact include:

- The afforested areas in the construction of plants should be fully taken into account and green belts should be planted around the industrial zone;
- Build waterfront parks along the main watercourses of Zhuzhou city; in designing the urban highway full consideration should be taken into the construction of the green belt and green space in the middle of the street, so as to form green corridors in Zhuzhou city, and bring benefits to the urban ecological environment and landscape;
- In the plan and expansion process of urban development zone and economic development zone, avoid or protect high-yield farmland;
- Staged construction should be considered in building sewage treatment plants, and sewage treatment capacity of wastewater treatment plants should be adjusted according to conditions of the population expansion and enterprise entering of Zhuzhou city, so as to meet the requirements of urban expansion.

- In road construction full account should be taken into the use of new materials (such as permeable asphalt pavement), and in construction of roads and plants full consideration should be taken into infiltrating green space (elevation of green space is lower than that of the surface of plant and road). Use permeable road brick in the sidewalk; utilize porous materials to replace completely hardened surface in water catchment areas. By adopting series of measures mentioned above, impact of atmospheric precipitation for groundwater recharge is reduced.

Local environmental protection department should formulate rules of water pollutants and air emissions which is more complete, standardized and strict for plants and enterprises in the development zone;

Local environmental protection department should strengthen the supervision of water and air emission in enterprises of the development zone and formulate environment monitoring plans for a better grasp and understanding of pollution;

Develop other transport systems, such as setting non-motorized traffic, bicycle lanes and sidewalks;

Recommendations should also include adaptive management for impact, as the high uncertainty of impact or lack of information may result in an incomprehensive assessment.
10.4 Stakeholder dialogue and consultation system

For understanding of the public appeals and suggestion of the environmental protection department during project operation period, a stakeholder dialogue system could be established. The dialogue provides a forum for monitoring and the evaluating of regional development activities, and eco-environmental status and social development in Qingshuitang Ecological Industry New Town Core Area, so to keep all relevant agencies and the public informed about the latest situation of regional development and cumulative environmental and social impacts.

ZREIDC is responsible for organizing stakeholder dialogues on a regular basis; stakeholders invited include Hunan Provincial Environmental Protection Office, Environmental Protection Bureau of Zhuzhou, Environmental Protection Bureau of Shifeng District, Zhuzhou Bureau of Development and Reform, and representatives of major industrial enterprises as well as local villagers in Qingshuitang Ecological Industrial New Town.

During the operational phase of the project, the water environment and ecological monitoring data in Qingshuitang Ecological Industry New Town is open to all stakeholders. The main findings and recommendations of the conference will be officially sent to the related government department for taking necessary follow-up actions to ensure sustainable development and obtain integration and harmony between social economic development and maintenance of ecological function.
11 Information Disclosure and Public Participation

11.1 Public participation

The public has already extensively participated in the preparation of Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP). Therefore, the public concerns have been reflected in EIA/Environmental Management Plan/RAP.

To minimize the impacts of the project, communication with affected population will be throughout the project. The communication provides a bidirectional information channel via which the information about the project progress and implementation of Environmental Management Plan can reach the affected population, and feedback from the affected population can reach the contractor and Zhuzhou Recycling Economy Investment and Development Co., Ltd.

The contractor shall disclose the information about the project itself, main environmental issues and mitigation measures, as well as the responsible contacts at project sites.

A grievance system has been established in the RAP to address the concern of public about land requisition and compensation for livelihood.

11.2 Complaint and grievance system of environmental management plan

Complaint and grievance system is a bidirectional communication between project owner and the public, an important system that reduces the risk and social impacts of the project, and key method for project information disclosure and public participation. The Project Management Office (PMO) establishes a transparent and simple set of procedures for complaint collection and handling, so as to handle the public complaints objectively and efficiently and ensure the smooth going of social management plan.

Main body initiating complaints is the population affected by land requisition and house demolition, as well as other populations including construction workers.
The content of complaint shall be directly or indirectly connected with the project.

Units receiving complaints are diversified, mainly including local grass-root government organization or higher government institutions, PMO, judicial organs, etc.

Complaints can be made in oral or written form. In oral form, complainants shall report their problems or difficulties to PMO, village (community), other governmental authorities or relevant personnel in non-written form. In written form, complainants shall submit a written application to relevant authorities, in which the signature and basic information of complainant, complaint issues, complaint reasons, expected resolution or other recommendations shall be present.

11.2.1 Methods to collect complaints

(1) Reports of community (village) residential committee or community resettlement office, containing public complaints, progress, measure, existing problems, etc.

(2) Daily work logs sent to project owner by construction undertakers, reporting the civilian reaction to the construction works.

(3) Problems regarding land requisition coordination found by project owner during construction site inspection.

(4) Information reported by external monitoring institution.

(5) Letters and visits of affected persons

(6) Report from working station sent out by project owner.

(7) Specific problems found by inspection and auditing departments.

(8) Expenditure of compensation fund of land requisition and demolition collected from schedule of fund appropriation of bank account.

(9) Special investigation of internal monitoring institution.
11.2.2 Grievance procedures

Stage 1: affected persons can make their complaints to the community (village) or Community Office in oral or written form. The community (village) must make proper written records for oral complaints. The Office must provide a definite answer to any complaint within two weeks. If a large problem is involved in the complaint and higher resettlement office shall be asked for instruction, the reply of higher resettlement office to any complaint shall be made within two weeks.

Stage 2: If the answer from Stage 1 fails to satisfy the complainants, they may appeal to the Shifeng Land Requisition Compensation Office within one month after receiving the Stage 1 answer, and the Office shall make decisions to settle the complaint within three weeks.

Stage 3: If the Shifeng District Land Requisition and Compensation Office’s answer still fails to satisfy the complainants, they may submit the case to a civil court within 15 days after receiving the answer.

11.2.3 Principles for complaint handling

Resettlement offices at all levels shall conduct field research on the complaints brought about by the public, solicit public opinions, negotiate with complainants patiently and give an objective and fair answer as per national rules and RAP principles. Complaints out of their capacity shall be reported to higher authorities of land requisition and house demolition. Assistance shall be provided to the investigation of such complaints.

If the relevant organization fails to answer the complaints within required time period, complainants are entitled to appeal.

As women may have special complaints or grievance during resettlement, PMO requires that at least 1 female worker shall be hired in resettlement offices at all levels to receive female complaints. Local government and non-government organizations such as bureau of civil affairs, women's federation will supervise resettlement
activities, in order to protect the rights of affected population, especially, women.

11.2.4 Contents of complaint answer and methods to give answer

1. Contents of answer
   - A brief of complaint
   - Investigation results and facts.
   - Principles and standards specified by national rules and RAP.
   - Answer and concrete basis.
   - Complainants are entitled to appealing to higher resettlement office and civil courts. Expenses of litigation shall be borne by project owner.

2. Methods to give answers
   - For individual complaints, the answer shall be directly delivered to complainants in written form.
   - For complaints brought forward by a large number of people, a community (village) resident assembly shall be held, or documents shall be disseminated to concerned communities.

   Regardless the method, the documents of answers shall be delivered to the resettlement office which administrates the complaint.

11.2.5 Record, trace and feedback of complaints and grievance

During the implementation of RAP, resettlement office shall well record complaints and answers, manage and submit such documents to PMO in written form monthly. PMO will conduct regular inspect on the record of complaints.

In order to keep a complete record of complaints of affected population and answers of relevant authorities, PMO formulates a Complaint & Handling Record Form. See table 10.6-1 for the format of the form.

### Table 10.6-1 Complaint Record Form

<table>
<thead>
<tr>
<th>Recipient institution:</th>
<th>Date:</th>
<th>Place:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of complainant</td>
<td>Complaint</td>
<td>Expected solution</td>
</tr>
</tbody>
</table>
Main contents of complaints will be disclosed to the affected population of the project and delivered to each affected household in the manner of publicity material before implementation of RAP.

### 11.2.6 Contact information of personnel receiving complaints and grievance

PMO will assign persons to receive complaints and grievance of affected population. See table 10.6-2 for the contact information of such persons.

**Table 10.6-2 Information of Organization and Persons Receiving Complaints**

<table>
<thead>
<tr>
<th>Resettlement organization</th>
<th>Contact person</th>
<th>Address</th>
<th>Tel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMO</td>
<td>Long Lianjie</td>
<td>Yulan Villa, Shifeng Park, Shifeng District</td>
<td>0731-22194111</td>
</tr>
<tr>
<td>Land Requisition and Compensation Office in Shifeng District</td>
<td>Zhu Ren</td>
<td></td>
<td>0731-22333973</td>
</tr>
<tr>
<td>Resettlement Office of Tongtangwan Community Office</td>
<td>Luo Xinshan</td>
<td>Tongtangwan Community Office, Shifeng District</td>
<td>0731-28316218</td>
</tr>
</tbody>
</table>
12 Training Plan of Environmental Protection

12.1 Training and inspection

12.1.1 Symposiums & trainings

Project management institution plays a key role in coordinating and instructing the design and implementation of the project. During project implementation, PMO will organize a series of symposiums and Training on project procurement, finance, reimbursement, monitoring and evaluation to improve the capacity of project management personnel according to the management requirement for World Bank financed projects, in order to realize the goals of the project. Symposums and trainings will be carried out in following ways:

(1) Lecture given by external experts: training courses in project management, technology of environmental protection will be provided from time to time during the implementation of the project. External experts who are familiar with project management procedures of World Bank and environmental protection will be hired to provide Training on procurement, financial management, monitoring and environmental protection to project management offices at all levels.

(2) Participation in project management training provided by the World Bank at higher education institutions: PMO shall organize personnel to participate in various project management training classes organized by Tsinghua University, Xi’an Jiaotong University, Shanghai Tongji University, etc. and provide Training on procurement, financial management, and monitoring to project management personnel at all levels from time to time during project period. In this way, the management personnel can have systematic knowledge of the procurement, finance and safeguard policies of the World Bank. Training classes provide a platform for management personnel at all levels to communicate and discuss. These classes focus on how to solve problem, promote the implementation of the project and improve the capacity of project management organizations at all levels.

(3) Organize interim progress presentations and seminars as well as review meetings: interim progress presentations and seminars as well as review meeting will
be held in the two halves of each year during project period, in order to match up the two inspections of the World Bank in each year, promote the smooth going of project and sum up the experience. Experts of the World Bank and project owner will be invited to the meetings to discuss the problems and difficulties in project implementation and operation management and formulate scientific solutions and implementation plan of next year. In the meantime, experience accumulated in project management will be shared at the meetings.

12.1.2 Visits and inspections

Study and inspection tours at home and abroad will be arranged for relevant departments and authorities, aiming at learning advanced project management experience of other countries and regions, widening the horizons of management personnel through field study, so as to provide efficient service and management for the project and increase the overall management level. Visits and inspections are in following three ways:

1) Study tour at abroad: study tour at abroad will be arranged for provincial and municipal project institutions and relevant departments to learn the advanced project management experience of developed countries, research orientation of heavy metal contaminated soil treatment technology and policies on heavy metal contaminated soil treatment, which could facilitate the implementation and management of the project.

2) Visits at home: management personnel will be organized to visit provinces that have successful experience in contaminated soil treatment, such as Jiangsu, Zhejiang. Through objective comparison, the feature of heavy metal pollution treatment in Hunan province as well as the gap with other provinces will be well understood, development experience of developed province be learned. The PMO will proactively explore the effective mode to treat heavy metal pollution in Hunan province and promote such mode to wider range.

12.1.3 Vocational training for laid-off workers, relocated persons and land-expropriated farmers

1) Trainee: trainings will be provided to laid-off workers, relocated persons and land-expropriated farmers who have basic education and working capacity. Trainings will be provided to at least of 50% of abovementioned persons (at least one person
from each household).

(2) Training contents: Training on architecture construction, vehicle driving, workshop workers, flower & tree plantation, efficient plantation of agriculture crops, and cultivation technique will be provided to improve the re-employment skills and agriculture production capacity as well as incomes of laid-off workers and farmers.

(3) Training method: trainings provided to farmers will be carried out in a vivid and easy way with the help of CDs, lectures and video clips. In combination with on-site observation, demonstration, evaluation, experience communication and regular technical instructions, the capacity of participants to digest, understand, introduce and analyze technology will be enhanced.

12.1.4 Training for environmental protection and safeguarding

(1) On-the-job training for environmental management personnel

On-the-job training for environmental management personnel aims to strengthen the environmental management in project construction and operation, in order to ensure the quality of environmental monitoring and effective environmental management, and improve the overall quality of whole project. On-the-job training allows environmental management personnel to identify key environmental problems in construction period and know more about the problems in environmental management. Such problems shall be reported to environmental protection office in a timely manner so that necessary control measures can be taken immediately. During construction, project management institution shall invite experts in environmental protection or environmental management personnel who have similar experience to state possible environmental problems and corresponding solutions on site.

(2) Persons in charge of various construction works and trainings for construction personnel

Prior to commencement, systematic Training for environmental shall be provided to the person who have won the bid for project construction and its construction personnel, so as to avoid damage to environment caused by wrong operation in construction works. Trainings for contractor aim to clarify the responsibility of construction undertaker to protect environment, and that for construction personnel to underline the correct operation method in construction works to minimize the
unnecessary damage on environment. Trainings allow contractor to know its
obligation to protect environment, and possible consequence of environmental
damage. Through trainings, construction personnel can directly know the protection
degree and methods for environmental sensitive targets. Based on the actual situation
of the project, one-week training for construction personnel shall be provided.

(3) Regular environmental knowledge trainings shall be provided to staff by
project management institution during project operation, so that staff can identify
possible environmental problems on their own position and take necessary measures.
Each staff shall be equipped with the concept of environmental protection.

(4) Safeguard training

Labor safety and health shall be paid considerable attention in the cleaning and
transportation on polluted site. Before worker enter construction site, education for
safe construction shall be provided to all working personnel to underline the
particularity of on-site works. Working personnel entering construction site include
site management personnel, workers for cleaning and transport, excavator operators,
transportation drivers, etc. Safety educations and skill trainings shall be provided to
various working personnel.

12.2 Training schedule and implementation plan

Technical assistance and trainings of the project will be carried out with
uniformed plan and hierarchical management. At first, training contents and training
schedule will be formulated according to the overall objective and demand of the
project. In the meantime, the time arrangement of trainings will be given priority in
order to let technical assistances and trainings come into full play in project.
Technical assistances and trainings will be provided in the first two years of project
implementation.

Hierarchical management is adopted for technical assistances and trainings.
Technical resources inside and outside of Hunan province will be coordinated by
project management institution at provincial level. Project owner will provide
assistance in carrying out special study, experience seminar and promotion, and study
tours at other places according to project needs. In addition, PMO will provide
trainings to project management personnel in a uniformed manner, in order to
improve the capacity of project organizations to implement and manage the project.

In order to guarantee the quality of trainings, PMO will be fully responsible for instructing project organizations to carry out training and evaluation. A training result evaluation questionnaire will be prepared to evaluate the results, existing problems and recommendations of trainings, so as to improve training results constantly.
Table 12.2-1 Cost Estimate of Technical Assistances and Trainings (Soft Environmental Construction)

<table>
<thead>
<tr>
<th>No.</th>
<th>Category of cost</th>
<th>Date</th>
<th>Place</th>
<th>Organizer</th>
<th>Objective</th>
<th>Unit</th>
<th>Number</th>
<th>Unit cost (CNY 10,000)</th>
<th>Total cost (CNY 10,000)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inspection tour at abroad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Inspection tour at abroad</td>
<td>2016</td>
<td>U.S.A.</td>
<td>PMO</td>
<td>To learn technology in contaminated soil treatment through inspection tour</td>
<td>Person-time</td>
<td>7</td>
<td>7.00</td>
<td>49.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>1.2</td>
<td>Training at abroad</td>
<td>2017</td>
<td>Europe</td>
<td>PMO</td>
<td>To learn experience in environmental governance through inspection tour</td>
<td>Person-time</td>
<td>7</td>
<td>7.00</td>
<td>49.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>2</td>
<td>Inspection tour at home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Inspection tour at home (I)</td>
<td>2016</td>
<td>Jiangsu, Zhejiang, etc.</td>
<td>PMO</td>
<td>Environmental governance technology</td>
<td>Person-time</td>
<td>8 person ×2 groups = 16 persons</td>
<td>1.50</td>
<td>24.00</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Inspection tour at home (II)</td>
<td>2017</td>
<td>Guangdong, etc.</td>
<td>PMO</td>
<td>Inspection tour and experience exchange on environmental governance</td>
<td>Person-time</td>
<td>8 person ×2 groups = 16 persons</td>
<td>1.50</td>
<td>24.00</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Expert lecture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Person-time</td>
<td>150</td>
<td>1.00</td>
<td>150.00</td>
<td>Including expert cost</td>
</tr>
<tr>
<td>3.1</td>
<td>Lectures on the development of ecological and environmental industry</td>
<td>2016</td>
<td>Domestic</td>
<td>PMO</td>
<td>To improve the capacity of management personnel</td>
<td>Person-time</td>
<td>50</td>
<td>1.00</td>
<td>50.00</td>
<td></td>
</tr>
<tr>
<td>3.2</td>
<td>Lectures on environmental treatment and project operation</td>
<td>2017</td>
<td>Domestic</td>
<td>PMO</td>
<td>To improve the capacity of</td>
<td>Person-time</td>
<td>100</td>
<td>1.00</td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Category of cost</td>
<td>Date</td>
<td>Place</td>
<td>Organizer</td>
<td>Objective</td>
<td>Unit</td>
<td>Number</td>
<td>Unit cost (CNY 10,000)</td>
<td>Total cost (CNY 10,000)</td>
<td>Remarks</td>
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<tr>
<td>-----</td>
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<td>------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>Trainings for personnel of procurement, finance, and management</td>
<td></td>
<td></td>
<td></td>
<td>management personnel of environmental governance and construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Procurement training</td>
<td>2015-2017</td>
<td>Domestic</td>
<td>PMO</td>
<td>To get familiar with the procurement policies of the World Bank (civil works, goods consultation service, etc.)</td>
<td>Person-time</td>
<td>2 persons ×3 groups =6 persons</td>
<td>2.00</td>
<td>12.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>4.2</td>
<td>Financial training</td>
<td>2015-2017</td>
<td>Domestic</td>
<td>PMO</td>
<td>To get familiar with the policies on financial management and reimbursement of the World Bank</td>
<td>Person-time</td>
<td>2 persons ×2 groups =4 persons</td>
<td>2.00</td>
<td>8.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>4.3</td>
<td>Management personnel training</td>
<td>2015-2017</td>
<td>Domestic</td>
<td>PMO</td>
<td>To learn contract management knowledge</td>
<td>Person-time</td>
<td>2 persons ×2 groups =4 persons</td>
<td>2.00</td>
<td>8.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>5</td>
<td>Training for management &amp; publicity of environmental protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Lectures on environmental protection publicity</td>
<td>2017</td>
<td>Domestic</td>
<td>Environmental protection station</td>
<td>To improve the environmental awareness of urban residents</td>
<td>Person-time</td>
<td>100 persons ×2 groups =200</td>
<td>0.1</td>
<td>20.00</td>
<td>Fund of the World Bank</td>
</tr>
</tbody>
</table>

Remarks:
- Person-time:
- Fund of the World Bank
<table>
<thead>
<tr>
<th>No.</th>
<th>Category of cost</th>
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<th>Total cost (CNY 10,000)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2</td>
<td>Public service activity for publicity of environmental protection</td>
<td>2017</td>
<td>Domestic</td>
<td>Environmental protection station</td>
<td>To improve the environmental awareness of urban residents</td>
<td>Person-time</td>
<td>0.1</td>
<td>20.00</td>
<td>20.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>5.3</td>
<td>Training on operation &amp; management of environment protection</td>
<td>2018</td>
<td>Domestic</td>
<td>Environmental protection station</td>
<td>To improve the management level of environmental operation Knowledge of environmental protection, Fully learn the knowledge of environment protection and management, and understand the Environment Impacts Report</td>
<td>Person-time</td>
<td>50</td>
<td>10.00</td>
<td>10.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>6</td>
<td>Training on the capacity of project management personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25.00</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Training on management integrating procurement and finance</td>
<td>2016</td>
<td>Domestic</td>
<td>PMO</td>
<td>To get familiar with the polices on financial management and reimbursement of the World Bank</td>
<td>Person-time</td>
<td>16</td>
<td>8.00</td>
<td>8.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>6.2</td>
<td>Training on management integrating procurement and finance</td>
<td>2017</td>
<td>Domestic</td>
<td>PMO</td>
<td>To get familiar with the polices on financial management and</td>
<td>Person-time</td>
<td>20</td>
<td>10.00</td>
<td>10.00</td>
<td>Fund of the World Bank</td>
</tr>
<tr>
<td>No.</td>
<td>Category of cost</td>
<td>Date</td>
<td>Place</td>
<td>Organizer</td>
<td>Objective</td>
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<td>Total cost (CNY 10,000)</td>
<td>Remarks</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>reimbursement of the World Bank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>Training on MIS operation capacity</td>
<td>2018</td>
<td>Domestic</td>
<td>PMO</td>
<td>To get familiar with the operation of information management system of the project</td>
<td>Person-time</td>
<td>10</td>
<td>0.5</td>
<td>5.00</td>
<td></td>
</tr>
<tr>
<td>6.4</td>
<td>Site director and engineering environmental supervisor by supervision institutions</td>
<td>2015</td>
<td>Domestic</td>
<td>PMO</td>
<td>To learn knowledge of environmental supervision, and understand the Environmental Impact Report and documents of environmental protection design</td>
<td>Person-time</td>
<td>2</td>
<td>0.5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td>Technical director and construction direction of contractor</td>
<td>2015</td>
<td>Domestic</td>
<td>PMO</td>
<td>To learn knowledge of environmental protection and management</td>
<td>Person-time</td>
<td>5</td>
<td>0.2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Practical skill training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>7.1</td>
<td>Laid-off workers and relocated persons</td>
<td>2016, 2017</td>
<td>Domestic</td>
<td>Bureau of Human Resources, Shifeng District</td>
<td>Re-employment training</td>
<td>Person-time</td>
<td>40 persons × 5 groups = 200 persons</td>
<td>0.5</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
## EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)

<table>
<thead>
<tr>
<th>No.</th>
<th>Category of cost</th>
<th>Date</th>
<th>Place</th>
<th>Organizer</th>
<th>Objective</th>
<th>Unit</th>
<th>Number</th>
<th>Unit cost (CNY 10,000)</th>
<th>Total cost (CNY 10,000)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td>Training for land-expropriated farmers</td>
<td>2016, 2017</td>
<td>Domestic</td>
<td>Bureau of Human Resources, Shifeng District</td>
<td>Employment training</td>
<td>Person-time</td>
<td>50 persons ×3 group = 150 persons</td>
<td>0.5</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>7.3</td>
<td>Construction personnel</td>
<td>2015-2022</td>
<td>Domestic</td>
<td>PMO</td>
<td>To learn knowledge of the environmental protection of the project</td>
<td>Person-time</td>
<td>100</td>
<td>0.06</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7.4</td>
<td>Site management personnel Site operation personnel</td>
<td>2015-2022</td>
<td>Domestic</td>
<td>PMO</td>
<td>To get familiar with management systems of safe production and civil production, and emergency management measure</td>
<td>Person-time</td>
<td>20</td>
<td>0.1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>Equipment &amp; machinery operator (including excavator driver, transportation driver)</td>
<td>2015-2022</td>
<td>Domestic</td>
<td>PMO</td>
<td>Only personnel who are trained and get corresponding licenses are allowed to be an excavator or transportation driver</td>
<td>Person-time</td>
<td>20</td>
<td>0.1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>584</td>
<td></td>
</tr>
</tbody>
</table>
13 Environmental and Social Management Framework (ESMF)

13.1 Purpose and Scope of the ESMF

The ESMF is needed due to the following considerations:

- In the 8.48km² project area, there are still industrial facilities in operation. Per domestic regulations, any closure of industrial facilities is subject to site investigation and remediation as necessary;
- There are around 5.75km² land plots in the project area have been considered risk acceptable or risk controllable. Nevertheless, risk assessment is based on planned land use which may change. If, for example, a planned industrial land plot is changed to residential use, its risk to human health may become unacceptable and further remediation effort is needed.
- Other remediation or development activities proposed by the ZREIDC, such as the Qingshui Lake Constructed Wetland.

Since the specific locations of such potential remediation activity is not known during the project preparation, this ESMF will guide the ZREIDC on the environment and social screening and subsequent assessment of sub projects during implementation, including the relevant sub project-specific plans that have to be developed in compliance with the World Bank policies.

Given substantial site investigation has been conducted during the project preparation, a good understanding of the project area is obtained. Potential environmental and social impacts and mitigation measures are known. This ESMF provides a streamlined procedure for the preparation of environmental and social assessment, including the screening, environmental documentation, review, public consultation and information disclosure, etc. A resettlement policy framework for potential remediation activities has been prepared during the project preparation as well.

13.2 Framework Procedures

A. Environment and Social Screening

The PMO/PIU will complete the below screening form to identify key environmental and social issues associated with a proposed remediation activity. The PMO/PIU will send the form to the World Bank and Zhuzhou EPB/Shifeng District EPB and place in the project file.

<table>
<thead>
<tr>
<th>Subproject Name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subproject Location</td>
<td></td>
</tr>
<tr>
<td>Subproject Proponent</td>
<td></td>
</tr>
</tbody>
</table>
### Questions

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answer</th>
<th>If Yes WB Policy triggered</th>
<th>Do req. triggered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are the subproject impacts likely to have significant adverse environmental impacts that are sensitive(^2), diverse or unprecedented? Please provide brief description:</td>
<td></td>
<td><strong>OP 4.01 Environmental Assessment Category A</strong></td>
<td>Env. Sensitive</td>
</tr>
<tr>
<td>Do the impacts affect an area broader than the sites or facilities subject to physical works and are the significant adverse environmental impacts irreversible? Please provide brief description:</td>
<td></td>
<td><strong>OP 4.01 Environmental Assessment Category A</strong></td>
<td></td>
</tr>
<tr>
<td>Is the proposed project likely to have minimal or no adverse environmental impacts? Please provide brief justification:</td>
<td></td>
<td><strong>OP 4.01 Environmental Assessment Category C</strong></td>
<td>No adverse beyond</td>
</tr>
<tr>
<td>Is the project neither a Category A nor Category C as defined above? Please provide brief justification:</td>
<td></td>
<td><strong>OP 4.01 Environmental Assessment Category B</strong></td>
<td>Limit</td>
</tr>
</tbody>
</table>

---

\(^2\) Sensitive (i.e., a potential impact is considered sensitive if it may be irreversible - e.g., lead to loss of a major natural habitat, or raise issues covered by OP 4.04, Natural Habitats; OP 4.36, Forests; OP 4.10, Indigenous Peoples; OP 4.11, Physical Cultural Resources; or OP 4.12, Involuntary Resettlement; or in the case of OP 4.09, when a project includes the manufacture, use, or disposal of environmentally significant quantities of pest control products);

\(^3\) Examples of projects where the impacts are likely to have significant adverse environmental impacts that are sensitive, diverse or unprecedented are large scale infrastructure such as construction of new roads, railways, power plants, major urban development, water treatment, waste water treatment plants and solid waste collection and disposal etc.

\(^4\) Examples of projects likely to have minimal or no adverse environmental impacts are supply of goods and services, technical assistance, simple repair of damaged structures etc.,

\(^5\) Projects that do not fall either within OP 4.01 as a Category A or Category C can be considered as Category B. Examples of category B sub-projects include small scale in-situ reconstruction of infrastructure projects such as road rehabilitation and rural water supply and sanitation, small schools, rural health clinics etc.
### EMP of World Bank-China Proposed Zhuzhou Brownfield Remediation Project (Qingshuitang Area)

<table>
<thead>
<tr>
<th>Question</th>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are the project impacts likely to have significant adverse social impacts that are sensitive, diverse or unprecedented? Please provide brief description:</td>
<td><strong>OP 4.01 Environmental Assessment Category A</strong></td>
<td>ESIA</td>
</tr>
<tr>
<td>Will the project adversely impact physical cultural resources? Please provide brief justification:</td>
<td><strong>OP 4.11 Physical Cultural Resources</strong></td>
<td>Addressed in ESIA (ESIA with PCR Management Plan and/or Chance Find Procedures)</td>
</tr>
<tr>
<td>Will the project involve the conversion or degradation of non-critical natural habitats? Please provide brief justification:</td>
<td><strong>OP 4.04 Natural Habitats</strong></td>
<td>Addressed in EIA</td>
</tr>
<tr>
<td>Will the project involve the significant conversion or degradation of critical natural habitats?</td>
<td><strong>OP 4.04 Natural Habitats</strong></td>
<td>Not eligible</td>
</tr>
<tr>
<td>Does the project procure pesticides (either directly through the project, or indirectly through on-lending, co-financing, or government counterpart funding), or may affect pest management in a way that harm could be done, even though the project is not envisaged to procure pesticides?</td>
<td><strong>OP 4.09 Pest Management</strong></td>
<td>Addressed in EIA (Pest Management Plan)</td>
</tr>
<tr>
<td>Does the sub-project involve involuntary land acquisition, loss of assets or access to assets, or loss of income sources or means of livelihood? Please provide brief justification:</td>
<td><strong>OP 4.12 Involuntary Resettlement</strong></td>
<td>Resettlement Action Plan</td>
</tr>
<tr>
<td>Are there any ethnic minority communities present in the sub project area and are likely to be affected by the proposed sub-project negatively or positively? Please provide brief justification:</td>
<td><strong>OP 4.10 Indigenous People</strong></td>
<td>Ethnic Minority Development Plan/Indigenous Peoples Plan</td>
</tr>
</tbody>
</table>

**6** Generally, sub projects with significant resettlement-related impacts should be categorized as A. Application of judgment is necessary in assessing the potential significance of resettlement-related impacts, which vary in scope and scale from sub project to sub project. Subprojects that would require physical relocation of residents or businesses, as well as sub projects that would cause any individuals to lose more than 10 percent of their productive land area, often are categorized as A. Scale may also be a factor, even when the significance of impacts is relatively minor. Sub projects affecting whole communities or relatively large numbers of persons (for example, more than 1,000 in total) may warrant categorization as A, especially for projects in which implementation capacity is likely to be weak. Sub projects that would require relocation of Indigenous Peoples, that would restrict their access to traditional lands or resources, or that would seek to impose changes to Indigenous Peoples’ traditional institutions, are always likely to be categorized as A.

**7** Examples of physical cultural resources are archaeological or historical sites, including historic urban areas, religious monuments, structures and/or cemeteries particularly sites recognized by the government.

**8** Subprojects that significantly convert or degrade critical natural habitats such as legally protected, officially proposed for protection, identified by authoritative sources for their high conservation value, or recognized as protected by traditional local communities, are ineligible for Bank financing.
Will the project have the potential to have impacts on the health and quality of forests or the rights and welfare of people and their level of dependence upon or interaction with forests; or aims to bring about changes in the management, protection or utilization of natural forests or plantations? Please provide brief justification:

<table>
<thead>
<tr>
<th>Will the project have the potential to have significant impacts or significant conversion or degradation of critical natural forests or other natural habitats?</th>
<th>OP4.36 Forestry</th>
<th>Addressed in EIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>No eligible</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Conclusion and Safeguards Instruments Required:

The sub project is classified as a Category ________ project as per World Bank OP4.01, and the following safeguards instruments will be prepared:

1. ____________________________________________
   |

2. ____________________________________________
   |

3. ____________________________________________
   |

4. ____________________________________________
   |

5. ____________________________________________
   |

### B. Due Diligence

The PMO/PIU will carry out due diligence of the site that is proposed for remediation, including necessary additional monitoring, risk assessment, land ownership, worker settlement (in the case of factory closure), etc. The due diligence report should be included in the project file.

### C. Environmental Documentation

The PMO/PIU is required to prepare Environmental Impact Assessment (EIA) and/or Environmental Management Plan (EMP) to address environmental, social, health and safety issues for site remediation or development activities in the project area.
D. Review and Approval

The EA will need to be reviewed by local environmental protection bureau and the World Bank who will provide comments, recommendations and clearance to the EIA/EMP.

E. Public consultation and information disclosure

During preparation of the environmental documents, public consultation and information disclosure should be carried out following domestic requirements and World Bank policies. The disclosure and consultation should be carried through questionnaire survey, interviews and group meetings. Full draft EA reports should be disclosed. Public opinions and concerns should be incorporated into the technical design and environmental documents where appropriate.
14 Budget for Implementation of Environmental Management Plan

Environmental protection budget has been developed and incorporated in project costs including mitigation measures, monitoring and supervision and management costs. It is worth noting that the project itself is an environmental improvement project, a large portion of environment-related cost is integral part of physical works, and could not specifically separated and shown in this table. The total EMP budget estimate for the project is 74,036,900 RMB, about 4.9% of the total project cost. The detailed EMP budget is shown in 13.1-1.
<table>
<thead>
<tr>
<th>Item</th>
<th>Measures</th>
<th>Budget (RMB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological protection, Erosion control</td>
<td>Bush and grass plantation, drainage facility, site restoration</td>
<td>35,948,600</td>
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<tr>
<td>Acoustic environment</td>
<td>Construction Temporary noise reduction measures</td>
<td>500,000</td>
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<td>Operation Noise reduction measures</td>
<td>100,000</td>
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<tr>
<td>Air</td>
<td>Construction Measures (e.g. water spraying)</td>
<td>500,000</td>
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<tr>
<td></td>
<td>Dust suppressing, sealing packaging and excavation pit cover on organic contamination site</td>
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<tr>
<td></td>
<td>Operation PPE for workers</td>
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<tr>
<td></td>
<td>Water spraying, cover</td>
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<td></td>
<td>Greening at sites</td>
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<tr>
<td>Surface water</td>
<td>Construction Rainwater collection tanks for closed enterprises</td>
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<tr>
<td></td>
<td>Oil separation settling tank</td>
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<td>Mobile wastewater treatment system</td>
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<td>Chlorination treatment tank for quarry pit water</td>
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<td>Operation Sewage treatment system for environmental center</td>
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<td>Leachate treatment system for landfill</td>
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<td>Groundwater</td>
<td>Construction Anti-seepage ground for project facility sites</td>
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<td>Operation Rainwater collection and anti-seepage design</td>
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<td>Anti-seepage measures for dewatering facilities</td>
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<td>Landfill anti-seepage measures</td>
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<td>Closure Leachate monitoring</td>
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<td>Site sealing</td>
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<td>Post remediation Groundwater monitoring</td>
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<tr>
<td>Solid waste</td>
<td>Construction Recycling of construction waste</td>
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<td>Landfill disposal</td>
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<td>Sludge S/S treatment and disposal</td>
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<td>Operation Routine garbage collection and disposal</td>
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<tr>
<td></td>
<td>Total</td>
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