CHINA

HUAINAN MINING AREA REHABILITATION PROJECT

ENVIRONMENTAL and SOCIAL IMPACT ASSESSMENT

EXECUTIVE SUMMARY

Huainan Municipality, Anhui Province

November, 2014

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1.0 INTRODUCTION

This document provides a summary of the environmental impact assessment and social assessment report conducted for the Huainan Mining Area Rehabilitation Project (P133000) ("Project"), highlighting key issues of environmental concerns of the unstable geo-structure within the project area and its respective implications to proposed project intervention, including the closure of the dumpsite and construction of infrastructures. This report provides a summary of alternatives considered, mitigation measures, as well as social assessment issues, public consultation and information disclosure activities carried out. A summary of the Environmental and Social Management Plan (ESMP) is also provided.

Based on the scope and the nature of the project, the project has been designated as a Category A project, consistent with the Bank Safeguard Policy. A full Environmental Impact Assessment Report was prepared by the Anhui Coal Mine Industry Design & Research Institute and a social assessment report was prepared by the Sanxia University. The full EIA report was approved by Anhui Provincial Environmental Protection Bureau.

The Project Development Objective is to support environmental remediation and redevelopment of the JiuDa subsidence area in Huainan city, occupying a total surface area of 9.3 km^2.

2.0PROJECT DESCRIPTION

The City of Huainan is located in the north central part of Anhui Province, China, along the mid-reach of a major watercourse in central China, the Huai River. Huainan has a population of 2.45 million, covering an area of approximately 2,600 km^2. The project activities will take place over an area of some 9.3 km^2 in Datong District of Huainan city.

The City of Huainan has a long history of coal mining dating back more than 100 years. Extensive coal mining activities has caused significant ground subsidence, thereby resulting in serious structural damage to buildings, residential and commercial properties, municipal infrastructures, roadways, water streams, and damages to former farming operations, as well as the collapse of an abandoned dumpsite. Uncontrolled leachate migration from the dumpsite over the years has resulted serious environmental impacts to the local environment with untreated high strength leachate accumulating around the perimeter of the dumpsite, flowing into local water streams and, certainly, impacting on local groundwater aquifers. The proposed Project includes the following components and sub-components:

(a) Environmental remediation, site clean-up and landscape rehabilitation: (i) cleanup of over 20 mining and waste dump sites/piles, soil/vegetation restoration, and reinforcing closed mine shafts; (ii) re-vegetation of 412 hectares; and (iii) a site-wide green path of 13.8 km in length, with basic sanitation service facilities such as public toilets and dust bins.

(b) Water Stream Rehabilitation and storm water drainage system: (i) rehabilitation of drainage channels with a total length of 7.7 km; (ii) constructing connecting surface water streams, storage ponds and crossing structures; and (iii) irrigation facilities for the trees and vegetation.

(c) Datong Dumpsite Closure: (i) reshaping and final capping of the dumpsite containing some 2.8 million m^3 of waste over an area of about 11 ha.; (ii) constructing a boundary dike with vertical barrier wall (extending beyond the dumpsite base into the known clay layer) along the perimeter of dumpsite to contain and minimize leachate migration; (iii) constructing a leachate collection and storage system for transporting leachate for treatment off-site; and (iv) constructing a landfill gas collection and treatment system.

(d) Urban Infrastructure Improvement includes the construction of four roads with a total length of 8.3 km and installation of pipelines for water supply (8.6 km), wastewater collection (5 km) and storm water management (15.3 km).

(e) Site Utilization for Community Development: (i) a tree nursery and associated facilities for maintenance of the environmental remediation areas, and for retail sales (around 54.6 ha); (ii) a flower market and associated facilities (9.8 ha); (iii) a Bonzai garden and associated facilities (7.4 ha); and (iv) two visitor service stations with vehicle and bicycle parking facilities.

As an environmental remediation project, the Project would bring much needed improvements to local environmental conditions, minimize potential threats to public health, as well as spur community development and economic growth.

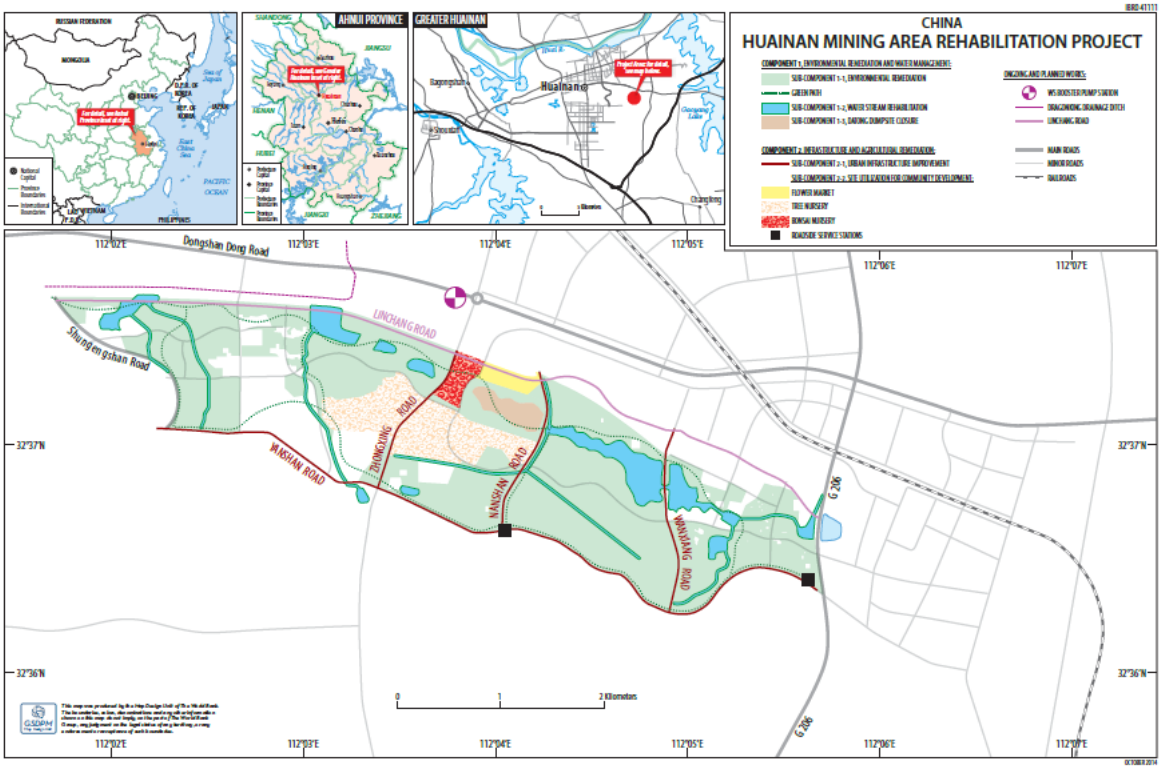


Figure 2.1 Project Location and Layout

3.0ENVIRONMENTAL ASSESSMENT PROCESS & LEGAL FRAMEWORK

A full environmental impact assessment study was conducted in accordance with the Terms of Reference agreed to by the World Bank. Two rounds of extensive public consultations were conducted over the period from May 2013 to June 2014. This includes public meetings/workshops involving residents and stakeholder groups of the local communities, local businesses, village associations and local government agencies. In addition, survey questionnaires were used to gather stakeholder views and concerns. Opinions and concerns received were fully considered and addressed in the EIA documents and incorporated in the project design. The EIA report and the ESMP were disclosed locally on June 11, 2014, through announcements via the local project web site and newspaper, and were re-disclosed on September 5, 2014.

3.1 World Bank Safeguard Policies, Requirements and EHS Guideline

Compliance with World Bank Safeguards Policies

Safeguard Policies	Actions
Environmental Assessment (OP/BP4.01)	• Category A project as the project is likely to cause adverse environmental impacts - A full EA has been conducted and the EIA report and the ESMP have been completed. • The Project area has been extensively damaged by ground subsidence caused by decades of extensive mining activities. The Project investments are expected to greatly improve local environmental conditions, and reduce and minimize threats to public health.
Forests (OP 4.36)	• The 9.3 km^2 Project area contains 137 ha of woodland that are of planted or second-growth trees consisting of common local species. The Project plans to create an additional 374 ha of forest and other vegetation by plantation of trees, bamboos, grass, and shrubs, thereby significantly improving area landscape, reducing soil erosion and stimulating community development. Careful design and implementation is required to minimize the risk of introducing invasive species to the Project area.
Pest Management (OP 4.09)	• The Project will neither finance procurement of pesticides or equipment for pesticides application. The management of planted trees and nursery may increase the use of pesticides.
Physical Cultural Resources (OP/BP 4.11)	• A PCRs survey was conducted as part of the EA study. The EA revealed that a proposed tourist service station is in the vicinity of a church with a separation distance of 51 meters. Consultation has been conducted with the church and relevant stakeholder. As such, the proposed tourist service station will not have material impacts to the church. • Other specific mitigation measures including chance finds procedures have been proposed in the ESMP.
Involuntary Resettlement (OP/BP 4.12)	• Project design has been optimized to minimize the scope of involuntary resettlement, as it cannot be completely avoided.

	• A Resettlement Action Plan has been prepared in both English and Chinese to address the key aspects of the resettlement activities, which include demolition of several building structures, limited amount of land acquisition and some land use on a temporary basis. • Due diligence reviews were conducted for those functionally linked works and findings were reported in the Resettlement Action Plan.
Social Assessment	• A Social Assessment study was conducted, incorporating information gathered through a series of public consultation process, survey questionnaires, interviews, and focus group discussions in 7 communities. Female attendees represented 60% of the participants at group discussions. • Specific discussion sessions were organized with local government agencies and NGOs (e.g. ethnic & religious groups, the Women Federation). • The Project would bring significant positive impacts to the local communities in terms of improved environmental conditions, reduction of potential health threat and increase economic growth and employment opportunities. • Potential negative impacts relating to land acquisition is addressed in the Resettlement Plan, which involves the involuntary resettlement of 39 households. • A number of consultation sessions were held throughout the project preparation stage involving specifically these 39 households to ensure that their concerns are fully addressed.
Consultation	• Two-round public consultation program carried out during project preparation included, local consultation meetings, one-on-one interviews with key stakeholders and completion of a survey questionnaire by participants to ensure concerns, opinions, suggestions were fully documented. • Feedbacks gathered from the community and stakeholder consultation program were fully addressed and incorporated for project design optimization, as well as the EIA, ESMP and ECOP preparation.
EHS	• General EHS Guideline; • Mining Guideline

3.2 Chinese Regulatory Requirements

This project EIA study and report was prepared in accordance with requirements set out in China's Environmental Protection Laws and the National Laws of Environmental Impact Assessment, as well as requirements issued by the State Council relating to environmental protection requirements for engineering projects. Chinese regulatory requirements relating to air emission, water pollution prevention and protection, waste management and soil protection and conservations, pesticide management laws, etc, were fully consulted to ensure compliance in the conduct of this EIA.

Chinese technical standards for air quality, surface and ground water qualities, soil and sediment qualities were also fully described in the EIA study and applied in terms of assessing baseline conditions, as well as setting compliance targets following project intervention.

The Hefei Coal Mine Industry Design and Research Institute was retained to conduct the EIA study on May 1st, 2013. Numerous site investigations were conducted with baseline sampling and testing conducted by Huainan Environmental Monitoring Station.

Compliance with Chinese Regulatory Requirements

Regulatory Requirements	Actions
Environmental Impact Assessment Law	• EIA prepared by a reputable EIA consultant with appropriate accreditation in China and training in Bank EA process. • EIA document reviewed and approved by local Environmental Protection Bureau.
Requirements for the Public Participation in Environmental Impact Assessment	• A series of public consultation events were held during project preparation stage in local communities & villages that may be impacted by the proposed project. • EIA & ESMP documents were released for public information via local government web site & newspaper announcements.
Regulatory Requirement for Environmental Protection, including technical standards, emission and discharge limits and technical design standards & codes for air quality, surface and groundwater qualities, contaminated soil, sediment, landfill site design and remediation standards, leachate control & treatment requirements, as well as Noise Impact Assessment & Ecological Environment, etc.	• Extensive monitoring of baseline environmental conditions (including, existing land uses, soil, surface and groundwater qualities, sediment characteristics, waste piles and dumpsite conditions) were conducted and results were assessed and documented in the EIA report. • EIA and project design parameters used in the Feasibility Study followed all relevant national regulatory requirements. • Project designs will ensure achievement of environmental standards for air and water (both surface and groundwater) qualities, leachate management and waste disposal requirements.

4.0ENVIRONMENTAL & SOCIAL BASELINE

4.1 Environmental Baseline

The proposed Project involves extensive restructuring of the existing landform to improve the landscape of the coal mining subsidence area that have been damaged over many decades of industrial activities. Ground subsidence has caused serious damage to local urban infrastructures such as road and water streams. There is currently no sewage collection system within the Project area. As such, in order to ensure that proposed project investments are appropriate in terms of providing maximum environmental improvements and bringing the most appropriate benefits to the local communities, a comprehensive survey and assessment of environmental baseline conditions within the Project area was conducted, specifically including the following areas.

4.1.1 Geo-Hazard Risk Assessment

The baseline geo-hazard risk assessment of the project area was carried out within the project area with respect to construction of infrastructures and closure of the dumpsite. The Geo-hazard

study was undertaken under close supervision of the Bank Task Team, incorporating international best practices to thoroughly delineate the extent of the risks associated with existing landforms and ground conditions, The geo-hazard study produced a map showing the areas identified with different degrees of geo-hazard/instability (see Annex 1) which provided core requirements and parameters for the project design:

(a) Geo-hazards related to mining shafts - All 34 mine shafts (with 24 within the Project Area) have been closed, backfilled and secured based on Chinese national standards However, detailed analysis indicated that individual risk zones (for ground collapse) still exist, with the diameter of each risk zone extending 35 to 45 meters. As such, no urban infrastructures or public areas shall be established within the risk zones, without additional ground stabilization measures. Alignments for proposed roadways, water and sewer lines were carefully selected to avoid potential risk areas for further subsidence. Figure 2.1 shows map of the project area, including specific locations of proposed urban infrastructures. Huainan Municipality has developed a city master plan, making the project area as a green space. No urban infrastructure shall be established within the risk zones. The master plan will be enforced by the Huainan Municipality. The land use plan will be used as the basis for detailed designs of various components of the proposed urban infrastructure. Furthermore, 3 mine shafts in close proximity of the dumpsite are to be reinforced to avoid the risk of further ground subsidence that may negatively affect the integrity of closed dumpsite.

Abandoned Mine Shaft

(b) Geo-hazards related to Karst phenomena - Risk from karst formation has been exacerbated by coal mining activities & years of water pumping. Dumpsite closure footprint is to be adjusted to avoid and provide a safe distance from karst areas.

(c) Ground subsidence monitoring system - A new ground subsidence monitoring system was initiated at the Bank Task Team recommendation. Monitoring results have confirmed that ground subsidence has essentially been stabilized.

4.1.2 Surface Water Quality

(a) A comprehensive surface water quality monitoring program was initiated covering 28 monitoring points, strategically identified to represent existing surface water features. In most cases, 3 monitoring points (upstream, mid-stream and downstream of surface water bodies were sampled. Results from initial round of sampling indicated that some water samples, in the vicinity of the dumpsite, have exceeded regulatory standards, mostly likely resulting from leachate plume migration from dumpsite; and

(b) As there would be significant alterations made to landforms and existing surface water bodies by project investments, a number of surface water sampling locations would be selected as "permanent" sampling locations, as these sampling locations would still exist after project implementation. These sampling locations would be used to monitoring expected improvements to surface water qualities as a result of the proposed Project.

4.1.3 Groundwater Quality

(a) A groundwater monitoring program was instituted during project preparation to assess existing baseline conditions of ground water quality and flow in the vicinity of the project area. Ten groundwater monitoring wells were installed with 2 wells up-gradient of the groundwater flow at the dumpsite, one at each side of the dumpsite, and 6 wells downstream of the dumpsite. Several rounds of monthly samples were obtained and analyzed for a number of regulated pollutants. The results have shown that the groundwater quality in the area failed to meet the required Class III of Groundwater Quality Standards (established for drinking water supply sources) for a number of parameters, including total Caliform, Sulfate, TDS, total hardness, Hg and Ni,(see Annex 2). Six rounds of monthly groundwater samples were taken during project preparation. However, no clear trend lines can be established due to relatively wide fluctuations of several regulated pollutants. Analysis of sampling results indicated that concentrations of NH3-N, COD and Nitrate are generally declining, while sulfate levels increased.

(b) Five of the ten existing groundwater monitoring wells were selected and would be maintained as "permanent" groundwater monitoring wells to monitor and assess expected changes (likely improvements) to ground water qualities over time after project implementation. The EIA report specified the requirements of these five monitoring wells (one up-gradient, one at each side, and two downstream of the dumpsite) in accordance with natioal regulatory requirements in China.

4.1.4 Soil Quality

Assessment of soil quality within the project area was considered of having particular importance in two aspects - one in terms of identifying any particular areas that may have excessive level of contamination and, therefore, are not suitable for the planned land uses, such as nurseries, service stations or flower markets; secondly, it is critically important to identify "hot spots" with excessive level of hazardous wastes. If identified, excavation and removal of "hot spots" are necessary in order to remove sources of contamination and avoid further groundwater contamination and potential threat to public health and safety.

(a) As part of the EIA baseline assessment, soil samples from the Project area were taken based on a systematic grid approach to thoroughly delineate soil characteristics within the Project area.

(b) Seventy three (73) composite soil samples were taken based on a 500-meter grid. An additional four samples were taken outside the Project area at distances of approximately 20 to 30 meters from the Project boundary. These samples were intended to serve as indicators for comparative assessment during the sampling protocol. Furthermore, additional soil samples were taken in close proximity of the 35 waste piles identified

within the Project area. This 35 soil samples were taken for specific purpose to identify potential contamination of soil that may result from existing waste piles on site.

(c) As such, a total of 103 soil samples were taken within the Project area. In addition, all soil samples were composite samples, with each composite sample derived from two grab samples taken at depths of 2 cm and 20 cm below surface grade.

(d) This comprehensive soil sampling program produced conclusive results indicating that soil qualities within the Project area meet the Class II of the Ambient Soil Quality Standards (the Class II standard is established for agriculture and farming applications. The specific data of the soil quality tested are given in Annex 3.

Comparison of the Chinese Standard with those in the developed countries were conducted, and the result of comparison indicates that heavy metals limits in Chinese standard for Class II are equivalent to SSLs (Soil Screening Levels) in the Netherlands and the USA, except Cd (Chromium), where the Chinese standard is lower than that in USA and Dutch standards. The As (Arsenic) limit of the Chinese standard is lower than that of the Netherlands but higher than that in the USA. The Ambient Soil Quality Standard (GB 15618-1995) and its comparison with the international standards are given in Annex 4.

Typical Waste Piles within Project Area

4.1.5 Waste Piles

Site inspection during project preparation revealed that industrial waste materials have been disposed of within the Project area over the years, many from unknown or unidentifiable sources. As such, a thorough site inspection was conducted to identify and mark existing waste piles within the Project area. The intent of this site inspection was to identify and document all waste piles within the Project area. The quantity and quality of these waste piles must be established prior to determining appropriate methods for handling these existing waste piles.

(a) Site survey documented 35 such waste piles within the Project area. All waste piles were identified with GPS identifiers.

(b) Representative composite samples from the 35 waste piles were obtained by taking several grab samples at various points of the waste piles, depending upon the size of the waste piles and physical nature of the waste material.

(c) The samples were tested in accordance with international best practices by utilizing the TCLP (Toxicity Characteristic Leaching Procedure) method. Laboratory results indicate that all 35 waste piles do not contain hazardous waste according to Ambient Soil Quality Standard of China (GB15618-1995), including heavy metals and mercury.

(d) Further assessment of the waste materials were suggested to identify if any of the materials may be re-used during project implementation as backfill or construction materials with the remaining materials to be incorporated into the dumpsite during site remediation and closure, as the dumpsite would require significant amount of material for proper contouring and grading.

4.1.6 Sediment Quality

It is expected that during project implementation, a total of 7,680 m3 of sediment would be excavated to provide proper drainage and stream rehabilitation. Hence, the treatment and disposal of excess sediment material need to be determined.

(a) Two rounds of sediment sampling were conducted during project preparation.

(b) Test results for the sediments samples indicate that the quality of the sediments meet the Class II of the National Ambient Soil Quality Standard intended for farming and agricultural applications. Under this project, excavated sediments will be used as backfill material for low-lying areas/ponds for surface vegetation. For such applications, sediment qualities would only be required to meet Class III standard, which is less stringent than the class II standard. Details of the sediment quality are given in Annex 5

(c) It is estimated that the total volume of sediment to be excavated would be fully utilized for backfill purpose within the project area. In addition, backfill areas are all very close to the sediment dredging areas, so as to minimize the transport distance.

4.2 Socioeconomic Baseline

The primary objectives of the Project are to improve environmental and ecological conditions of the coal mining subsidence area, and to spur sustainable community development and employment opportunities for local residents. As such, the Project would bring many environmental, social and economic benefits to local communities. However, a number of local residents and businesses would be directly or indirectly affected. As such, a detailed social assessment study was conducted to identify specific social issues and their respective mitigation measures.

1. Land ownership structure within the Project area of 9.3 km^2 - approximately 25% of the land is collectively owned land, while the remaining 75% of the land is state-owned.
2. Socio-economic situation of population and households living within the Project area and immediately adjacent to the Project area were documented. At the present time, there is a total of 1,928 residents in the project area who rely on deep groundwater wells as their source of water supply. Those residents who only have access to shallow wells would have to transport water supply from other areas, as the shallow wells have been heavily polluted.
3. Information on the businesses that are still operating within the Project area and the total number of workers employed by these operating businesses were documented. The record shows that there were 33 industries, of which, 28 have been closed up in recent years. There are only 5 industries involved in the manufacturing of construction materials that are still in operation.
4. Services entities, such as schools or hospitals that are still operating within the Project area and in the adjacent communities were fully documented, including the number of people they employ and number of people they serve, e.g. number of students attending these schools and the average number of patients they care.

5.0 ANALYSIS OF ALTERNATIVES

5.1 Dumpsite Remediation and Closure

It is well recognized by the pollution source investigation program that the former dumpsite is probably the most significant pollution source within the Project area. Ground subsidence has caused the collapse of the former waste dump, further exacerbating the environmental hazards caused by on-going leachate migration into water streams and groundwater aquifers.

Four alternative approaches to dumpsite remediation were assessed:

1. Leave dumpsite as it - business as usual without proper closure.

   This approach was considered not viable, as it would not address the most significant pollution source in the project area, and defeats the primary purpose of this Project.

2. Excavate and relocate waste from the dumpsite to the City's sanitary landfill and/or waste-to-energy facility for disposal.

   This approach would eliminate the dumpsite from the project area. But, at the same time, this option would require the excavation and trucking of the entire amount of waste (close to one million metric tons) currently at the dumpsite to either the sanitary landfill or the City's waste-to-energy (WTE) facility for incineration. As the waste material is saturated with water, trucking of such waste material would cause significant environmental impacts to local residents and communities along the transport routes. Furthermore, it is highly questionable if the WTE facility would be able to handle highly organic waste with extremely high water content. If the sanitary landfill is used for waste disposal, it would greatly occupy a significant portion of the overall design capacity of the sanitary landfill. Furthermore, this option would require high operating costs for trucking and incineration and/or landfilling cost.

3. Dumpsite mining to recover recyclable materials with residual disposal at sanitary landfill and/or waste-to-energy facility.

   While this approach has been practiced successfully in some cases in other countries, this option is mostly suitable where the intention is to "create" additional waste disposal capacity at former landfills, and where it is expected that the waste material in the landfill contains a high fraction of recyclable material, as mostly in developed countries. However, this option is not designed for landfill or dumpsite remediation. Extremely stringent operational practices for worker health and safety as well as for adjacent communities would also be essential in ensuring that landfill mining activities would not cause threat to public health and safety, as explosion is a real concern if landfill mining activities encounter methane pockets in the waste deposit area. Furthermore, unit cost would also be extremely high.

4. In-situ closure and remediation of dumpsite.

   This option perhaps represents the most common approach employed for remediation and closure of former dumpsites or substandard landfills in China and, indeed, around the world. Stringent measures and conservative engineering design parameters, including: the construction of impermeable boundary wall anchored into the deep clay layer to contain and minimize potential leachate plume migration; dumpsite capping and surface grading

to minimize infiltration of rainfall; landfill gas extraction wells to reduce emissions of methane and other potentially toxic air pollutants. Modeling results show that the leachate migration can be effectively curbed, reducing the pollution load into the environment by 99%. Furthermore, measures were taken to fully integrate the dumpsite setting (after closure) into the area landscape by proper site re-configuration with sufficient buffer zone, installation of final cap, side slope contour and grading, all with native vegetation.

This analysis of alternatives for dumpsite closure was conducted with full considerations from environmental, social, financial and operational perspectives. The result conclusively demonstrated that the preferred option is to conduct dumpsite remediation and closure in-situ (option 4, above), which represents the least-cost option, best adaptation to local conditions, and compliance with the environmental requirements and project objectives.

Dumpsite remediation and closure will incorporate all international best practices for similar site remediation projects. Mitigation measures will be extensively employed to reduce and eliminate potential negative impacts that may result from this approach. Remedial measures include reducing and minimizing potential air emission with a landfill gas collection and flaring system; vertical barrier wall around the dumpsite perimeter to contain and prevent leachate migration; site re-configuration and surface capping to reduce leachate generation, soil erosion; diversion of water streams from dumpsite footprint, and; site grading to reduce surface water infiltration.

5.2 Leachate Treatment

Leachate management is perhaps the most important aspect of proper landfill management and is also usually the highest cost item of landfill operation. As such, proper analysis of the leachate treatment options and technologies are essential in terms of environmental protection and operational efficiency. Three alternatives were assessed in this project, which include:

1. Leachate Recirculation

   Leachate recirculation involves the construction of a leachate collection and equalization pond at the site, along with a pumping system to deliver the collected leachate for discharging into the waste deposit area. This approach has usually the lowest cost and is widely practiced at operating landfills in many countries. Aside from having low operating cost, the injection of leachate back into the waste deposit area has the benefit of accelerating the decomposition and stabilization of the waste, thereby shortening the contaminating life of the dumpsite. However, this approach is deemed to be not suitable for open dumpsites without baseliner and leachate collection systems, as leachate recirculation may increase contaminant migration to groundwater aquifers. Furthermore, leachate storage pond would need to be sized with sufficient capacity to accommodate 20 or 30-year storm events. Leachate recirculation would also preclude the use of installing the final cap with a layer of synthetic liner. As such, a clay liner would be used instead. The continued operation of the leachate recirculation system would also be incompatible with the project objective of ecological rehabilitation for the project area.

2. On-site Leachate Treatment and Discharge.

   This option would require the construction of a leachate treatment plant at the dumpsite. The system would require essential treatment facilities, including MBR reactor with 2 stage RO system. This system would require high capital investment and O & M costs.

Furthermore, there is also a need for disposing concentrates produced by the RO system, and additional land space for treatment facilities, which may also be incompatible with the overall landscape of the Project area after project implementation.

3. Off-site Treatment and Disposal.

   This option involves the least amount of capital and O & M costs as well as land spaces for leachate storage and trucking. The opportunity exists for this project to truck leachate (estimated at 5 m^3 per day) to the leachate treatment plant of the sanitary landfill located approximately 6.5 km away, as the existing plant has adequate excess treatment capacity in the foreseeable future. As the amount of leachate decreases and the leachate quality improves, the contract cost for leachate treatment may be further reduced. The option does not require the construction of a dedicated leachate treatment facility. As such, it is most compatible with the project site landscape after project implementation.

5.3 Alternatives for Landscape & Urban Infrastructures

Alternatives for other project components were also thoroughly assessed and selected options were incorporated into the project design. These includes water stream rehabilitation, landscape slope stabilization, road and water supply and wastewater pipeline alignments, selection of tree species and other ground cover vegetation. For example, the materials from excavation, de-silting as well as from construction waste piles have been considered for reuse in road construction and Datong Dump closure, where appropriate.

5.4 Comparison of With and Without Project Scenarios

The scenarios of "With" and "Without" Project have been considered. The positive environmental, social and economic impacts that would result from the Project are obvious in terms of improving environmental conditions within the project area and local communities, as well as promoting economic growth. Thus the Project is proposed.

6.0 IMPACT ASSESSMENT & MITIGATION MEASURES

The nature of this proposed Project is site remediation and rehabilitation of ecological features and urban infrastructure within the Project area. The implementation of this Project would minimize environmental degradation resulting from extensive coal mining activities. As such, the proposed Project would bring significant positive improvements to the local natural environment and communities. Negative environmental impacts are related to certain limited aspects of social and economic conditions or are temporary and/or transitional in nature during project implementation.

During project preparation, mitigation measures for specific aspects of the project design were thoroughly assessed in order to identify optimal approaches to minimizing environmental and social impacts.

6.1 Dumpsite Remediation & Closure

6.1.1 Site Configuration and Grading

A detailed site survey was conducted to gather accurate site information regarding physical topography of the dumpsite conditions, heights and depths of waste deposit areas, waste quantities and density, and current surface drainage conditions of the dumpsite. In addition, the survey covers the assessment of surface and groundwater conditions in the close vicinity of the dumpsite.

Several alternative approaches to dumpsite closure were considered in order to: a) minimize potential leachate migration to surface water streams; b) achieve optimal side slope gradient to reduce potential soil erosion and leachate breakouts; c) minimize construction activities during implementation; d) facilitate on-going site operation and monitoring, etc.

The selected option calls for consolidating the dumpsite into one contiguous waste deposit area, instead of the existing two separate waste heaps, and re-divert a key drainage stream, which currently divides the dumpsite into two parcels away from the dumpsite area. This design approach would greatly reduce the scope of construction activities, including the length of perimeter dike, leachate collection network, and vertical barrier walls, etc.

The consolidation of the total waste deposit area will allow a more effective grading plan for dumpsite side slopes to prevent soil erosion and reduce potential leachate breakouts.

6.1.2 Design of Dumpsite Final Cap

The design of the dumpsite final cap is to be strictly in compliance with national standards in China while incorporating international best practices to minimize storm water infiltration, thereby reducing the quantity of leachate generation from the dumpsite. The construction of the final cap will include a layer of impermeable synthetic liner, a landfill gas collection layer and a layer of soil sufficient for sustaining surface vegetation.

In addition, although the geo-hazard survey report shows that further ground substance is likely to be minimal, a conservative design approach has been adopted to avoid potential faults along the south side of the dumpsite with an adequate separation distance for safety.

6.1.3 Leachate Collection and Management

While mitigation measures are being incorporated into the design of dumpsite remediation and closure to minimize leachate generation, a leachate collection and management plan was developed to effective collect and manage the remaining leachate that will be generated from the dumpsite. Specifically, leachate mitigation and collection measures include the following:

1. A perimeter concrete dike around the footprint of the waste deposit area, which will be integrated with a continuous vertical barrier wall, extending to and anchored 3 m into the bottom clay layer with a permeability of 10^{-6} cm/s. This vertical barrier wall is proposed as a measure to prevent lateral migration of leachate plume;
2. A leachate collection pipe network around the base of the dike to extract leachate from the landfill;

3. Additional leachate extraction wells strategically located within the dumpsite to remove leachate mounts that may accumulate at the base of the waste deposit area;
4. A leachate collection and storage pond with floating cover;
5. Three leachate treatment options were considered including, option (a) on-site treatment, option (b) piping to municipal wastewater treatment plant and, option (c) trucking by tankers to leachate treatment plant located at the City's sanitary landfill. The selected option (c) is to transport leachate by tankers to the existing leachate treatment plant of the sanitary landfill located at only 6.5 km from the Project area, as this facility has excess capacity and can readily accept additional leachate quantity that is expected to be generated from the dumpsite. A Due Diligence review of the leachate treatment facility including landfill performance was conducted, which concluded that environmental performance of the landfill is in compliance with the relevant standards and the excess capacity can readily accommodate the leachate from this project.
6. The quantity of leachate that is to be collected and requires treatment is estimated to be 23.34 m^3/d. According to China technical specifications for landfill design, the properties of the leachate after dumpsite closure is expected to have the following characteristics - pH 6-9, COD 5,000 mg/l, BOD_5 2,000 mg/l, NH_3-N 3,000 mg/l and SS 1,000 mg/l.
7. The migration of leachate into the environment will be greatly contained after the completion of the closure works, with an expected 99% reduction in pollution loading. A model was prepared to simulate migration of leachate plume in case of failure of the vertical barrier wall. Modeling results indicate that at least 50% of the leachate volume would still be contained within the dumpsite. Leachate plume migration (represented by nitrogen in the form of ammonia) over a 20-year horizon can be shown as in Figure 6-1.

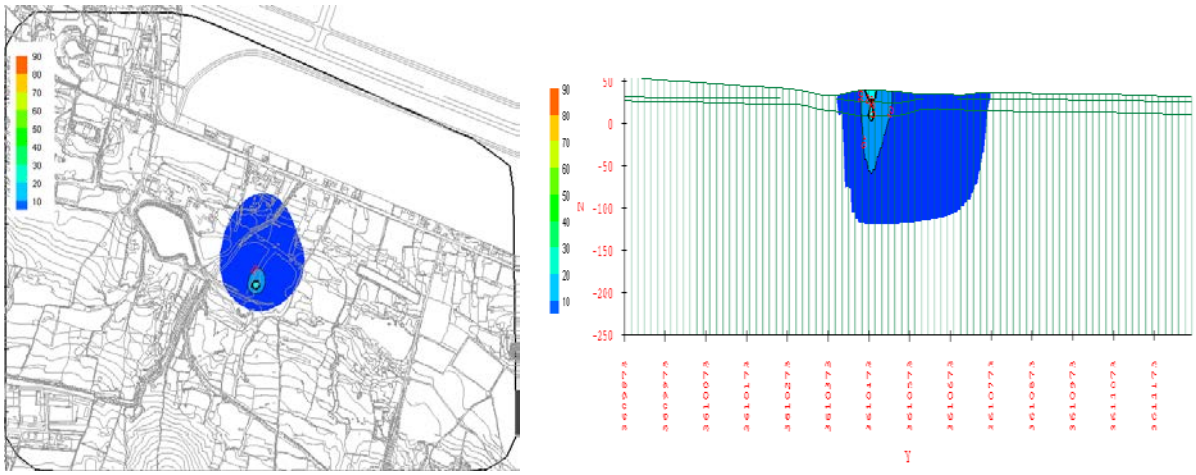


Figure 6-1 Diffusion of NH3-N in Groundwater in 20-year horizon

6.1.4 Landfill Gas Control and Treatment

An active landfill gas extraction and treatment system will be installed for the dumpsite with a net work of vertical gas collection wells distributed over the entire dumpsite surface, along with a central landfill gas flare unit. This approach will reduce odor and improve area air quality, as collected landfill gas and other pollutants will be destroyed by the gas flare system.

6.2 Existing Waste Piles

All 35 waste piles within the Project area have been sampled and tested. Results indicate that none of the waste materials is defined as hazardous waste by national and international standards. As such, selected waste materials from existing waste piles, such as construction and demolition waste, may be used as backfill material during site construction activities. Excess materials will be disposed of at the dumpsite during dumpsite re-configuration and reshaping.

6.3 Sediment Removal, Treatment and Disposal

Similarly, all sediment samples from seven ponds have been tested and results have indicated that sediment qualities are better than National Standards for Class II Soil in China. Hence, the project design will involve excavation of sediment, followed by dewatering at selected locations within the project area. Dried sediments will be incorporated into tree planting areas.

6.4 Impacts on Forests

There are 137 hectares of woodland scattered in the 9.3 km^2 project area. The woodland is either of planted or second-growth trees consisting of common local species. The project proposes to plant a forest in a big area for soil stabilization, greening and recreational purposes. A total 374 ha in the project area will be planted with a variety of trees ranging in size from yearlings to 4-6 year trees, shrubs, bamboo and other vegetation. This investment will improve significantly the landscape of degraded lands, reduce soil erosion, and provide local residents with space for recreation.

Baseline Condition Prospective Landscape

The EA identified some negative risks (e.g. invasive species) which may occur if the plantation is not properly designed and implemented. Under the support of forest consultants, the project has selected a variety of indigenous species, which are compatible with local soil characteristics and are not prone to pest and disease. Any invasive species will be strictly avoided. Therefore the risk is minimal. The selection of vegetation species was carried out following a number of criteria, including, (i) soil conditions and soil conditioning requirements; (ii) hydrological conditions; and (iii) selected landscaping/vegetation categories concurred by the Expert Panel and local

specialists. Consultation with local forestry specialists and local Forestry Bureau has been conducted and their technical opinions were incorporated in the project design.

The vegetation will need water for irrigation, for which an irrigation system has been included in the design. Approximately 753,400m^3 of storm water would be collected each year in water ponds within the project area, and is considered as adequate for the irrigation needs.

6.5 Pest Management

While the project will neither finance the procurement of pesticides or equipment for pesticides application, the reforestation and nursery construction and operation will result in an increase in the use of pesticides for these project activities. Consistent with the provisions of Pest Management Policy (OP 4.09), A Pest Management Plan, as part of the ESMP, has been developed for the project to improve farmers' knowledge in terms of minimizing the use and safe application of pesticides and promoting integrated pest management.

6.6 Physical Cultural Resources

A PCRs survey, as part of the EA, has been conducted. The EA shows that the construction of one of the two tourist service stations is in the vicinity of a Church with a separation distance of 51 meters. The church is not registered as cultural relic. However, it is considered as PCRs due to its religious significance to local communities. The project will not cause any significant impacts to the church. Instead, it will provide much improved environment for the local communities. Consultation has been conducted with the church and relevant stakeholders such as local cultural protection agency. Specific mitigation measures have been proposed in the ESMP including, (i) installation of noise barrier and prohibiting the use of high noise-generating equipment during religion events; and (ii) chance finds procedures.

6.7 Social Impacts and Mitigation Measures

It is widely recognized that the implementation of this project would bring much needed positive social and environmental impacts to tens of thousands of people in the local communities and the general public, including economic growth and community development. As part of the project planning and feasibility study process, a Social Assessment was conducted as part of the project preparation, which concluded that the main negative social impacts are land acquisition and resettlement required for project interventions, as well as construction related impacts as detailed below.

Land Acquisition and Resettlement

Based on the findings from a social baseline survey (See Section 4.2), potential social impacts were identified as land acquisition and resettlement. According to OP4.12, inventory surveys were carried out on the need for potential land acquisition and the population that will be affected by resettlement. Consultation with the affected residents and businesses was carried out and a Resettlement Action Plan was prepared, which was shared with the affected residents and businesses.

The implementation of this project would involve some permanent land expropriation and building demolition, and hence some residents will need to be relocated. Every effort has been

taken in optimizing the project design in order to minimize the need for land acquisition. The project would require the following involuntary resettlement:

(a) Permanent relocation of six households in Zhanhou community for project construction, affecting 26 people.

(b) Acquisition of collectively-owned land of 177.7 Mu (11.8 ha) in Jiulonggang town of Datong District. Thirty three farming households (122 people) will be affected. All expropriated lands are cultivated lands, which will be used as flower market.

(c) Long term land leasing of 1,533 mu (102 ha) of collectively-owned land in Chenxiang Village, for the use as nursery garden and ecological rehabilitation. Affected people include 306 households with a population of 1,042.

(d) Relocation of one operating business, the Tianhe Boiler Accessories Factory, which has 27 employees.

(e) Acquisition of state-owned land of 1,056 mu (70.4 ha) which is currently occupied by four small enterprises which have not been in operation for some time, and hence no people will be affected by this land acquisition. However, it is expected that the businesses will be compensated appropriately.

Impacts from Construction Activities

Public consultation sessions indicated that local communities and residents are very much in support of the project, as their livelihood have long been seriously affected by the poor environmental and hygienic conditions of the project site, and the proposed remediation project will greatly improve the quality of their life. It is, however, recognized that residents in the close proximity of the project area will be negatively affected by certain amount of noise, dust, traffic resulting from construction activities during project implementation.

Social Impact Mitigation Measures

In addition to the preparation of the detailed Resettlement Action Plan (RAP) and the Environmental and Social Management Plan (ESMP), the following specific mitigation measures have been established:

(a) *Consultation with affected communities and residents* - This will ensure that public inputs and concerns will be fully addressed in optimizing the project design;

(b) *Compensation of affected assets at full replacement cost and provide support to livelihood adjustment* - Compensation will be paid to the affected people for their land and houses at full replacement cost. Additional allowance will be provided to vulnerable groups such as female households and the disabled in the process of house reconstruction;

(c) *Provide skill training and job opportunities to affected persons*;

(d) *A grievance redress mechanism* has been established and included in the Resettlement Action Plan.

(e) In order to manage potential risks associated with long term land leases, a detailed land transfer process and procedure, describing the legitimate rights of both parties have been included in the RAP; and

(f) To minimize the impacts on normal life of residents during construction, measures have been included in the ESMP, which mainly include but not limited to the following:

(i) The road and water supply pipeline will be constructed section-by-section to reduce negative impacts and inconvenience to the public;

(ii) Providing additional road signs to limit vehicle speed and carry out traffic safety propaganda;

(iii) The contractor will follow strict noise control requirements, and to take actions to minimize noise emission as much as possible;

(iv) Prohibit the use of equipment that generate high noise level at night, and/or avoid night work, where possible;

(v) Dust control by applying water regularly at entrance roads and temporary roadways to reduce the level of airborne dust; and

(vi) Remove construction refuse and major pollution source from construction camp in a timely manner and sanitize the construction camp, and regulate behaviors of the construction workers.

6.8 Cumulative Impact

In the preparation of the EA, the VECs for cumulative impact analysis have been screened. Because the project is intended to remediate the local environment by closing dumpsites, construction of drainage system, etc., the adverse impacts are very localized and limited.

Huainan is facing challenges in the management of the water environment, among which the overriding issues is the water pollution. In order to tackle the water pollution problem, Huainan Government has developed an ambitious plan-The 12th Five Year Plan for Environment Protection (the Plan hereinafter), which establishes the water pollution load reduction target that by year 2015 the COD will be reduced by 2,823 t/a and NH3-N by 357 t/a.

To meet the water pollution load reduction target, the Plan calls for a series of works centered on municipal wastewater collection and treatment, and leachate collection and treatment from landfills. This project is an integral part of the Plan and the projects in the future and current have been identified. It is estimated that the project alone will contribute 0.3% of COD reduction target while 0.4% of NH3-N target.

6.9 Arrangement for Local People Benefit from Land Value Increase

Benefiting Arrangements

There is a population of 13946 in the area which has potential of land value increase as a result of project implementation, including 2212 of rural population (Chenxiang village, Xiacai Village, Qingfeng community and Datong Street) and 11734 of urban population. The size of the area is 195.21 hectares, including 49.36 hectares of collective land distributed in Chengxiang village, Xiacai village, Qingfeng community and Datong Street and 145.85 hectares of state-owned land.

Measures have been taken to ensure both urban and rural residents in the area to benefit from the potential land value increase.

Urban residents: Among 11,734 of urban residents, 9,548 people have properties within the belt and their properties will be appreciated along with land appreciation, so they will gain benefit from land value increase as a result of the project implementation. The remaining 2,186 persons to be affected by land development in the future will be compensated by replaced housing area with floor area of 1.2 times of the original living area. The resettlement site will be within the belt. Therefore they will be able to benefit from the land value increase. If these people are relocated outside of the belt, the land value and its appreciation of the resettlement site will not be lower than that of the land within the belt.

Rural residents: As indicated in table 1, there are 2, 212 rural residents within the belt. These people own 49.36 hectares of collective land, of which there are 26.2 hectares of cultivation land and 23.16 hectares of land for housing construction. The collective land is distributed in two villages including Chenxiang village and Xiacai village and remaining land is distributed in four collective entities including Chenxiang Village, Xiacai Village, Qingfeng Community and Datong Street. In order to make the rural residents benefit from land value increase through land development in the future, the government will take the following measures:

a) To update the Regional Comprehensive Land Price at least once every two years in order to guarantee that the land appreciation can be reflected in new land compensation standard. It was agreed that Land Compensation Standard will be updated for three times during project implementation respectively in 2015, 2017 and 2019.
b) Land area expropriated each year shall not exceed 20% of the total collective land area within the belt. It means that collective land expropriated in the area shall not be more than 10 hectares each year during project implementation. Thus there will have land to be expropriated over the next few years after land appreciation. Therefore rural residents will be able to benefit from land appreciation.
c) To allocate 5-10% of expropriated land to village collective for economic development as per relevant policies. Specific measures and procedures are the following: 1) government pay compensation to affected people at the Regional Comprehensive Land Price; 2) convert the collective land into state owned land when full compensation is paid; 3) government transfers a piece state-owned construction land, which equal to 5-10% of actual size of expropriated collective land, to village collective for economic development; 4) local people will decide how to use the land for development and the benefit distribution appreciation among rural residents.
d) For those rural residents to be relocated will be resettled within the belt in principle. In case some residents want to move outside of the belt, the land value of the resettlement site should not be lower than the land value within the belt.

Monitoring mechanism

Currently, the municipal government of Huainan City has a well-established monitoring mechanisms and auditing procedures with regard to the land acquisition, demolition and resettlement. To monitor the implementation of the mechanisms design for local people to benefit from land appreciation, a specific monitoring arrangement will be established as part of Environmental and Social Management Plan. The monitoring arrangements and indicators are the following:

a) The external resettlement monitoring unit will monitor the implementation of the mechanism to benefit local people from land value increase and include the findings as a part of the biannual resettlement monitoring report.
b) The area to be monitored will include all land plots within the belt which have the potential of land appreciation as a result of the project implementation.
c) The monitoring indicators and contents:

- Amount of state-owned lands purchased and stored and collective lands expropriated each year during the construction period of the project
- Population affected by state land purchase and collective land acquisition
- Resettlement sites of affected people
- Market price of resettlement houses within and outside of the belt
- Status of Regional Comprehensive Land Price updating
- Amount and location of state construction land allocated to the village affected by land acquisition and the status of its development and utilization
- Distribution of benefits generated from the land allocated to the village among local people within the village

6.10 Summary of Mitigation Measures

Based on the impact assessment, the Environmental and Social Management Plan developed a series of mitigation measures to avoid, minimize, and mitigate any adverse environmental and social impacts, and institute remedial actions in the event of an adverse impact. These mitigation measures were designed in accordance with relevant national laws, regulations, rules and standards in China, as well as the World Bank safeguard policies (including the General EHS Guidelines) to address the impacts during the design, construction and operation periods. A summary of the key mitigation measures are provided in Annex 6.

7.0PUBLIC CONSULTATION & INFORMATION DISCOSURE

7.1 Public Consultation

In accordance with the requirements of the China's EA Law and the World Bank, two rounds of public consultation were conducted by the EIA team. The first round focused on environmental screening to define public concerns, to assist identification of key environmental issues and to draw public response and comments on the initial set of potential adverse impacts and their

corresponding mitigation measures identified prior to the completion of the EA TOR. The second round was designed to ensure public awareness of the EA effort and final project definition, potential adverse impacts and mitigation measures. A draft EA report was provided during this second round of public consultation process. Details of the two rounds of public consultation are presented in Table 7-1.

Table 9-1 Implementation of Public Consultation

Round	Timing	Participants	Method	Organizer
1	June, 2013	Representatives of communities and villages in the project affected area; experts and relevant departments regarding the physical cultural resources	Questionnaires and public meeting	EA Consultant
2	May –July 2014	Representatives of communities and villages in the project affected area; experts and relevant departments regarding the physical cultural resources	Questionnaires and public meeting	

During the consultation process, the public expressed a range of concerns, focusing on the land use, recovery of livelihood, and environmental impacts including airborne dust, noise, and water pollution. Participants expressed their hope of getting employment opportunity for the various construction activities. Public concerns were either addressed at the public meetings or incorporated in the EA. Public consultation sessions indicate strong support for the project as they believe that the project would be a good approach to improving their living conditions and potential adverse impacts will be effectively addressed and reduced to an acceptable level through proposed mitigation measures.

7.2 Information Disclosure

Information on the project EA has been disclosed to the public throughout the public consultation. An advertisement has been placed on the Huainan Daily, the most popular local newspaper on June 11, 2014 during the second round of public consultation to invite the public to express their concerns about the project. The advertisement also informed the public with regard to public access to the draft EIA report which has been placed in the affected villages and communities that are easily accessible to the affected people since June. 2014. The full text of the EA documents were also made available on a local website (http://www.hnhb.gov.cn), since June 4, 2014.

8.0ENVIRONMENTAL MANAGEMENT PLAN

Apart from potential adverse impacts discussed above, it is expected that during the project implementation phase, site construction activities will have negative impacts to the local communities and residents. Although these impacts are expected to be temporary in nature, every effort should be made to minimize potential impacts to the local communities. As such, a stand-alone Environmental and Social Management Plan (ESMP) was prepared, consistent with findings of the EA. This ESMP sets out requirements during project implementation and

stipulate specific roles and responsibilities for contractors and government agencies for site supervision, monitoring, and reporting, as well as requirements for worker health, safety and hygiene.

All ESMP requirements will be fully incorporated into contract documents to clearly specify responsibilities of all contractors and operators and their agents and employees.

8.1 Institutional Arrangements

An institutional arrangement has been prepared to clearly delineate the roles and responsibilities for the implementation of ESMP (See Figure 8.1), which is compliant with regulatory responsibilities of relevant agencies in China, while providing adequate site management during project implementation.

Environmental Supervision

During project implementation, environmental supervision is to be carried out by qualified supervision unit accountable to the PMO. The supervision engineering company will be required under the contract to assign dedicated and qualified Environmental Supervision Engineer(s) to supervise and monitor on a daily basis the performance of the contractor(s) in accordance with the ESMP. The key responsibilities of the environmental supervision engineer(s) include:

(a) Development of environmental supervision plan prior to commencement of site construction activities;
(b) Review of preliminary design and detailed designs to ensure that environmental mitigation measures in ESMP are fully incorporated into project design;
(c) Assist the PMO in organizing and implementing training for contractors and management staff on ESMP requirements;
(d) Review terms of construction contracts to ensure that roles and responsibilities for ESMP implementation, monitoring and reporting are fully addressed in relevant contract documents;
(e) Review construction organizational structures, technical plans and construction schedule to ensure proper handling of environmental safeguards issues;
(f) Review environmental compliance of construction equipment and machines;
(g) Conduct daily supervision on ecological protection, water, air and noise impact, and monitor and/or supervise the implementation of environmental mitigation measures, and accept and sign off acceptance based on environmental compliance;
(h) Identify problems of ESMP implementation and authorize alterations initiated by the contractor(s);
(i) Provide regular reports on ESMP implementation status to PMO, and/or World Bank.

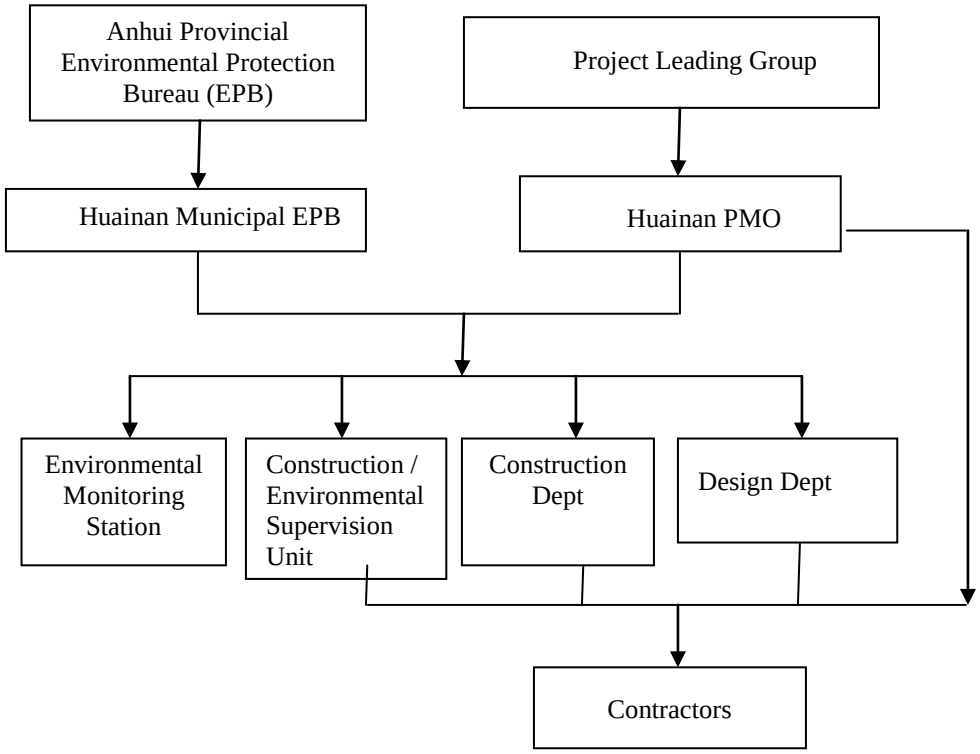
8.2 Environmental Monitoring

A comprehensive environmental monitoring program is to be prepared for the construction and operation of various components of the proposed Project. Monitoring includes air and water (surface and ground water) qualities, and levels of noise emission. The PMO is to use the environmental monitoring plan as a means of documenting and reporting adherence to ESMP requirements.

Capacity Development and Training

To ensure effective implementation of the ESMP, training for environmental management is to be provided to PMO staff. Environmental training is to be conducted, prior to the commencement of construction activities, for relevant staff of the PMO, contractors and supervision engineers. Training contents will include relevant national environmental laws/regulations; World Bank safeguards policies, environmental management plans, environmental supervision and monitoring techniques and procedures, Environmental Code of Practice (ECOP) and reporting requirements, etc.

Figure 8.1. Environmental Management Responsibility Chart During Project Implementation



8.3 Mitigation Measures of ESMP

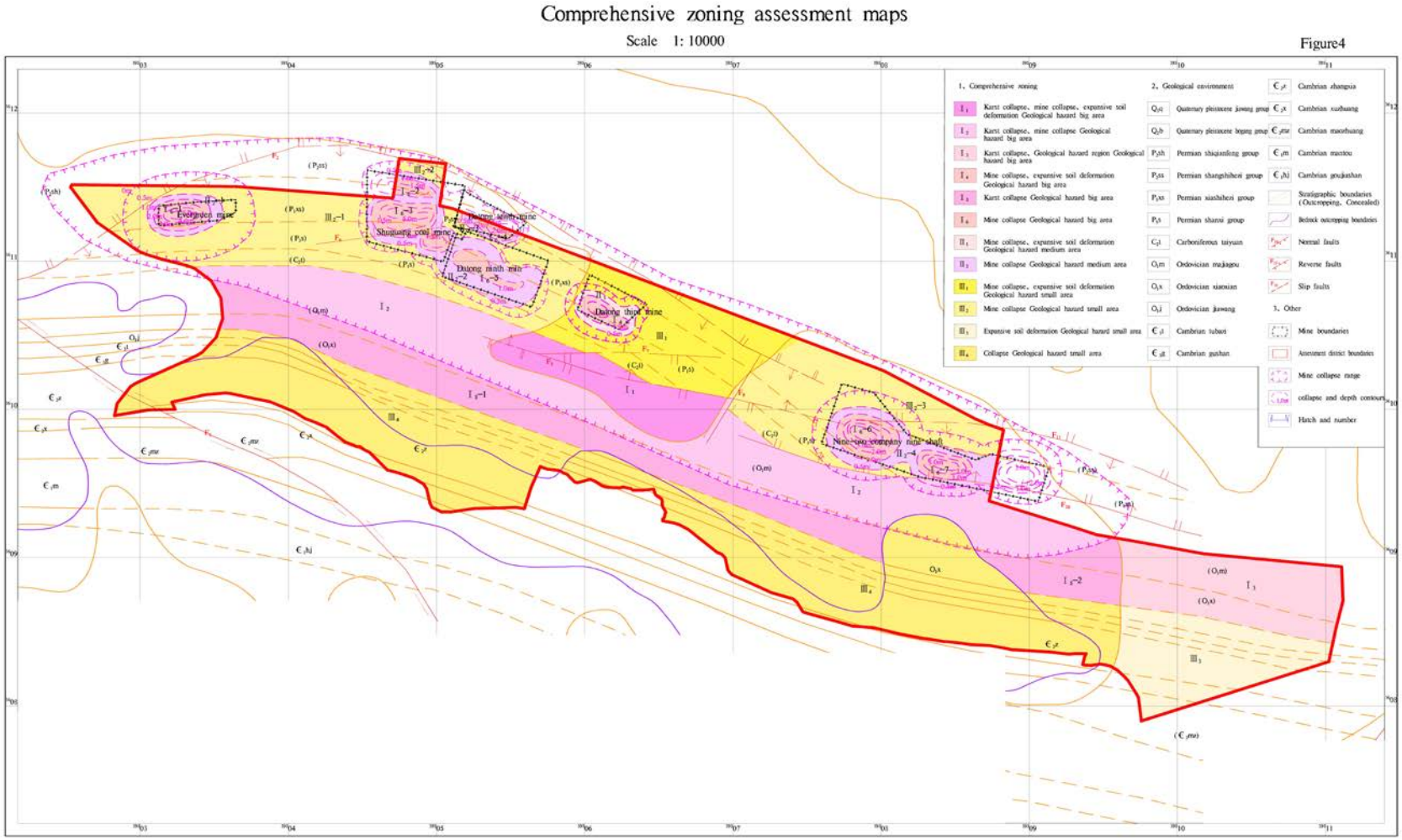
The ESMP provides detailed specifications of mitigation measures to reduce and eliminate negative environmental and social impacts that may rise during project implementation. The development of mitigation measures follows the regulatory requirements in China and established good practices. Mitigation measures cover the following aspects of potential environmental impacts (See more details in Annex 6). Existing accumulation of leachate around the dumpsite will be removed and transported to the leachate treatment plant at the sanitary landfill prior to the commencement of any site remedial activity for the dumpsite.

9.0BUDGET FOR ENVIRONMENTAL MANAGEMENT PLAN

Cost estimates for the implementation of all mitigation measures, including those relating to supervision, monitoring and reporting have been prepared and included in the total project cost. The total budget requirement is estimated at 357.32 million RMB, including mitigation measures required during project construction, as well as the annual operating budget, where applicable, as shown in the following table:

Items	Description	Construction Period (RMB millions)	Annual Operation Period (RMB million)
1	Environmental protection measures	2.44	1.0
2	Environmental Monitoring	0.55	0.085
3	Environmental Training	2.0	0.22
4	Administration	2.41	0.70
5	Soil and water conservation measures (environmental remediation)	347.91	--
6	Total	355.31	2.01

Annex 1 Geo-hazard Zones Map



Annex 2 Groundwater Quality Data - Sample Monitoring Results

Groundwater Quality Monitoring results

Sampling site (monitoring well no.)	Ammonia nitrogen	Chloride	Cr (hexavalent)	Fluorine	Sulfate	Nitrate	Nitrite
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
DX-1	0.054	332	0.004L	2.2	925	4.44	0.004
DX-1’	0.225	113	0.004L	1.0	376	16.2	0.359
DX-2’	0.317	82.2	0.004L	2.0	709	3.80	0.109
DX-4’	0.065	54.9	0.004L	0.9	351	2.13	0.216
DX-5’	0.214	57.1	0.004L	0.9	169	10.3	0.067
DX-6’	0.568	62.3	0.004L	0.6	26.5	13.0	0.416
DX-7’	0.065	48.7	0.004L	0.6	154	4.50	0.101
DX-8’	0.042	95.9	0.004L	0.9	277	2.72	0.070
DX-9’	0.054	84.2	0.004L	0.8	42.3	0.49	0.032
DX-10’	0.934	51.3	0.004L	1.7	89.4	0.15L	0.005
DX-11’	0.892	44.4	0.004L	0.8	206	0.30	0.539

Groundwater Quality Monitoring Results (cont'd)

Sampling site (groundwater well no.)	Zn	As	Hg	Pb	Cd	Total bacterial count	Total coliform group
	mg/L	μg/L	μg/L	mg/L	mg/L	No./mL	No./L
DX-1	0.022	0.001L	0.0004	0.0044	0.0005L	16	79
DX-1’	0.024	0.002	0.0010	0.0025L	0.0005L	35	2.2×102
DX-2’	0.046	0.001L	0.0012	0.0056	0.0005L	14	33
DX-4’	0.015	0.001L	0.0013	0.0043	0.0005L	25	17
DX-5’	0.025	0.001L	0.0006	0.0025L	0.0005L	49	46
DX-6’	0.028	0.001L	0.0005	0.0025L	0.0005L	61	32
DX-7’	0.034	0.001L	0.0008	0.0025L	0.0005L	29	39
DX-8’	0.046	0.001L	0.0004	0.0025L	0.0005L	15	33
DX-9’	0.026	0.001L	0.0048	0.0074	0.0005L	20	26
DX-10’	0.003	0.001L	0.0020	0.0025L	0.0005L	6	7
DX-11’	0.025	0.003	0.0014	0.0025L	0.0005L	110	14
DX-14	0.097	0.005	0.0019	0.0025L	0.0005L	24	70

Annex 3 Soil Quality Data

Monitoring item		TR14#	TR15#	TR16#	TR17#	TR18#	TR19#	TR20#	TR21#	TR22#	TR23#
pH		7.53	8.01	7.58	7.74	7.59	7.54	8.29	8.05	7.84	8.30
Hg		0.704	0.016	0.074	0.038	0.161	0.100	0.108	0.099	0.085	0.102
As		7.30	8.69	7.86	11.6	21.5	6.46	7.83	9.34	17.9	13.2
Cu		25	21	45	22	34	48	25	27	46	29
Zn		78.7	58.2	88.7	52.2	55.8	100	92.1	76.8	91.8	63.3
Ni		21	39	54	15	4	62	25	20	51	34
Pb		29.7	25.0	41.2	18.7	24.1	40.4	42.6	23.3	37.5	19.8
Cd		0.11	0.08	0.15	0.03	0.09	0.16	0.46	0.08	0.13	0.06
Cr		45	53	53	39	69	83	23	27	82	83
HCH	α-HCH	3×10-4	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	1.5×10-3	0.0001L	0.0001L	0.0001L
	γ-HCH	3×10-4	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L
	β-HCH	2.0×10-3	0.0001L	1.5×10-3	3×10-4	0.0001L	4.4×10-3	1.2×10-3	6×10-4	0.0001L	0.0001L
	δ-HCH	5×10-4	0.0001L	0.0001L	1×10-4	0.0001L	0.0001L	0.0001L	4×10-4	0.0001L	0.0001L
DDT	p,p'-DDE	0.0001L	0.0001L	3×10-4	0.0001L	1.9×10-3	5×10-4	5.9×10-3	2.25×10-2	0.0001L	6×10-4
	o,p'-DDT	2.0×10-3	0.0001L	0.0001L	0.0001L	0.0001L	4.8×10-3	1.4×10-3	2.9×10-3	0.0001L	0.0001L
	p,p'-DDD	4.7×10-3	0.0001L	0.0001L	5×10-4	8×10-4	4×10-4	2.6×10-3	1.9×10-3	0.0001L	5×10-4

	p,p’-DDT	7.8×10-3	0.0001L	1.7×10-3	1.4×10-3	1.5×10-3	1.46×10-2	8.7×10-3	1.61×10-2	0.0001L	5×10-4

Annex 4 Comparison with International Standards

During the development of environmental standards in China, relevant information and standards used in developed countries are often studied to learn the intention, the limits, the implication and restriction for the applications of these standards.

In China, the Ambient Soil Quality Standard (GB 15618-1995) is often used to evaluate the toxic level of the soil/sediments so as to determine whether the sediments can be applied for beneficial use without the restriction of application rate. To further understand the relevant standards used in developed countries for the screening of soils, comparisons with the standards in developed countries were made as follows:

1. Ambient Soil Quality Standard (GB 15618-1995)

Based on the use of the soil, the quality of the soil is classified into three classes, as follows:

Class 1: to protect the natural background soil quality to sustain the natural ecology;
Class II: to sustain farming for protection of human health;
Class III: to sustain the growth of forest and vegetation.

Table 1 Ambient Soil Quality Standard (GB15618-1995) unit：mg/kg

Class of soil		Class I	Class II			Class III
pH		Natural background	<6.5	6.5-7.5	>7.5	>6.5
Cadmium		0.20	0.30	0.30	0.60	1.0
Mercury		≤0.15	0.30	0.50	1.0	1.5
Arsenic	paddy land	≤15	30	25	20	30
	dry land	≤15	40	30	25	40
Copper	arable land	≤35	50	100	100	400
	Orchard	≤ --	150	200	200	400
Lead		≤ 35	250	300	350	500
Chrome	paddy land	≤ 90	250	300	350	400
	dry land	≤ 90	150	200	250	300
BHC		≤ 0.05	0.50			1.0
DDT		≤ 0.05	0.50			1.0

2. Soil Quality Standards in Developed Countries

Table 2 Soil Screening Levels in Developed Countries unit: mg/kg

Heavy metal	USA1		Dutch2
	Soil in industrial zones	Soil in Residential zones	
As	1.6	0.39	55
Cd	450	37	12
Cu	41000	3100	190

Hg	310	23	10
Pb	800	400	530
Cr	450	210	380

Note: 1. USEPA R9 PRGs.
2. Dutch Intervention Value (DIV) for residential soil.

These SSLs (Soil Screening Levels) alone do not trigger the need for response actions or defines as “unacceptable" levels of contaminants in soil. The screening refers to the process of identifying and defining areas, contaminants, and conditions, at a particular site that do not require further Federal attention.

3. Comparison of Standards

From Table 1 and Table 2, it can be seen that the Cd in the Chinese standard which is easily taken by plants and concentrated in the reproductive parts such as flower and fruits that will pose serious health risk to people who ingest them is much lower than that in the SSLs in USA and Dutch. The As in Chinese standard is much lower than that of Dutch but much higher than that in the USA. Other heavy metals limits in Chinese standard for Class III are equivalent to Dutch SSLs, but much lower than the USA’s SSLs.

Annex 5 Sediments Quality Data

Sample No.	Date of monitoring	pH	Hg	As	Pb	Cu	Cr	Cd	Ni
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	2013-5-14	8.04	0.780	4.92	26.8	34.2	45.3	0.107	25.5
2	2013-5-14	7.98	0.540	5.57	26.1	33.6	44.7	0.092	28.4
3	2013-5-14	7.86	0.790	4.53	25.0	37.9	50.1	0.087	43.1
4	2013-5-14	8.13	0.931	9.34	39.3	27.8	57.4	0.078	36.0
5	2013-5-14	8.13	0.624	7.57	20.7	18.7	56.5	0.058	31.1
Sample No.	Date of monitoring	HCH				DDT			
		α-HCH	γ-HCH	β-HCH	δ-HCH	p,p’-DDE	o,p’-DDT	p,p’-DDD	p,p’-DDT
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
1	2013-5-14	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L
2	2013-5-14	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L
3	2013-5-14	1.14×10-2	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L	0.0001L
4	2013-5-14	1.62×10-2	1.58×10-3	2.45×10-3	1.17×10-3	7.78×10-3	2.72×10-3	8.91×10-3	0.173
5	2013-5-14	1.87×10-3	3.99×10-3	2.84×10-4	1.23×10-4	0.0001L	0.0001L	0.0001L	0.0001L

Annex 6 Mitigation Measures

ECOPs During Design Stage

Project Components	Environmental / Mitigation Measures
Environmental Rehabilitation	• Selection of native plant species with strong resistance to diseases for planting of trees & other vegetations. • Plants and vegetations that are resistant to water are selected for planting around surface water ponds and potential flood areas. • Trees and vegetations with shallow root systems are selected for final cap over dumpsite, in order to avoid potential damage to dumpsite final cap structure
Water Stream and Storm Water Drainage System Rehabilitation	• Incorporate additional space for the design of surface water storage area where drainage flow is limited. • Use of good quality sediment materials on site for construction backfill, space greening, etc instead of trucking off site for disposal.
Urban Infrastructure Improvement	• Consideration for potential further ground settlement, road construction is to be of asphalt mix type to facilitate future maintenance work. • Road design will provide segregation of pedestrians from vehicle traffic flow.
Site Utilization for Community Development	• Design and construction of visitor service stations to provide necessary services and minimize potential negative impacts to scenic areas by visitor traffic. • Adoption of native species of plants to prevent invasive species in the project area.

ECOPs During Project Construction

Activities	Potential Impacts/Issues	Mitigation Measures	Implemented By	Monitored By
Wastewater from Construction activities	Contamination of surface water streams	• Installation of wastewater collection & storage facilities at equipment & vehicle maintenance yard to collect wastewater generated from these operation for oil-water separation treatment and implement reuse of treated water on site with no discharge. • Establish wastewater settling pond on site to collect all wastewater generated from miscellaneous operation to remove sediment and reuse of treated water on site.	Construction Contractors	Site Supervision Unit
Sewage from construction worker		• Construction workers are to be accommodated at surrounding housing facilities or hotels in order to minimize sanitation water generated on site. Where necessary, specific wastewater storage facilities will be provided for off-site disposal at sewage treatment plants - no on-site disposal of sewage.	Construction Contractors	Site Supervision Unit
Site Drainage water		• Surface drainage channels will be installed to collect surface water from site for subsequent use for on-site activities	Construction Contractors	Site Supervision Unit
Dust	Impact on air quality for project site and	• Minimize need for outdoor storage of construction materials. Where necessary, outdoor storage	Construction Contractors	Site Supervision Unit

	local communities	facilities will be covered at all time. • Timely backfill for any excavated locations. Where necessary, compaction should be applied including application of water for dust suppression. • All transport vehicles of earth and gravel materials shall be equipped with tarp cover. • Vehicles to be washed prior to existing from project site. Strict compliance with load limits for vehicles. • Regular water spray to minimize dust on all roadways.		
Vehicle Emission		• All vehicles and motorized construction equipment used for project activities to be compliant with vehicle emission standards	Construction Contractors	Site Supervision Unit
Noise Emission	Transport Vehicles and Construction Equipment	• Adoption of equipment with low level of noise emission. • Control vehicle speed to reduce noise and prohibit unnecessary honk. • Workers to hear hearing protection equipment. • Noise screening will be used where appropriate. • Equipment with high noise emission shall not be used for any construction activities during the night. • Where necessary, advance notice shall be provided to local residents	Construction Contractors	Site Supervision Unit

		in case of specific construction activities with expected high noise emission.		
Construction Waste	Esthetic impact and hygienic conditions	• All waste generated from construction activities shall be sorted for maximum recycling. Residuals shall be stored at designated locations, and transport to proper off-site disposal locations.	Construction Contractors	Site Supervision Unit
Domestic waste from workers		• Recycling and disposal facilities for domestic waste shall be stored at properly designated waste disposal bins to be collected and disposed of by city sanitation collection system for subsequent disposal at sanitary landfills.	Construction Contractors	Site Supervision Unit
Ecological Features		• Workers shall be provided and instructed with proper behavioral conducts and not to cause any damage to trees and other plants within the project site. • Implement specific measures to prevent soil erosion at construction sites, taking precautions to optimize amount of excavation. • Maintain original surface vegetation to prevent soil erosion and impact to surface water stream quality. • Prepare surface drainage plan prior to starting major excavation activities.	Construction Contractors	Site Supervision Unit

		• Instruction to prevent accidental or willful killing of animals.		
Cultural Relics	Protection of cultural objects	• Discovery of objects with cultural and historic value shall be dealt with in accordance with applicable national laws.	Contractors	Site Supervision Unit
Religious Establishment	Noise and other nuisance impact	• Specific plan is to be prepared for potential impacts to neighboring church activities, especially during Sundays - noise screening may be necessary.	Contractors	Site Monitoring Unit
Social Impacts	Complaints & Grievance Redress	• Public consultations to be continued during project implementation stage	PMO	Project Leading Group

Site Specific Mitigation Measures During Operation Period

Items	Project Components	Mitigation Measures
1	Dumpsite Leachate Control & Management	• Measures have been taken to minimize leachate generation and migration, including proper site grading to prevent infiltration of surface water into dumpsite footprint; Installation of final cap will further reduce potential leachate generation from dumpsite. • Installation of vertical barrier wall will contain and reduce lateral movement of leachate plume, thereby minimizing potential groundwater contamination. • Leachate will be collected and stored at the leachate storage pond for subsequent trucking by tankers to leachate treatment plant located at sanitary landfill of 6.5 km away. • Cover for leachate storage pond shall be maintained at all times to minimize potential odor generation and impact of rainfall. Daily shipment of leachate to leachate treatment facility shall be conducted. • Leachate transport vehicles shall be enclosed tanker truck in proper working condition without leaks. Any leaks on ground surface shall be cleaned up immediately.
2	Dumpsite Dike & Slope Maintenance	• Dumpsite surface contour shall be inspected on a quarterly basis during the first year of operation, and then annually thereafter to ensure the proper maintenance of surface contour and a side slope gradient at 1:3.5 or 1:4. The top surface gradient shall be maintained at a minimum of 5%. Any settlement and/or surface cracks shall be repaired.
3	Potential fire hazards & public safety at dumpsite	• A buffer zone of 8 meters shall be maintained between the dumpsite perimeter and the rest of the ecological surroundings of the project site. • Appropriate and adequate fire-fighting equipment shall be maintained at the dumpsite service facility. • Prohibition of smoking or other actions that may cause source of fire at the vicinity of dumpsite. Monitoring devices for methane gas shall be installed at appropriate locations at the dumpsite. All equipment and vehicles used at the dumpsite shall be equipped with fire-fighting equipment. • All safety requirements associated with landfill gas collection and flare system shall be properly instituted and maintained by qualified staff for system maintenance, as recommended by equipment manufacturers and national regulatory requirements for similar landfill gas collection and flare system. • Specifically trained and qualified staff shall be retained for the operation of the landfill gas system
4	Application of Pesticides	• The selection and adoption of native species of trees and other vegetations should minimize the use of pesticides within the project area. • Special techniques should be employed for forestry management instead of the use of pesticides and herbicides.

5	Prevention of Forest Fire	• Strict requirements for buffer zone for prevention of forest fires • Develop public communication and promotional materials for fire prevention within the project area. Implement national and local requirements for appropriate fire prevention measures. • Establish fire prevention plan for the project site, including the hiring of designated staff for fire monitoring activities covering specific areas. Monitoring results shall be reported to the Forest Bureau and the Fire Prevention Department.

Site-specific Mitigation Measures for Construction Phase

Items	Project Components	Mitigation Measures
1	Dumpsite Remediation and Closure	• As an integral part of dumpsite remediation, site is to be re-shaped, compacted, graded to proper gradient to maintain slope stability, creating clearance space for high voltage transmission lines, define and reduce dumpsite footprint to avoid potential unstable mineshafts and karst areas. • Project design to include perimeter dikes to maintain site stability and prevent surface water infusion. • Installation of vertical barrier walls (total surface area of 19,110 square meters) around the perimeter of dumpsite to contain potential leachate migration. Vertical barrier wall shall consist a synthetic HDPE liner and a Geotechnical clay liner with a minimum thickness of 600 mm. • Construction of leachate collection and storage facility on site. • Installation of a network of landfill gas collection wells and a gas flare system • Surface grading will be provided to divert storm water away from dumpsite footprint, and reduce leachate generation. • Final cap design will incorporate system to minimize storm water infusion and landfill gas emission.
2	Nanshan Church	• Equipment with high level noise emission should be banned during the period when the church is holding ceremonies.