

Global Environment Facility  
China Contaminated Site Management Project (P145533)

**Environmental and Social Assessment  
Executive Summary**

October 2014

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## 1. Introduction

### 1.1 Project background

1. Soil pollution has become a serious health and environmental threat in China, contaminating the food chain with heavy metals, fertilizers and pesticides, persistent organic pollutants (POPs) and solvents; and polluting groundwater and surface waters. The Chinese Government has become aware of the serious socioeconomic risks resulting from soil pollution and carried out China's first soil pollution survey from April 2005 to December 2013. The survey covered all arable land, partial forest land, grassland, unused land, and construction land with a total area of about 6.3 million square kilometers. On April 17, 2014, the Ministry of Environmental Protection (MEP) and Ministry of Land and Resources (MLR) jointly issued a Communique on results of this survey. It states that soil pollution in some regions is severe, soil quality of arable land is worrying, and soil environment problems in abandoned industrial and mining sites are prominent. The overall percentage of sample points exceeding the screening threshold in the country is estimated at 16.1%. About 33% of sample points in highly polluting industries, Industrial Parks, abandoned industrial sites, and mining areas, 20% in arable land, 26% in wastewater irrigation areas and 20% in the land along highways show contamination. The main contaminants found are heavy metals (cadmium, nickel, arsenic, cuprum, mercury, lead, chromium, zinc) and organic pollutants (hexachlorocyclohexane-HCH, dichlorodiphenyl trichloroethane-DDT, and polycyclic aromatic hydrocarbons-PAHs). These results demonstrate the extent of the country's land pollution problems. On one hand, this poses environmental and health risks in China's most densely populated areas, on the other hand, this is an obstacle to redevelopment, and urban and rural economic growth.

2. The Chinese Government issued the following regulations or official documents regarding cleanup of contaminated sites:

- In 2004, the former State Environmental Protection Administration, now MEP, issued a Notice on Effective Prevention and Control of Environmental Pollution for Industrial Enterprise Relocation (SEPA 2004, No. 47).
- In June 2008, MEP issued an official document entitled "Recommendations on Strengthening Soil Contamination Prevention and Remediation."
- In 2011, the State Council issued "Opinions on Strengthening Key Tasks on Environmental Protection", which requires that environmental assessment and environmentally sound management should be carried out for contaminated sites before they can be redeveloped.
- In November 2012, MEP, MLR, the Ministry of Industry and Information Technology (MIIT), and the Ministry of Housing, Urban and Rural Development (MHURD) jointly issued a "Notice on Safeguarding Redevelopment of Industry-contaminated Sites".
- In January 2013, the State Council further issued "Work Arrangement on Soil Protection and Comprehensive Treatment in Near Future".
- Based on the 12th Five-Year (2011-2015) Plan (FYP) for National Economic and Social Development of the People's Republic of China, MEP has developed and issued (1) the National Environmental Protection 12th FYP; and (2) the National POPs Prevention and Control Plan during the 12th FYP period.

3. MEP is also now making great efforts to include a "Soil Pollution Prevention and Control Law" in the legislation plan of the National Congress. The initial draft of the law has been prepared and comments are being widely collected. The Law, when it is finalized, will be

submitted directly to the National People's Congress for approval without a need of going through the Legislative Affairs Office of the State Council, which means that its review and approval process will be much shortened, although it is not clear yet when the Law will be issued. Recently, MEP has also internally approved in principle an "Action Plan for Soil Pollution Prevention and Control" (i.e., Tushitiao), which is expected to be approved by the State Council by end of 2014. The objective of the Action Plan is that by 2020, soil environment of arable land will be effectively protected, deteriorating soil pollution will be contained, and soil quality in some regions will be improved. The total investment is expected to reach trillions of RMB. China has also considered international technical assistance, an important means to introduce good practices and experiences from developed countries for expediting its process of addressing site contamination issues.

4. The Stockholm Convention, listing twenty-two POPs chemicals to date, was adopted in 2001 and entered into force on May 17, 2004. China demonstrated its commitment to the Convention by ratifying it early, and it came into effect for the country on November 11, 2004. Parties are requested to develop appropriate strategies for identifying sites contaminated by chemicals listed in Annex A (elimination), B (restriction) or C (unintentional production) of the Convention; if remediation of those sites is undertaken it shall be performed in an environmentally sound manner.

5. It is estimated that China had about 60 DDT, chlordane and mirex, hexachlorobenzene (HCB), heptachlor, and toxaphene and four polychlorinated biphenyls (PCBs) production factories (initial site investigation was carried out in 47 out of the 60 sites with POPs contamination identified), 38 endosulfan producers, 72 HCH (and DDT) producers, and 12 (8 are still in production today) PFOS producers. Most of these factories were equipped with outdated technologies and lacked proper waste and wastewater handling and rainfall collection systems, which could lead to soil and groundwater pollution. Evidence of site contamination was found through site visits, such as presence of waste residues and strong odors of pesticides in and around the production areas. In addition, China also has some legacy e-waste contaminated sites containing heavy metals, PCBs, pentabromodiphenyl ether (PBDE), polybrominated biphenyls (PBBs), dioxin and polybrominated dibenzodioxins (PBDDs) mainly in Guangdong, Zhejiang and Fujian provinces resulting from extensive operations in the past: incineration, crushing, dumping, and use of concentrated acid to extract precious metals and direct discharge of the effluent. Due to lack of nation-wide or sectoral hazard material tracking systems and reporting requirements for producers and users, as well as risk assessment requirements before land use change and land owner change, some POPs contaminated areas have already been dismantled and redeveloped without thorough investigation and, where needed, remediation.

6. This project aims to assist China to address issues that it is facing for prevention and control of contaminated sites including: policy and legal constraints, institution and capacity constraints, information constraints, technology constraints and financing constraints.

## **1.2 Project development objective**

7. The project development objective (also the global environmental objective) is to improve the country's capacity for managing site contamination, and demonstrate identification and cleanup of sites contaminated with POPs and other hazardous chemicals in an environmentally sound manner.

### **1.3 Project components**

**8.** The Project will include activities at both national and provincial levels. Chongqing municipality and Liaoning province as pioneers with strong commitment and ownership for managing contaminated sites have been selected as the two demonstration areas among four municipalities or provinces (Requests of Expression of Interest were sent to 11 provinces and municipalities), which expressed interest to participate in the Project.

**9.** The Project will support investment, technical assistance (TA) and administration measures and technical guidelines development for the cleanup of contaminated sites (control of contaminated sites). Sites for pilot cleanups will be POPs (and other hazardous chemical) contaminated sites. The Project will also include TA and administration measures and technical guidelines development for prevention of industrial contaminated sites and agricultural contaminated land.

**10.** From contamination identification to cleanup closeout, risk assessment helps form management decisions made at each stage of a site or land's life cycle. The goal of the human health and environmental evaluation process is the development of risk information to determine whether a removal action and/or remedial action is necessary, or conversely, whether the site may be closed out with no further action. The Project will introduce and transfer knowledge on human health risk-based remediation approach.

**11.** The Project consists of three components described below.

#### **Component 1: Capacity Development for Prevention and Control of Site Contamination**

**12.** Sub-component 1.1: Development of Administrative Measures, Technical Guidelines and Financing Options for Contaminated Site Cleanup. As MEP is working on the Soil Pollution Prevention and Control Law and its Implementation Rules and has issued four Technical Guidelines<sup>1</sup> on cleanup of contaminated sites, this sub-component will focus on development of other necessary technical guidelines for both prevention and control of site contamination. These will include: (i) technical guidelines for pollution risk prevention and control at the producing industries; (ii) technical guidelines for prevention and control of environmental pollution during industrial enterprise relocation; and (iii) Best Available Techniques (BAT) list of remediation for POPs contamination. This sub-component will also include development of administrative measures on professional qualifications of site cleanup companies, information disclosure and public participation at the national level. In Chongqing and Liaoning, this sub-component will include development and issuance of administrative measures for management of contaminated sites and environmental supervision for site remediation, and environmental risk screening levels for contaminated sites. This sub-component will also support studies on possible financing options (including public and private partnership - PPP) and market incentives for contaminated site cleanup.

**13.** Sub-component 1.2: Knowledge Management and Awareness Raising in Support of Prevention and Control of Site Contamination. This sub-component will develop and provide systematic training courses for nation-wide government officials and cleanup practitioners on laws, regulations, technical guidelines/standards, and environmental and social safeguard

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<sup>1</sup> China has issued four technical guidelines on contaminated sites (in Feb. 2014, effective since July 1, 2014) for environmental site investigation, environmental site monitoring, risk assessment, and soil remediation.

requirements for contaminated site cleanup (including occupational and community health and safety), and for polluting industries in Chongqing and Liaoning on establishment of environmental and social management systems (ESMS) to prevent soil and groundwater pollution. Knowledge exchange and experience sharing events or workshops will be organized. It is expected that a national training system for prevention and control of site contamination established under the Project will continue beyond the project life through the issuance of administrative measures for training.

**14.** This sub-component will also conduct public awareness activities for prevention and control of site contamination, and community involvement (public consultation) activities for cleanup demonstrations under Component 2.

**15.** Sub-component 1.3: Management Tools for Prevention and Control of Site Contamination. This sub-component will develop a national database for POPs contaminated sites by carrying out initial site investigation and risk assessment of POPs sites in China: mainly POPs pesticides, e-waste and PFOS contaminated sites, as well as mercury contaminated sites (as relevant) and developing a national database. The national database is expected to be expanded and used by MEP and other ministries after the project life for monitoring and managing contaminated sites in China. A national priority list of these POPs sites will be produced based on environmental and health risks and other factors.

**16.** This sub-component will also support feasibility study for constructing a knowledge and remediation center in Chongqing by collecting information on all potential contaminated sites in Chongqing, assessing currently available in-situ and ex-situ remediation approaches and technologies, and presenting the business potential for such a center. Based on these results, a business plan will be prepared considering possible PPP to make sure that the center will be able to operate efficiently and competitively. It is expected that the center in Chongqing will provide advisory services and contamination treatment services resulting from future cleanup of many of municipalities contaminated sites.

**17.** This sub-component will also, for the purpose of demonstration, support establishing regional soil and groundwater contamination prevention and warning system at the Changshou Industrial Park in Chongqing. This will include identification and investigation of the soil and groundwater contamination risks (including POPs) of the Park and assessment of these risks to determine risk-acceptable, risk-warning, and risk-mitigation areas, which can provide a risk source layout for the Park. Based on the risk source identification and assessment, an integrated environmental management system, including hazardous material tracking and information reporting system, environmental safety planning, early risk warning, emergency management, and impacts and remediation option assessment after pollution incidents will be developed. Experience learned will be shared with other industrial parks in China for potential replication.

**18.** Anxiety is growing in China about contaminated soil in the country's agricultural centers (such as Hunan province) and the potential effects on the food chain. Some farmland soil in suburbs of most cities is polluted with heavy metals and organic pollutants (mainly POPs) as indicated by the national soil survey results. Hunan has requested a loan from the World Bank (to be delivered in FY 2017) to support its efforts on improving agriculture production base safety and quality by cleaning up heavy metal (such as cadmium, lead and arsenic) and organic pesticide contaminated farmland, cutting off polluted water irrigation, reforming cropping system, and applying integrated pest management for reducing chemical use. This sub-component will also support screening cost-effective remediation technologies through small-scale field pilots and reviewing the policy gaps for prevention and control of agricultural land contamination in Hunan.

These outputs will support the technical design of the lending project in Hunan and will be shared with other provinces. This activity will be managed by FECO with technical support from the Hunan Provincial Agriculture Department.

19. Sub-component 1.4: Technical Expert Team and Project Monitoring and Evaluation. This sub-component will support hiring of international and national technical experts with both site cleanup knowledge and remediation engineering experience, to support FECO and the two Project Management Units' (PMU) daily management of the project. This sub-component will also support monitoring and evaluation of the project outcome indicators and results by collecting evidence-based information and data, as well as organizing the project launch and completion workshops.

### **Component 2: Cleanup Demonstrations of Sites Contaminated with POPs (and Other Hazardous Chemicals)**

20. This component will demonstrate the cleanup of several sites (estimated 5-6 in total) contaminated with POPs (and other chemicals). Before a site is ready for remediation action, site investigation, risk assessment to determine remediation goals, remediation program, environmental and social management plan (ESMP), and public consultation and information disclosure will be carried out, prepared, approved and documented. The first demonstration site, which used to be a pesticides warehouse in Chongqing (Ganshui site), has been identified and confirmed during project preparation. According to the construction planning 2003-2020 for Guanshui Town Qijiang County, the site is planned for residential land in future. A site-specific cleanup Environmental Assessment (EA) report has been prepared for this site with detailed contamination scope and proposed remediation plan (see Annex 2). The remediation process will include site clearing, protection of building structure, wall surface peeling, excavation, packaging of contaminated materials, transportation to and storage at the treatment site, treatment/disposal and remediation completion. No aftercare of the site is needed because it will be fully cleaned up with the removal of contaminated materials. Remediation of this site will be initiated as soon as the Project is approved.

21. The other sites will be confirmed during project implementation. A preliminary site selection has been carried out, and identified another seven potential candidate sites from a total of 160 potential POPs contaminated sites (mainly chemical and industrial production sites and some warehouse sites and e-waste sites)<sup>2</sup>. The sites were screened using such criteria as impact on human health and environment, site contamination characteristics, location, size, redevelopment potential etc. The site cleanup EA reports will be prepared for each site selected under this component and approved by the Bank before initiating the bidding process for remediation. The EA report for the Ganshui site will be used as a model EA for the other sites.

### **Component 3: Project Management**

22. This component will support incremental operating costs associated with project management, including day-to-day project implementation, procurement and financial management, and environmental and social safeguards functions carried out by FECO, the Chongqing PMU and the Liaoning PMU, including coordination and collaboration among

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<sup>2</sup> Information on storage, dump or disposal sites possibly contaminated by the 10 new POPs is very limited by now. China has investigated obsolete waste of the first 12 POPs in 47 sites, 22 of which are considered as contaminated sites. Details are provided in the Site Selection Report prepared during project preparation.

national and local government agencies, non-government agencies and the private sector (land owner, polluter or land redeveloper; see Annex 3 for implementation arrangements).

## **2. Summary of Key Safeguard Issues**

**23. Environmental and Social Impacts.** The project itself is an environmental remediation and risk reduction effort which aims at supporting the Chinese government's efforts to improve its capacity for managing contaminated sites, and demonstrate identification and cleanup of sites contaminated with POPs and other hazardous chemicals, and thus has significant positive environmental and social benefits through eliminating POPs pollution sources at demonstration sites and enhancing environmental quality of the project area.

**24.** The environmental and social safeguards issues are mainly related to the site cleanup demonstration activities under the Component 2, including: potential environmental and health risks involved in contaminated site excavation, building demolition, contaminated waste packaging/ transportation/storage; possible land acquisition and resettlement of local residents; social disturbance of site enclosure, excavation and traffic; nuisance of noise and dust; potential environmental impacts of ex-situ contamination remediation at new locations and final disposal of remediated soils. These impacts, though likely to be site-specific, could be significant to the environment and community health if not well-managed. Therefore, the project is classified as Category A as per OP4.01 Environmental Assessment.

**25. Environmental and Social Instruments.** The project plans to conduct site cleanup remediation for 5-6 demonstration sites in total during the implementation stage. To address the potential environmental and social impacts envisaged for the demonstration sites cleanup and remediation, an Environmental and Social Management Plan (ESMF) has been prepared to guide the safeguards preparation and implementation for demonstration sites. The ESMF specifies procedures for environmental and social safeguards documents preparation as per requirement of World Bank safeguards policies, the World Bank Group's EHSR and national laws/regulations. Site-specific Environmental Assessment (EA) reports including social safeguards for the demonstration sites (except for the first site) will be prepared during project implementation stage following the ESMF requirements.

**26.** A first demonstration site has been identified and prepared for implementation once the project is approved. A full EA report has been prepared, which covers site investigation/monitoring, risk assessment, alternative analysis of remediation technologies, remediation plan, environmental and social management plan (ESMP) and public consultation and information disclosure. The site is a used pesticide storage place in Ganshui Town of Qijiang District of Chongqing City. The warehouse was built in 1961, and used to store various pesticides, including HCHs, DDTs, Methamidophos, Dimethoate, and Asomate. The sensitive receptors near the site include residential houses, one school and three office buildings (with distance of 30-360m). There are a couple living on the site as doorkeeper of the empty warehouse. Preliminary and detailed site samplings have been conducted and contamination of Arsenic and HCHs are confirmed, with soil concentrations over (a few times) the screening level of the Beijing Contaminated Site Environmental Risk Screening Levels (DB11/T811 -2011). Risk assessment has been conducted for the site, based on which cleanup target is determined to ensure an acceptable risk of  $10^{-6}$ . The total contaminated soil to be remediated within the boundary of the warehouse covers an area of ca. 260m<sup>2</sup> and maximum depth of 1.5 m (total volume of ca. 150 m<sup>3</sup>). There is no indication of groundwater contamination according to site sampling. It is concluded that the soil contamination is limited within a certain area of the warehouse, with not

very significant contamination. Remediation of such a small site with small amount of contaminated soil is likely to have site- specific but readily manageable impacts.

**27.** During site remediation, the couple needs to be temporarily relocated and will come back to their house upon completion of remediation of the site. Based on the detailed investigation of the Ganshui site area, there is no presence of indigenous people. For the temporary relocation of the one family (janitor family of the warehouse), consultation has been conducted with the affected family and the warehouse owner. Based on consultations, compensation is to be provided to the family for a temporary relocation of four months, with budget included in the environmental and social management plan in the EA. Their house (and the connecting warehouse) will be adequately protected by professional engineering design to ensure safety condition upon their return.

**28.** Alternative remediation technology selection is an important key part of the site cleanup activity, and has been incorporated into the Environmental and Social Management Framework (ESMF) for demonstration sites to be implemented during the project implementation stage. For the first demonstration of site, i.e. Ganshui site in Chongqing, over 20 in-situ and ex-situ remediation technologies have been considered in terms of technical feasibilities, applicability, environment and economic aspects. Based on comprehensive analysis, two remediation options were selected, i.e. anaerobic biodegradation + phytoremediation as the key pilot remediation plan, and cement-kiln incineration as a backup plan.

**29.** Besides the first demonstration site, seven additional candidate sites have been identified through a site screening study conducted during project preparation stage. Initial safeguards screening has been conducted for these sites following the ESMF procedures to confirm the World Bank safeguards policy applications. The detailed site EA including investigation and remediation plan will be conducted during project implementation stage after remediation pilots have been selected from the seven candidate sites.

**30.** The selected candidate pilot sites for cleanup demonstration under the project are likely to be used for land development (e.g. commercial or residential purpose) after pollution remediation. These factors are taken into considerations by the risk assessment of the project, where long-term land use development is considered as exposure scenario analysis. It is also likely that for some demonstration sites to be selected and remediated during project implementation, the site contamination and optimal remediation solutions may guide the land use planning in the long-term to ensure overall maximized environmental, social and economic benefits.

**31.** Activities under project Component 1 are Technical Assistance (TA) and capacity building activities. Environmental and social safeguard issues will be integrated into the TA activities as needed following the Bank's Interim Guidelines on the Application of Safeguard Policies to TA Activities in Bank-Financed Projects and Trust Funds Administered by the Bank. For example, when TORs and reports for sub-components 1.3 are prepared, safeguard issues will be considered and discussed with the Bank prior to any final reporting, technology piloting, system building, and/or purchase of equipment (monitoring equipment, etc.).

**32. Capacity for Preparation and Implementation of Safeguard Instruments.** The project national implementing agency will be the Foreign Economic Cooperation Office (FECO) of the Ministry of Environmental Protection (MEP). FECO has been designated as the national lead implementing agency for all POPs activities for implementation of the POPs Convention since 2002. It has prepared and implemented 12 POPs projects financed by the GEF, five of them are

supervised by the World Bank and three of the five have been completed. FECO has accumulated experiences and capacity of managing POPs projects according to the Bank's safeguard and fiduciary requirements.

**33.** The selected two demonstration areas: Chongqing municipality and Liaoning province, are pioneers in China who have taken early actions on contaminated site remediation (e.g. issuance of local contaminated site regulations and implementation of site remediation etc.), and remains highly committed to implement the project following Bank's safeguards policies. Both have previous experiences of managing remediation of large contaminated sites. The project may also involve provincial governments in other provinces for site cleanup demonstrations, and site cleanups in other provinces will be managed by FECO.

**34.** However, the capacity of FECO and the two demonstration areas for assessing and managing the potential environmental and social risks and impacts associated with the project is weak. In China, the most commonly used but relatively expensive remediation practice is excavation followed by ex-situ treatment, such as depositing contaminated soil in an off-site landfill, and/or neutralizing with kiln treatment. In-situ remediation technologies which are often less costly whilst taking more time to implement, are still in the early stage of research and piloting. Furthermore, the concept of risk assessment and risk management for contaminated sites has not been accepted widely and used normatively yet. Therefore, capacity building activities have been thoroughly designed in Component 1 of the project to provide training to these local governments and site remediation practitioners during the project implementation stage.

**35. Public Consultation and Information Disclosure.** The key stakeholders of the contaminated site cleanup will include site owners, project affected people, local community and government organizations and concerned NGOs, as well as project management agencies (two PMUs/FECO). Public consultation and information disclosure is an important part of the site cleanup process. Requirements of consultation with project affected people are incorporated into the ESMF based on the World Bank safeguards policy requirements. For each site cleanup project, at least two rounds of public consultation will be conducted with participation of project affected people: (i) first round at TORs stage or at the preliminary site investigation stage during which local public shall be informed of the general information of the project (site cleanups) and consulted on their concerns; (ii) second round when the site-specific draft EA is available in which the key findings of environmental assessment and mitigation measures are provided to public for comments and feedback. The draft and final site EA documents will be locally disclosed in the project areas.

**36.** For the Ganshui site, public consultations were conducted during the EA preparation in November 2012 and March and July 2014. Over 80 people in the nearby communities were consulted during the process, including the affected couple on the site. All consulted people expressed broad support to timely implementation of the site remediation. Main concerns from the public are traffic disturbance and noise/dust impacts, for which due attention has been given in the ESMP. The full draft Ganshui EA report has been disclosed in the website of Chongqing Environmental Protection Bureau on July 11, 2014 with announcement published in the Chongqing Evening Newspaper dated July 12, 2014.

**37.** The following Session 4 summarizes the key findings of site screening. Session 5 and 6 summarize the ESMF and the key findings of the Chongqing Ganshui Site Cleanup EA Report.

### **3. Legal, Policy and Management Framework**

#### **3.1 Policies of the World Bank Group**

- OP/BP4.01: Environmental Assessment;
- OP/BP4.12: Involuntary Resettlement;
- OP/BP 4.11: Physical Cultural Resources;
- OP/BP4.10: Indigenous People;
- World Bank Group Health, Safety and Environment General Guidelines;
- World Bank Group Environment, Health and Safety Guideline for Waste Management Facilities;
- Bank's Interim Guidelines on the Application of Safeguard Policies to Technical Assistance (TA) Activities in Bank-Financed Projects and Trust Funds Administered by the Bank.

#### **3.2 Key National Laws and Regulations**

**38.** Environmental Protection Law of the People's Republic of China (2014): Article 32 “China will intensify protection for the air, water, soil and so on, establish and improve the system for investigation, monitoring, evaluation and restoration”. Article 42 “the enterprises and other manufacturers discharging pollutants shall take proper actions to prevent and control pollution and hazards to the environment caused by the waste gas, waste water, waste residues, medical waste, dust, foul gas, radioactive substances as well as noise, vibration, optical radiation, electromagnetic radiation and so on generated during production, construction and other activities. The enterprises discharging pollutants shall establish an environmental protection responsibility system, and define the responsibilities of the person in charge of the enterprise and the personnel related”.

**39.** Environmental Impact Assessment Law of the People's Republic of China (2002): Article 16 “China adopts classified management for environmental impact assessment of construction projects based on their extents of impact on the environment. Article 25 “Where the environmental impact assessment documents of a construction project has not been examined by the competent authority defined in applicable laws or fails to pass the examination, the authority in charge of examination and approval of the project shall not approve and make it eligible for construction, and the construction unit may not commence”.

**40.** National Hazardous Waste Inventory (2008): wastewater treatment sludge generated during pesticide production (263-011-04), and expired raw materials and abandoned drugs during production and preparation of pesticides (263-012-04) are listed as hazardous waste in this inventory.

**41.** Land Administration Law of the PRC (2004): Article 27 “The State shall establish land survey system. People's governments at or above the county level in company with relevant departments at the same level shall carry out land investigation. Land owners or users should cooperate with the investigation and provide relevant information”. Article 47 “For land acquisition, compensation should be given according to the land original use”. Article 48 “After the land compensation and resettlement plan is finalized, the local government shall hear the opinions of rural collective economic organizations and farmers through announcement”.

42. Real Right Law of the PRC (2007): Article 84 “The neighboring right holder of real estate shall correctly handle the neighboring relationship according to the principles of help production, easy life, solidarity, fair and reasonable”. Article 89 “Buildings construction shall not violate the relevant national construction standards and prevent adjacent buildings ventilation, lighting and sunlight”. Article 90 “The right holder of real estate shall not violate the state regulations to dispose solid waste, emit air pollutants, water pollutants, noise, light, electromagnetic radiation and other harmful substances”.

### 3.3 Relevant National Department Regulations and Rules

- China National Implementation Plan for the Implementation of the Stockholm Convention on Persistent Organic Pollutants (2007) requires to eliminate POPs pesticide and remediate POPs contaminated sites.
- Circular on Environmental Pollution Control during Relocation of Enterprises (GHB (2004) No. 47): “for the already developed and being developed industrial area for relocation, formulate plans for soil environment investigation, exploration and monitoring, investigate the pollution sources within construction region, determine the work plans of site cleanup and the implementation plan for function recovery of soil, and eliminate environmental pollution of soil as soon as possible”;
- Circular on Guaranteeing Environmental Safety for Redevelopment and Utilization of Sites of Industrial Enterprises (HF [2012] No. 40) further requires to: “investigate the contaminated sites, reasonably plan the use of contaminated sites, strictly control land transaction of contaminated sites, strictly manage environmental risk assessment and remediation, control land transaction of contaminated sites, and effectively avoid site pollution”.
- Circular for Intensifying Treatment and Remediation of Contaminated Sites at the Original Locations of Industrial Enterprises in Chongqing Municipality (YBF (2008) No. 208) defines to solve the problem of pollution at the original locations of industrial enterprises in Chongqing Municipality, reduce the risks of re-utilization of land at the original location, especially as residential land, against the human health, and require the responsible parties to complete treatment and remediation for the pollution sites.
- Notice on Issuing the Guidelines on Improving Compensation and Resettlement Systems for Land Acquisition (MLR [2004] No.238)
- Regulations of the Ministry of Land and Resources on Public Hearing on Land and Resources
- Decision of the State Council on Deepening the Reform and Rigidly Enforcing Land Administration (SC [2004] No.28)
- Notice of the State Council on Issues Concerning the Strengthening of Land Control and Adjustment (SC [2006] No.31)
- Notice of the General Office of the State Council on Forwarding the Guidelines of the Ministry of Labor and Social Security on Doing a Good Job in the Employment Training and Social Security of Land-expropriated Farmers (SC [2006] No.29)
- Notice on Adjusting Fees for Using Additional Construction Land (CZ [2006] No.48)
- Notice of the Ministry of Labor and Social Security, and Ministry of Land and Resources on Doing a Good Job in Social Security for Land-expropriated Farmers Practically (MLSS [2007] No.14)
- Notice of the Ministry of Land and Resources on Doing a Better Job in LA Management (MLR [2010] No.238)

### 3.4 Relevant Department Regulations and Rules in Chongqing

- Circular for Intensifying Treatment and Remediation of Contaminated Sites at the Original Locations of Industrial Enterprises in Chongqing City (YBF (2008) No. 208) defines to solve the problem of pollution at the original locations of industrial enterprises in Chongqing City, reduce the risks of re-utilization of land at the original location, especially as residential land, against the human health, and require the responsible parties to complete treatment and remediation for the contamination sites. The Construction Plan of Ganshui Town of Qijiang County defines the future use of land of Ganshui Warehouse.
- Land Administration Regulations of Chongqing Municipality (Decree No.53 of the Chongqing Municipal Government) (1999)
- Land Acquisition Compensation and Resettlement Measures of Chongqing Municipality (Decree No.55 of the Chongqing Municipal Government) (1999)
- Interim Measures of Chongqing Municipality for Basic Endowment Insurance for Farmers Converted into Urban States in Land Acquisition after January 1, 2008
- Notice of the Chongqing Municipal Government on Adjusting Land Acquisition Compensation and Resettlement Policies (CMG [2008] No.45)
- Notice of the General Office of the Chongqing Municipal Government on Strengthening Land Acquisition and House Demolition Management Practically (CMGO [2013] No.27)
- Notice of the Chongqing Municipal Government on Further Adjusting Land Acquisition Compensation Rates (CMG [2013] No.58)

### 3.5 Relevant National and Local Technical Guidelines and Standards

- Technical Guidelines for Investigation of Site Environment (HJ 25.1-2014);
- Technical Specification for Monitoring of Site Environment (HJ 25.2-2014);
- Technical Guidelines for Risk Assessment of Contaminated Site (HJ 25.3-2014)
- Technical Guidelines for Soil Restoration of Contaminated Site (HJ 25.4-2014)
- Guidelines for Evaluation of Site Environment (DB11/T 656-2009);
- Screening Levels for Soil Environmental Risk Assessment of Sites in Beijing (DB11/T811-2011): With respect to environmental risk evaluation of contaminated sites, it defines the screening values of  $\alpha$ -HCH in soil of residential, afforestation, industrial/commercial purposes are 0.2 mg/kg, 0.2 mg/kg and 0.3 mg/kg respectively, those of  $\delta$ -HCH in soil of residential, afforestation, industrial/commercial purposes are 0.2mg/kg, 0.2 mg/kg and 0.7 mg/kg respectively, those of  $\beta$ -HCH in soil of residential, afforestation, industrial/commercial purposes are 2 mg/kg, 2 mg/kg and 3 mg/kg respectively, those of  $\delta$ -HCH in soil of residential, afforestation, industrial/commercial purposes are 0.3 mg/kg, 0.4 mg/kg and 3 mg/kg respectively.
- Technical Specification for Restoration Acceptance of Contaminated Site in Beijing (DB11/T 783-2011).
- Technical Guidelines for Environmental Risk Assessment of Site Contamination in Chongqing (Chongqing EBP 2010).
- Technical Guidelines for Supervision and Acceptance of Remediation of Contaminated Soils from Industrial Move-out (Chongqing EBP 2013).

#### 4. Summary of Selection of Candidate Sites for Cleanup Demonstrations

43. A site selection exercise was carried out during project preparation. The purpose of the selection is to identify a list of candidate sites suitable for the project component 2, not to prioritize the sites for remediation. The potential eight demonstration site selection was based on such criteria as local governments' willingness and commitment to participate in the demonstration project, clear land redevelopment plan and notable land value after cleanup, clear information on site ownership and environmental liabilities, size and complexity, as well as environmental and health risks, taking into account the demonstration nature of this project, project funding level, and that contaminated site remediation in China is now mainly driven by urgency of land redevelopment and new remediation technologies are more appropriate to test in smaller and less complex sites.

##### 4.1 Screening of POPs contaminated sites

44. **Screening.** 160 potential POPs sites (mainly chemical or industrial production sites) were collected through multiple sources including the National Implementation Plan of POPs Convention, the China Association of Fluorine and Silicone Material Industry, the China Pesticide Information Network, and so on. Among them, 56 sites were selected by excluding those that have no any site contamination information or have been remediated. After that, the list is further reduced to 15 sites by removing the sites whose are "Owner Unclear", "Liability for Pollution Unclear" and "Free of Pollution Upon Investigation" (see [Table 1](#)).

**Table 1. Basic information of 15 potential POPs contaminated sites**

No.	Optional site	Main production process/product
SITE 1	E-waste Incineration Site in Guiyu, Guangdong	E-waste incineration and acid pickling
SITE 2	Yangmeiya E-waste Incineration Contaminated Site in Longtang Town, Qingyuan, Guangdong	E-waste incineration and acid pickling
SITE 3	Xingtai Pesticide Co., Ltd.	DDT powder, highly effective cypermethrin fumigant, dichlorvos fumigant, etc.
SITE 4	Zhangjiakou Changcheng Agrochemical (Group) Co., Ltd.	PVC repro, herbicide, technical-grade pesticide, mixed herbicide, insecticide
SITE 5	Hunan Pesticide Factory	Arsenical, organochlorine pesticide, organophosphorus pesticide, chemical raw materials and pesticide intermediates
SITE 6	Pesticide Warehouse of Zhuzhou Welfare Plant in Hunan	Mixture of arsenic dusts and HCH
SITE 7	Northeast Pharmaceutical Group Co., Ltd.	DDT, HCH, HCB, API (active pharmaceutical ingredient), formulation and chemical intermediates
SITE 8	Shenyang Chemical Industry Co., Ltd.	Technical-grade HCH, pentachlorophenol, trichlorobenzene, chlor-alkali chemicals, petrochemicals
SITE 9	Shandong Dacheng Pesticide Co., Ltd.	DDT, dicofol, caustic soda, etc.
SITE 10	Shanxi Taiyuan Chemical Co., Ltd, the Chlor-Alkali Branch	DDT, caustic soda, PVC, etc.
SITE 11	Tianjin Dagu Chemical Co., Ltd.	HCB, PCP-Na, PVC and caustic soda, etc.

SITE 12	Tianjin Chemical Plant, Tianjin Bohai Chemical Co., Ltd.	DDT, hydrochloric acid, caustic soda, sodium bisulfide, etc.
SITE 13	Jingkou Warehouse of Chongqing Municipal Agricultural Means of Production (Group) Co., Ltd.	DDT, HCH, DDVP, dipterex, rogor, methamidophos, MLT, acephate, dimehypo (monosultap), chlordimeform, isocarbophos, etc.
SITE 14	Qijiang District Pesticide Persistent Organic Pollutant Storage Site in Chongqing	DDT, HCH, DDVP, methamidophos, rogor and folimat
SITE 15	E-wastes Dismantling Site of Tianjin Ziya Circular Economy Industrial Park	Waste from E-wastes Dismantling

**45. Selection of candidate sites.** Information were collected for the 15 sites through questionnaires and site visits on site representativeness, environmental and health risks, landing planning after cleanup (potential environmental, social and economic benefits after cleanup), and possible fatal flaws of sites (legacy issues such as site ownership, legal status, disputes with present industries and unclear division of liabilities for clean-up costs and rights to cleaned land after the remediation or possible claims to land use by present industries or residents). Based on this information, eight screening criteria (see the table below) were established for the 15 candidate sites down to the 12 sites. The Site 1, Site 2 and Site 9 do not meet Criterion 8, while the Site 3 does not meet Criterion 5. However, it is recommended preserving Site 1 because that it is a typical E-waste incineration site in China.

Screening Principles	Selection Criteria
Principle of priority	Criterion 1: in demonstration area
Principle of representativeness	Criterion 2: Main type of POPs contaminated sites: pesticide production sites, industry of fine chemicals, waste incineration, and dismantling and incineration of e-waste, topographical condition, geographical zone,
	Criterion 3: Main POPs contaminants: pesticides and dioxins
	Criterion 4: Appropriate size of contaminated sites
Principle of risk	Criterion 5: Medium or high risk on human health
	Criterion 6: Medium or high risk on environment
Principle of benefit	Criterion 7: Notable environmental and economic benefits after cleanup
	Criterion 8: Clear land redevelopment plan after cleanup

**46.** Beside the four sites located in demonstration areas (site 7, 8 in Liaoning, and site 13, 14 in Chongqing), Analytic Hierarchy Process (AHP), a multiple-index and multiple-program comprehensive analytic method, was used to further evaluate the other eight sites among the 12 sites. AHP combines qualitative and quantitative analysis, and expresses and treats the subjective judgment of people in form of numbers. The top 4 POPs sites were selected as candidate sites according to the overall ranking of the eight sites. In summary, a list of total eight candidate sites (two in Chongqing, two in Shenyang, two in Tianjin, one in Hunan and one in Guangdong) is established for possible participating in the Project Component 2. An Environmental and social impacts screening report based on the World Bank Policy of OP 4.01 was prepared for each of the eight candidate sites as shown in the 4.2 section.

## 4.2 Safeguard screening for the candidate sites

**Table 2. Safeguard screening for the candidate sites**

No	Candidate site	Sensitive targets surrounding the sites	Safeguard screening
1	Guangdong Guiyu E-waste Incineration Site	The site is located at the south bank of Beigang River (>300m to the river), Guiyu Town, 2km away from No.439 Village Road in the west and facing Junliao Village; Beilin Village is 600m away from the southwest of the site; the northwest of the site is an old factory; and there is the farmland (<500m) around the west and east of the site.	This site belongs to Class A site (OP 4.01) since it contains typical POPs pollutants, the site cleanup may have negative effect on the surrounding environment and people, and the influencing scope of the site has been wider than the actual area of places or constructions and facilities.
2	Hunan Pesticide Factory	The company is located in Shaoshan Demonstration Area, Xiangtan City, Hunan Province, is about 18km away from the urban areas of Changsha, Xiangtan and Zhuzhou, is in the center of Changsha, Xiangtan and Zhuzhou and has long been called as “golden triangle” of Hunan	This site belongs to Class A site (OP 4.01) since it is close to the environment-sensitive area, contains typical pollutants and site cleanup negatively impacts the surrounding environment and people. The site pollution may have great potential impacts on the Xiangjiang River, although still unknown.
3	Northeast Pharmaceutical Factory in Liaoning	The factory is located in the center of Tiexi District, Shenyang City. The distance to several residence communities and a middle school is less than 500m.	This site belongs to Class A site (OP 4.01) since it contains typical pollutants and negatively impacts the surrounding environment and people. The local government has put this site on the schedule of relocation, and this site is currently under the site environmental investigation.
4	Shenyang Chemical Plant in Liaoning	The Plant is also located in Tiexi District, Shenyang city. The distance to several residence communities less than 500m.	This site belongs to Class A site (OP 4.01) since it contains priority pollutants and easily negatively impacts the surrounding environment and people. The local government has put this site on the schedule of relocation, and this site is currently under the site environmental investigation.
5	Dagu Chemical Plant in Tianjin	The company site is located in Tanggu District, Tianjin city. Tanggu district is the center of Tianjin Binhai New District. The site is about >300m to Bohai sea and <500 m to residential and recreation area.	This site belongs to Class A site (OP 4.01) since it contains typical pollutants.
6	Jingkou Pesticide Storehouse of Agricultural Means of Production Company in Chongqing	Jingkou Warehouse is situated at west bank of Jialingjiang River, adjacent to Chongqing No.64 Middle School (formerly Jingkou Middle School) in the north, G212 national highway in the west, about 300m from Jialing River in the east and 200 m away from Jingkou Primary School and neighboring the former Chongqing Agricultural Pesticide Chemical (Group) Co., Ltd. (Chongqing Agricultural Pesticide Factory) in the south. It is about 2400 m to the point for drinking water getting from Jialing river.	This site belongs to Class A site (OP 4.01) since it contains typical pollutants and is close to the river and site cleanup may negatively impact the surrounding environment and people.

7	Qijiang District Pesticide Storage Site in Chongqing (the first site for cleanup demonstration prepared during the project preparation stage)	The site is located as Ganshui Town in Qijiang District, which is in the south of Chongqing City. There are residential areas, schools, administration office area and other sensitive targets within the region 200m around the site. The distance to Ganshui river is about 20m.	This site belongs to Class A site (OP 4.01) since it contains typical pollutants and is close to the river and site cleanup negatively impacts the surrounding environment and people. The site was contaminated with hexachlorocyclohexane (HCH) and also arsenic within the warehouses. The site is close to a family which will be relocated according to a temporary resettlement compensation plan, but there is no involuntary immigration of any individual or family.
8	E-waste Dismantling Site of Tianjin Ziya Circular Economy Industrial Park	The Site is located in (Intersection of No. 19 Road and Zhejiang Road), Tianjin Ziya Circular Economy Industrial Park, Ziya Town, Jinghai County, Tianjin, covering an area of about 60 mu. It is 19 km from the urban areas of Tianjin, 65 km from the core area of Tianjin Binhai New Area, 120 km from Beijing, 240 km from Shijiazhuang, 43 km from Tianjin Airport and 75 km from Tianjin Port. The distance to Ziya river is >300m.	This site belongs to Class A site (OP 4.01) due to “containing typical pollutants”. The impact of pollutions in such site on surroundings is still unknown.

47. Based on the available information collected during project preparation, it is expected that cleanup of either one of the selected eight candidate sites will not: cause significant change or degradation of any natural habitat; or require the construction of a new flood control dam; or rely on any existing flood control dam or any dam under construction; or need land acquisition; or prohibit anyone from using any economic resource which they use daily; or force any individual or family to resettle permanently; or have significant effect on minority since the site is not located in the minority living area. However, the cleanup is expected to have social impacts on local community and residents using or living near the contaminated sites. And during site remediation, contaminated soils will be excavated for either in-situ or ex-situ treatment. Physical Cultural Resources might be found during excavation. Therefore, the Bank’s safeguard policies: OP/BP 4.01 Environmental Assessment, 4.11 Physical Cultural Resources, 4.10 Indigenous People and 4.12 Involuntary Resettlement, are considered triggered. Site-specific EA will identify, assess, and mitigate these issues by the site investigation, risk assessment, remediation plans, and ESMPs.

## 5. Summary of Environmental and Social Management Framework (ESMF)

### 5.1 Environmental and Social Safeguard Procedures

48. For the contaminated sites to be confirmed during project implementation, the following steps of environmental and social impact screening, mitigation and management measures development and implementation will be followed:

- Step 1 - Identification of contaminated sites for cleanup demonstrations according to the selection criteria;
- Step 2 - Screening for potential environmental and social impacts;
- Step 3 - Development of site-specific TORs for Environmental Assessment (EA) and Social Assessment (SA), Resettlement Action Plan (RAP) and/or Ethnic Minority Development Plan (EMDP); when it is applicable, EA and SA should be integrated as ESA;

- Step 4 - Review of the safeguards screening in view of all World Bank safeguard policies and EA, RAP or SA/EMDP TORs by World Bank;
- Step 5 - Preparation of environmental and social safeguards documents;
- Step 6 - Review and clearance of the safeguard documents by government and the Bank;
- Step 7 - Implementation, supervision, environmental monitoring and reporting.

## 5.2 Site-specific Environmental and Social Assessment Procedures

49. The objectives of the site-specific environmental and social assessment are to:
- a) Identify the scope of site contamination through information collection, site investigation and sampling/testing;
  - b) Assess risks of the contaminated site and propose remedial target and remedial area based on the future land use;
  - c) Conduct alternative analysis for site remediation technologies and develop site remediation plan;
  - d) Develop environmental and social management plan.
50. The ESA will include:
- a) Site investigation. During site investigation, pollutants and pollution area of the site are confirmed; potential risk receptors and exposure pathways are investigated and the public (site-cleanup-affected people) consulted, soil types and other site characters are understood. Site investigation in general follows multi-phase approach which is an international best practice and also adopted recently in China for many contaminated site management. Phases can be divided in different way, but in general follow the same logic order:
    - (i) phase I preliminary assessment. During phase I site investigation, environmental pollution of the site is analyzed preliminarily and preliminary conceptual site model is established through data collection and analysis, field reconnaissance, public consultation and information disclosure, etc. If necessary, emergency treatment should be carried out firstly. Potential risk receptors will be investigated as well at this Phase.
    - (ii) phase II field sampling. Phase II site investigation is to screen whether there are risks on the site or not through preliminary sampling, including sampling, lab analysis and preliminary risk screening. If a risk is confirmed, detailed sampling shall be conducted.
    - (iii) phase III site investigation and additional sampling is needed. Phase III site investigation is to investigate site character parameters, receptor expose parameters, and hydrogeological conditions through data query, field measurement and lab analysis, etc. Additional sampling might be needed to further confirm the remediation scope.
  - b) Risk Assessment. During risk assessment, risks caused by site contaminants (POPs chemicals and other toxic chemicals if any such as heavy metals) to the environment and human health are analyzed quantitatively, then site remediation target is formulated and scope of remediation is determined.
  - c) Site Remediation Technology Program. The contaminated site remediation technology program should be prepared based on the site investigation and risk assessment. Firstly, refine the conceptual site model, determine the overall remediation goals and develop appropriate remediation strategy; secondly, determine the feasible site remediation technology through remediation technology screening and technical feasibility evaluation

- finally, establish the potentially feasible remediation technical program through the rational combination of all feasible technologies; then compare the solutions by taking economic, technical, environmental and social indexes into account so as to determine the best remediation technology program.
- d) Site Selection for Testing of Remediation Technologies. The Project will include testing of few remediation technologies that have been successfully applied abroad but not yet in China. There are principles that need to be followed for selection of the locations/sites for testing remediation technologies. Environmental impact assessment needs to be performed for the site, with the contaminated soil remediation testing work allowable only after passing the environmental acceptance.
  - e) Environmental and Social Management Plan. The ESMP is an instrument that will detail (a) the feasible and cost-effective measures to be taken during the implementation and operation of a project to eliminate or offset adverse environmental and social impacts, or to reduce them to acceptable levels; (b) the actions needed to implement these measures. The ESMP is an integral part of the ESA. The ESMP for the contaminated site cleanup sub-project will include the environmental and social impacts of the site cleanup activity, mitigation measures, environmental supervision plan, resettlement action plan if applicable, remediation validation plan, institutional arrangement and responsibilities, capacity building activities, and implementation schedule and cost estimate.
  - f) Public consultation and information disclosure. The safeguard documents, i.e. Environmental Assessment, Resettlement Action Plan and Social Assessment/Ethnic Minority Development Plan where applicable, are subject to public consultation and disclosure in an accessible place, in a timely manner, in a form and language understandable to the project-affected people. Particular attention will be given to ensure projected affected persons gets adequate time and ready access to draft documents before consultation takes place. The ESMF has also included a Resettlement Policy Framework and an Ethnic Minority Development Framework to guide preparation of the RAP and EMDP.

## **6. Summary of Environmental Assessment of the First Demonstration Site - Chongqing Ganshui site**

### **6.1 Site Description**

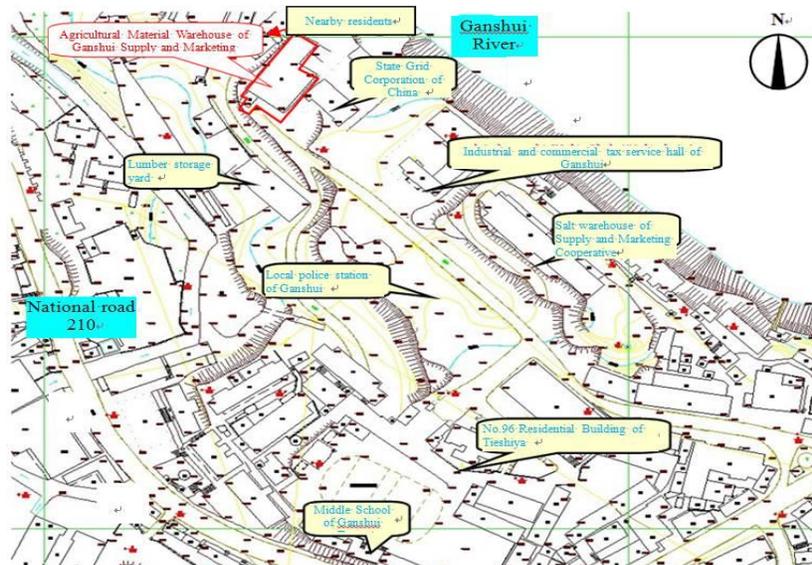
**51.** The agricultural materials warehouse owned by the Ganshui Supply and Marketing Cooperatives is located in northwest Ganshui County, Qijiang District of Chongqing, which was used to store pesticides, fertilizer, seeds, farming tools and so on from the early 1960s to late 1990s. In early 2002, the Cooperatives cleared up the agricultural materials in the warehouse, but the odor of pesticides can still be smelled up to now. Till July 2014, the warehouse structures are generally in good condition, but some roofs and storeroom walls have been severely damaged due to longtime absence of maintenance, and have been listed as dangerous houses by the owner (see [Figure 1](#)).



**Figure 1. The Ganshui site**

(1) The warehouse's front side; (2) The warehouse's back side; (3) The warehouse's left side; (4) The warehouse's right side; (5) The file storeroom; (6) The pesticides storeroom.

52. Agricultural Material Warehouse of Ganshui Supply and Marketing Cooperative is located in Ganshui Town of Qijiang County. There are river, residential areas, schools, administration offices and other sensitive targets within about 200 m around the site, as shown in **Figure 2**.



**Figure 2. Sensitive targets around the Ganshui site**

## 6.2 Site contamination

53. After three phases of investigation, Chongqing University of Technology and Chongqing Solid Waste Management Center totally took 61 soil samples at 24 soil sampling points, 2 ground water samples and 11 building surface samples. The sampling points are shown in **Figure 3**.

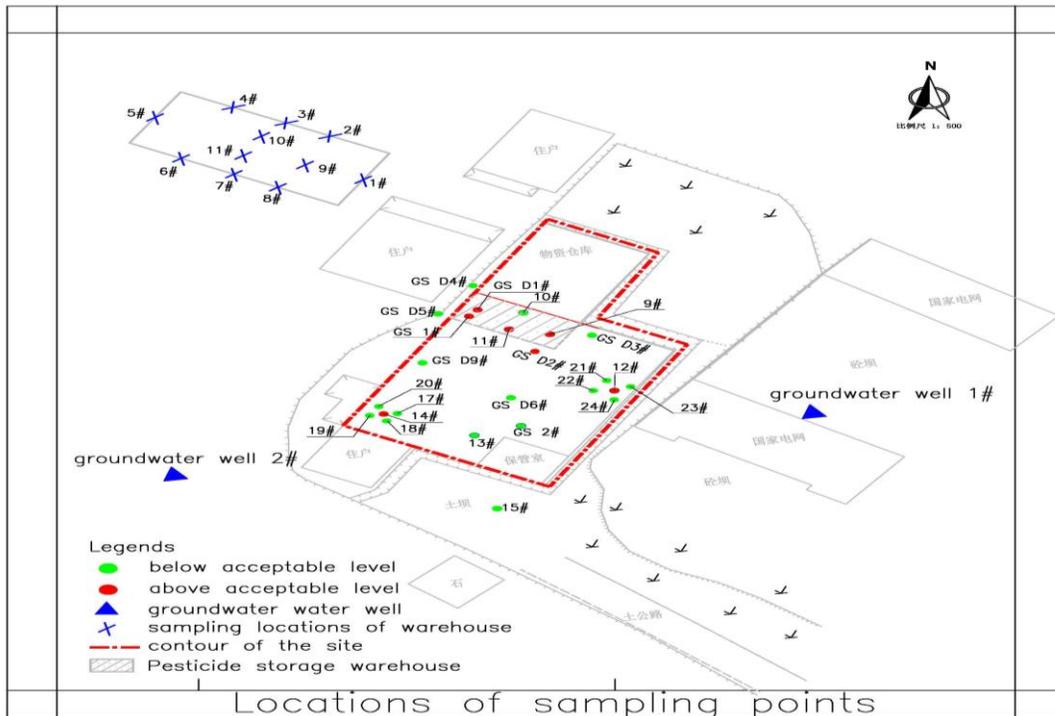
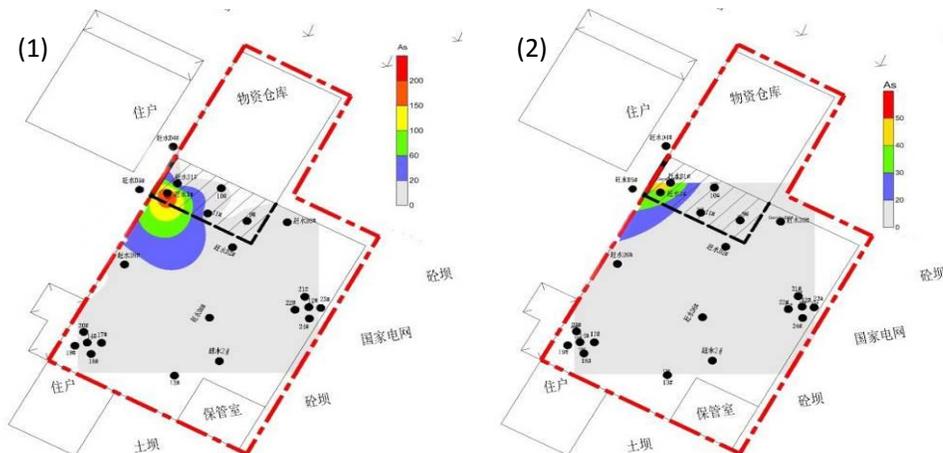
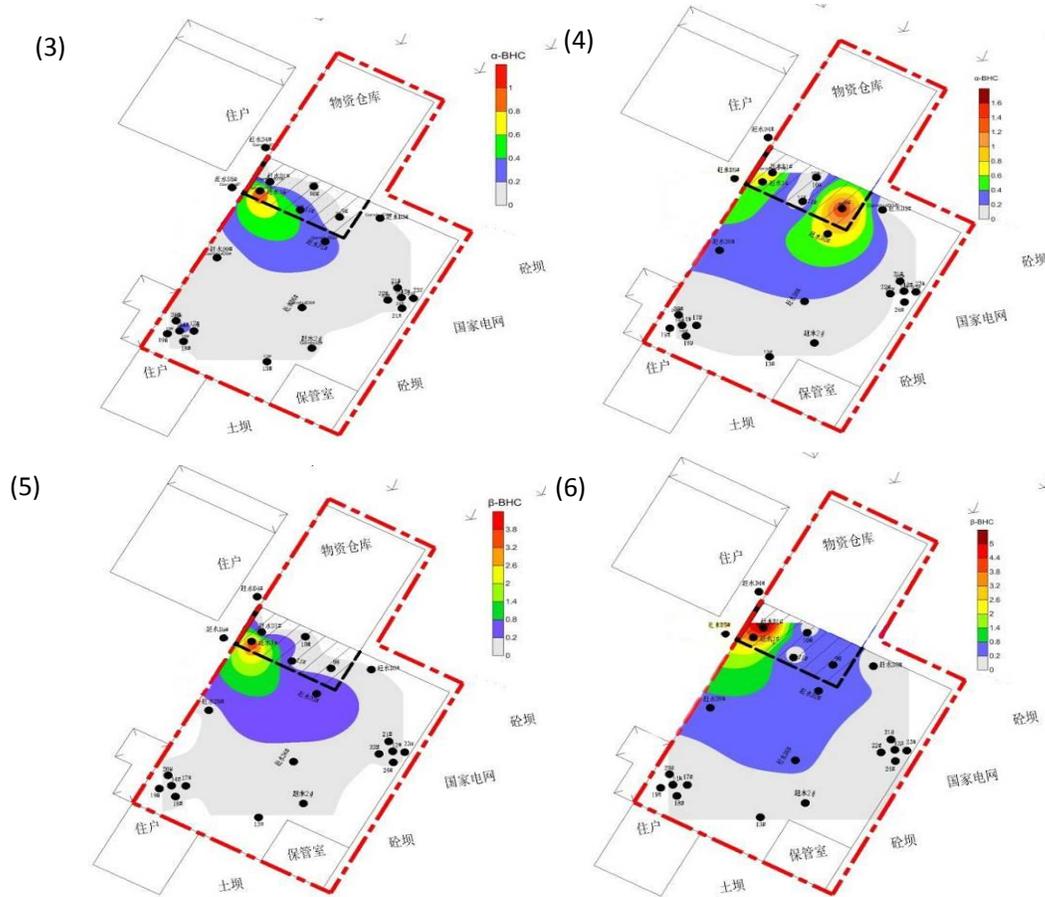


Figure 3. Sampling points at the Ganshui site

54. The target pollutants of the Ganshui site are arsenic,  $\alpha$ -HCH,  $\beta$ -HCH and  $\gamma$ -HCH, and only 7 soil sampling points were exceeding the acceptable level, and the highest concentration of arsenic,  $\beta$ -HCH and  $\gamma$ -HCH was 238 mg/kg, 1.53 mg/kg, 5.35 mg/kg and 0.55 mg/kg, respectively. While all target pollutants detected in the background soil are below the standard limit, suggesting that the Ganshui site was contaminated mainly by the storage of pesticides; No pesticide was detected in the underground water samples and arsenic is well below the PRC groundwater standard; The building surface of pesticide warehouse are also contaminated with  $\beta$ -HCH in the range of nd~2.33 mg/kg.



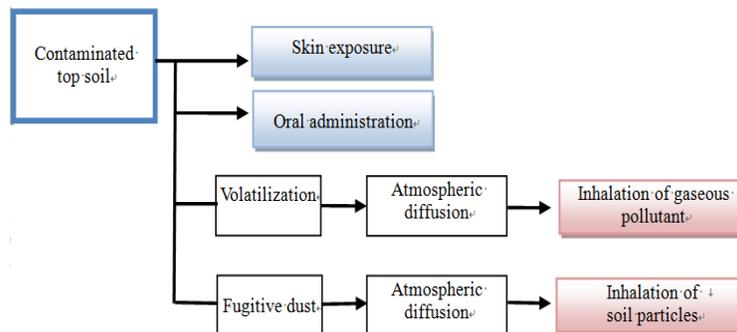


**Figure 4. Spatial distribution of pollutants**

(1) arsenic distribution of 0-0.8 m profile; (2) arsenic distribution of 0.8-1.6 m profile ; (3)  $\alpha$ -HCH distribution of 0-0.8 m profile; (4)  $\alpha$ -HCH distribution of 0.8-1.6 m profile; (5)  $\beta$ -HCH distribution of 0-0.8 m profile; (6)  $\beta$ -HCH distribution of 0.8-1.6 profile; The blue, the green, the yellow and the red area exceeding the acceptable risk levels need to be remediated.

55. As shown in **Figure 4**, the contaminated area of Ganshui site polluted extent of arsenic,  $\alpha$ -HCH and  $\beta$ -HCH is within warehouse building only, and the pesticide storage was most severely contaminated. Arsenic pollution is mainly concentrated in the 0-0.8 m layer soil,  $\alpha$ -HCH and  $\beta$ -HCH pollution is mainly concentrated in the 0.8-1.6 m layer soil.

### 6.3 Environmental and health risk assessment



### Figure 5. Conceptual exposure model of the Ganshui site

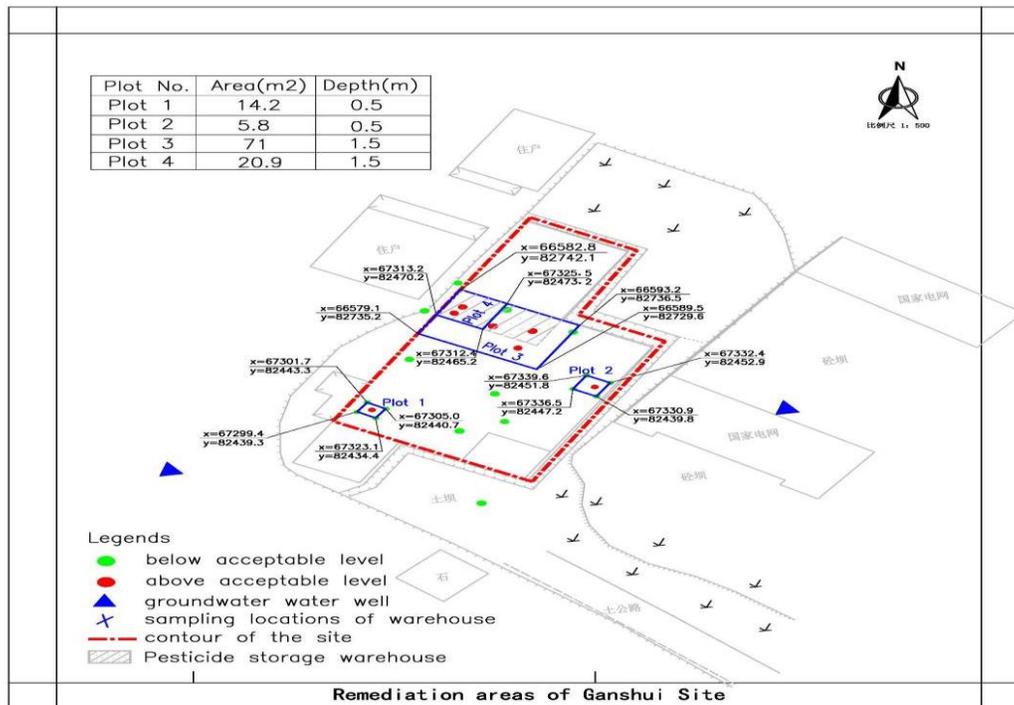
56. Based on the results of site environmental investigation, a conceptual exposure model of Ganshui Site was constructed (Figure 5) and revealed the mainly exposure ways such as oral administration, skin exposure and inhalation exposure.

57. The RBCA (Risk-Based Corrective Action)<sup>3</sup> model was used to evaluate the risk posed by site contamination, which use the 95% confidence upper limit of soil samples detection results as exposure concentrations. The results of risk assessment showed that the carcinogenic risk of arsenic,  $\alpha$ -HCH and  $\beta$ -HCH was  $2.07 \times 10^{-4}$ ,  $1.05 \times 10^{-5}$  and  $9.37 \times 10^{-6}$  respectively, which was higher than the acceptable carcinogenic risk level of  $10^{-6}$ , the hazard quotient of arsenic was also higher than acceptable non-carcinogenic risk level of 1. Therefore, remediation must be performed for the arsenic,  $\alpha$ -HCH and  $\beta$ -HCH contaminated Ganshui site.

58. Based on risk assessment results, and comparing the environmental risk screening levels in different countries, the recommended remediation goals of arsenic,  $\alpha$ -HCH and  $\beta$ -HCH at Ganshui site are 20 mg/kg, 0.2 mg/kg and 0.22 mg/kg respectively following the Screening Levels for Soil Environmental Risk Assessment of Sites in Beijing (DB11/T811-2011) which is the only soil pollution screening standard in China. These goals are all lower than the Netherlands soil intervention values (76, 17 and 1.6 mg/kg), while comparing with US EPA generic soil screening level, the recommended remediation goal of  $\beta$ -HCH is also lower (0.3mg/kg), but arsenic and  $\alpha$ -HCH are higher (0.67 and 0.085 mg/kg).

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<sup>3</sup> RBCA model is an action rule published by American Society for Testing and Materials (ASTM), which focuses on the remediation of contaminated soil and groundwater. In 2009, according to the action rule, American GSI environmental company developed RBCA model to be used in site risk assessment.



**Figure 6. Remediation scope of the Ganshui site**

59. According to the spatial distribution of arsenic,  $\alpha$ -HCH and  $\beta$ -HCH, the 4 plots to be remediated were determined as shown in Figure 6, and the total volume of contaminated soil and wastes is about 150.7 m<sup>3</sup> as follows in Table 3.

**Table 3. Volume of Contaminated Soil and Wastes**

Area/medium	Contaminants	Area (m <sup>2</sup> )	Depth (m)	Amount to be remediated (m <sup>3</sup> )
Plot 1/soil	$\alpha$ -HCH and $\beta$ -HCH	4.2	0.5	2.1
Plot 2/soil	$\alpha$ -HCH and $\beta$ -HCH	5.8	0.5	2.9
Plot 3/soil	$\alpha$ -HCH and $\beta$ -HCH	71.0	1.5	106.6
Plot 4/soil	$\alpha$ -HCH and $\beta$ -HCH, Asernic	20.9	1.5	31.4
Building surface and other wastes	$\beta$ -HCH	153.7	Wall: 0.05, Ground surface 0.10	7.7
<b>Total</b>		<b>249.8</b>		<b>150.7</b>

## 6.4 Remediation alternatives

### 6.4.1 Remediation technology selection

60. The selection of remediation technology for Ganshui POP-contaminated site follows several principles of technical feasibility, operability, suitability of existing conditions in Chongqing, and competitive remediation cost and so on. Over 20 in-situ and ex-situ remediation technologies have been considered and compared, based on which three candidate technologies are identified: co-incineration (cement kiln), anaerobic biodegradation and

phytoremediation were chosen for the remediation of typical  $\alpha$ -HCH,  $\beta$ -HCH and arsenic contaminated soils in the Ganshui site (Table 4).

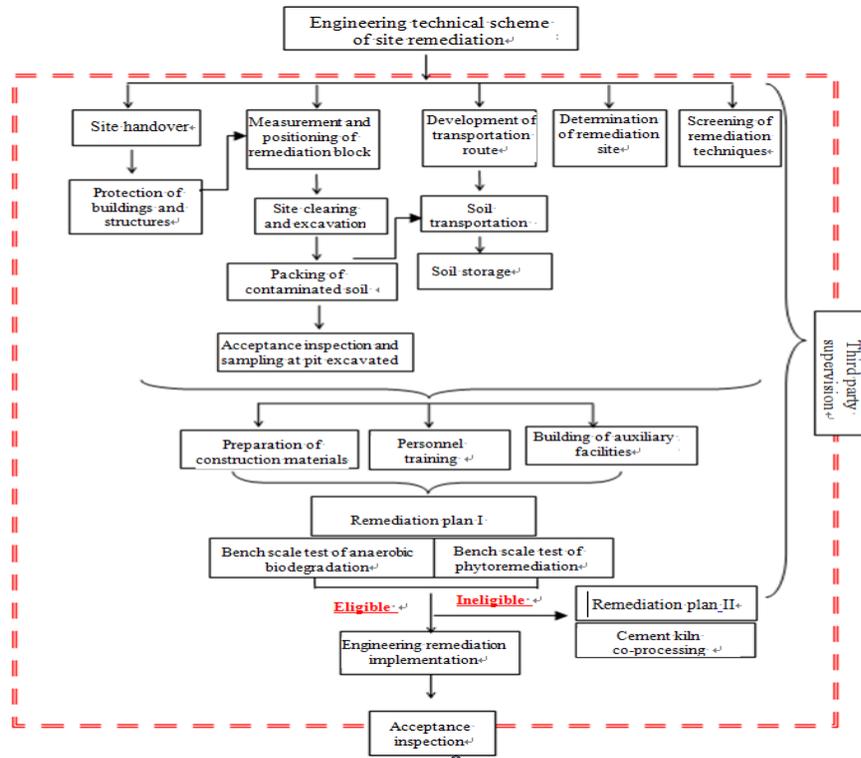
**Table 4. Remediation technologies for the Ganshui sites**

Medium	Target pollutant	Not requiring test	Requiring test
Soil	$\alpha$ -HCH and $\beta$ -HCH	Incineration	Anaerobic biodegradation
			Phytoremediation
	Arsenic	Incineration	Phytoremediation

61. Cement kiln co-incineration is acknowledged a relatively mature technology without requiring test in China, and more than 2 cement kiln-treated remediation projects were carried out in Chongqing. And 4 remediation projects and 4 lab-scale researches were conducted by using anaerobic biodegradation technology for HCH-contaminated sites, and 2 remediation projects of using phytoremediation technology were conducted for Arsenic-contaminated soils in China. Although phytoremediation is promising, its results in full scale application depend on various parameters that are difficult to determine with certainty in advance and a pilot test would be required to confirm the feasibility of anaerobic biodegradation and phytoremediation and obtain relevant technical parameters.

#### 6.4.2 Remediation plan

62. The overall technical procedure of remediation includes protection of existing buildings, excavation, transportation and storage of contaminated soils, implementation of contaminated soil remediation plan, acceptance inspection and so on (see Figure 7).



**Figure 7 Technical procedure of the Ganshui site remediation**

**63.** Since the owner of Ganshui site requires protecting the existing buildings, Chongqing PMU has entrusted Southwest Geotechnical & Design Institute of China Nuclear Industry to formulate a protection plan, including indoor wall foundation pit piles for reinforcement, and scaffold and bamboo clappers for safe excavation.

**64.** Chongqing Lafarge Cement Plant has been selected as the site for piloting anaerobic biodegradation and phytoremediation technologies. Due diligence review has been conducted for the Plant in terms of environmental performance. It is concluded that the Plant has been specifically renovated to accommodate co-incineration of pesticide contaminated soil. It has a specially designed hazardous waste storage house in line with national technical guidelines for hazardous waste storage facility. The rotary kiln protection line has been renovated to allow proper feed-in of contaminated soil, reduction re-formation of dioxin and adequate air pollution emission control. The co-incineration facility has passed through environmental impact assessment and been approved by Chongqing Environmental Protection Bureau. Routine emission monitoring data (including the period of co-incineration of pesticide contaminated soil) confirmed the emission compliance with national standards. The maximum dioxin emission is  $0.016 \text{ ngTEQ/Nm}^3$ , which meets the national standards of  $0.1 \text{ ng/m}^3$  and is lower than comparable international (EU and US) standards of  $0.11 \text{ ng/m}^3$  (IFC, EHS Guidelines for Waste Management Facility). The average dust removal efficiency of the bag-type dust remover in the kiln tail is 99.9%.

**65.** After being excavated, the contaminated soils of Ganshui site will be separately sealed and packed with double-decked plastic bag, and then be transported to Lafarge cement plant at Chongqing for storage and treatment. The route for transportation is as follows: Ganshui site - G210 national highway – Dongxi toll station (Lanzhou-Haikou Expressway) – Pingtaizi Bridge – Ring expressway – Jiangjin District, covering 83.5 km. Proper protective actions are developed in order to reduce the possible environmental impact during transportation.

**66.** Considering the advantages and disadvantages of remediation technologies, time requirement of the Ganshui subproject, alternative I (anaerobic biodegradation and phytoremediation) and alternative II (cement kiln co-processing) were designed for treatment of the contaminated soils of Ganshui site, and if alternative 1 fails to remedy the contaminated soil to the target level, then the alternative II will be the final resolution. No aftercare of the site is needed because it will be fully cleaned up with the removal of contaminated materials.

- a) **Alternative I** is composed of two pilot scale tests (i.e. anaerobic biodegradation and phytoremediation) as follows: Anaerobic biodegradation is to be conducted for the  $\alpha$ -HCH and  $\beta$ -HCH contaminated soils, adding 8g/L of Blood Meal and 20g/L of iron powder as the enhanced measures. For one batch test of 150 days treatment, four anaerobic tanks will be used for  $18 \text{ m}^3$  contaminated soils, and kept by water seal for the anaerobic condition. Meanwhile phytoremediation with ryegrass, purple medic, ciliate desert-grass and Cretan Brake will be used for the arsenic contaminated soil, and intercropping mode will be accepted. If the pilot field test is successful, all the rest soil from the Ganshui site will be treated by the two technologies and it is expected about 500 days is needed. The total budget of alternative I is about 1.28 million yuan including both capital and operating cost.
- b) **Alternative II** is cement kiln co-processing, the added contaminated soil accounted for 1.6%-3.0% of cement raw materials, and the mixed materials are kept with 2-6 seconds in the preheating furnace (the average temperature  $>800^\circ\text{C}$  and flame temperature  $>1000^\circ\text{C}$ ),

and with 5-6 seconds in the cement kiln (the average temperature >1450 °C and flame temperature >1800 °C), respectively. The budget of alternative II is about 0.71 million yuan for operating cost only. More than 150 days will be needed to complete treatment of the soil from Ganshui site.

67. Disposal of the soil remedied by Scheme (I): the risk of the soil can reach the allowable level after phytoremediation and anaerobic biodegradation. But it is conservatively recommended to limit the recycling of the remedied soil. In generally, the soil can be used for building roads, backfilling the foundation pits of non-sensitive areas, covering landfills or for landscape planting, rather than being used in sensitive areas, such as farmlands, water source protection areas and ecological preservation areas.

68. Disposal of the soil remedied by Scheme (II): the contaminated soil is completely destroyed through incineration in the cement kiln. Therefore, this scheme does not involve recycling of remedied soil.

69. A protocol for switching from Plan I (alternative treatment) to Plan II (incineration) will be developed before initiating the bidding process for site cleanup. The objective of the Project is to introduce alternative technologies. Due to the very small amount of waste of 150m<sup>3</sup> in this site, the alternative treatment is more expensive than co-incineration in the cement kiln. There are therefore incentives that could quickly put pressure on switching to Plan II for various reasons. Therefore, a strong protocol will be needed to make sure that everything that can be reasonably done to make Plan I successful has been done, and that in case of set-backs or disappointing intermediate results, first every effort is made to turn matters around before diverting to Plan II is even considered. The protocol will therefore not only prescribe the efforts that are required to focus on Plan I to make it work and adjust if needed, but also set some rules for (a) under what conditions diverting to Plan II could be considered, and (b) how this would be decided and who would need to authorize this. This will be subject to a Bank no-objection.

## 6.5 Environmental and social management plan

### 6.5.1 Management framework

70. According to remediation demands, the management framework (Figure 8) is established with management, supervision, consultation, and implementation entities which are cooperating with each other, and the corresponding responsibilities of these entities are defined as well.

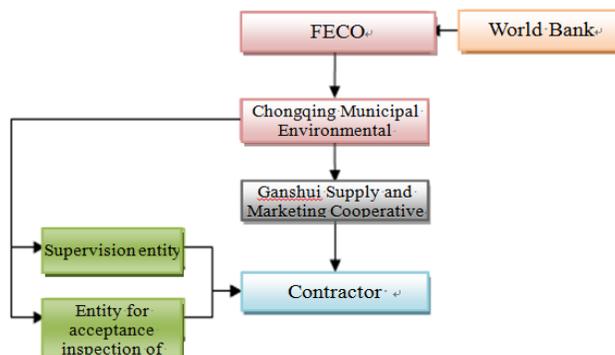


Figure 8. Management framework of the Ganshui subproject

**(I) Chongqing PMU:** Housed in Chongqing Municipal Environmental Protection Bureau will be responsible for the subproject implementation as follows:

- supervising the EA process for the Ganshui site;
- preparing monthly progress reports to FECO;
- contracting sub-contractors for the Ganshui site remediation via public bidding;
- employing engineering and environmental supervision entities via public bidding;
- contracting a third party to perform acceptance inspection via public bidding and submitting the inspection report to Chongqing EPB;
- implementing public consultation and information disclosure.

**(II) Chongqing Municipal Environmental Protection Bureau (EPB):** Responsible for the whole -process environmental supervision including: Examination and approval of site investigation, risk assessment, technical scheme and acceptance inspection reports for remediation of the Ganshui site; Disclose the information on the cleanup sub-project for the Ganshui site, and handle the public comments and complaints;

**(III) FECO:** Take charge of the coordination and management of sub-project including:

- coordinating with Chongqing PMU for project implementation;
- arranging mission activities by environmental and social specialists of the World Bank;
- submitting the semi-annual progress reports to the World Bank as required;
- employing environmental experts to provide technical support for site remediation;

**(IV) Owner of the Ganshui site:** Ganshui Supply and Marketing Cooperative of Qijiang County of Chongqing is the owner of the Ganshui site, and will be responsible for resettling the affected household with the support of Chongqing PMU.

**(V) Contractor:** Responsible for the subproject implementation as follows:

- developing an implementation plan and formulating detailed guidelines;
- carrying out the environmental and social mitigation measures;
- correcting the ineligible parts of remediation under the supervision of Chongqing PMU, Chongqing EPB, and the supervision entity.

**(VI) Supervision entity:** The third party supervision includes both engineering supervision and environmental supervision. The engineering supervision is mainly for engineering quality, costs, progress, and so on. The environmental supervision is to supervise the appropriate implementation of mitigation measures against the secondary environmental pollution, and whether the remediation process has caused adverse effects to environment.. In most cases, the contractor should engage two supervision entities for engineering supervision and environmental supervision respectively, while if the remediation project is simple and small, one supervision entity is also feasible. The supervision entity will collect soil, air, and water samples to verify any adverse impacts during the site remediation action.

**(VII) Entity for remediation validation:** As entrusted by the Chongqing PMU, after the cleanup contractor completes site remediation, the entity for remediation validation will evaluate the effects of site remediation through soil sampling and lab analysis, checking whether the parameters of soil after remediation reach the target levels of remediation. This entity will also compile an remediation validation report based on the cleanup contract and the engineering and environmental supervision reports.

**(VIII) World Bank:** Provide implementation support in line with relevant World Bank policies for cleanup of the Ganshui site. The Bank task team's environmental and social specialists will engage and advise the environmental and social specialists hired by FECO or PMUs supporting the demonstrations on the specifics of what will be needed for ESA/ESMP, land acquisition- or ethnic minority-related plans.

### **6.5.2 Mitigation of environmental and social impacts**

**71.** The main environmental and social impacts related to the project include: potential environmental and health risks involved in contaminated site excavation, building demolition, contaminated waste packaging/ transportation/storage; possible land acquisition and resettlement of local residents; social disturbance of site enclosure, excavation and traffic; nuisance of noise and dust; potential environmental impacts of ex-situ contamination remediation at new locations and final disposal of remediated soils. According to WBG EHS Guidelines, these impacts have been addressed and corresponding mitigation measures have been developed as shown in [Table 5](#).

### **6.5.3 Resettlement action plan**

**72.** The first site in Ganshui of the project will have only one household affected and need temporary resettlement for a few months during the remediation period of the site. An abbreviated resettlement action plan was incorporated in the ESMP to address temporary resettlement of the only household with two people (one retired husband and a housewife, both are not ethnic minority people). They live in a house adjunct to the Ganshui warehouse (the original dormitory of warehousemen) with fairly poor living conditions. They are a vulnerable couple. The Ganshui Supply and Marketing Cooperative (owner of the Ganshui site) offered free house for this couple who in return acted as doorkeeper of Ganshui warehouse in the past years. This Cooperative will help to complete the couple's relocation one month prior to site excavation and moving back to the house soon after the completion of the site cleanup, rent a 60 m<sup>2</sup> apartment and provide four months' living allowances that will be supplied by Chongqing PMU according the local standard. An agreement upon the above resettlement compensation and enforcement will be signed with the affected couple (both the husband and wife). The implementation of the agreement will be closely monitored by Chongqing PMU, FECO and the World Bank task team.

### **6.5.4 Responsibilities for Mitigation Action and Supervision**

**73.** The mitigation actions will be implemented by the contractor. The PMU of Chongqing and Chongqing EPB, and environmental supervision entity will supervise the contractor's performance ([Table 5](#)).

### **6.5.5 Cost Estimation for both Mitigation Actions and Supervision**

**74.** The total cost of mitigation actions will be included in winner bidder's bid. The funding sources will come from the project GEF grant and counterpart funds from national and local governments and the concerned private sectors (site owners, land owners, polluters). Budget for site cleanups including supervision cost will be included in Annual Work Plans and also procurement plan of the project. Selection of remediation contractors will be carried out through a comparative bidding process to make sure cost-effectiveness.

**Table 5. Environmental and social impacts and mitigation measures**

The activities of sub-projects	Potential impact	General mitigation action	Implemented by	Supervision organization
I. Secondary environmental pollution				
<p>Evacuation engineering of contaminated soil of Ganshui site</p>	<p>As evacuation construction is conducted manually indoors and noise and fugitive dust impacts caused will not go beyond the site boundary (inside Ganshui warehouse), population affected by them are mainly operators, which are mainly represented as follows:</p> <ul style="list-style-type: none"> <li>● Fugitive dust generated during excavation of contaminated soil</li> <li>● Fugitive dust generated during package of contaminated soil</li> <li>● Fugitive dust caused by peeling of surface layer wall inside storage warehouse of pesticide;</li> <li>● Glove that may have contaminated soil, mask and duster cloth used for wiping tools;</li> <li>● Such evacuation engineering will not generate waste water;</li> <li>● As value of noise caused by manual evacuation does not exceed 70dB, it can be neglected;</li> </ul>	<ol style="list-style-type: none"> <li>(1) Before the peeling of surface layer wall inside storage warehouse of pesticide, it is needed to make wall wet for reducing the occurrence of fugitive dust;</li> <li>(2) If moisture contents of contaminated soil are relatively small, spray water before the package to reduce the occurrence of fugitive dust;</li> <li>(3) Make package immediately after the excavation of contaminated soil to decrease the occurrence of fugitive dust;</li> <li>(4) Workers are required to take off frock and work shoes before leaving the site;</li> <li>(5) Collect wastes, such as gloves, mask and duster cloth, and submit to the contractor for unified treatment in accordance with provisions concerning polluting waste;</li> <li>(6) Provide special training about BHC-contaminated soil and emergency measures;</li> <li>(7) For non-evacuation area inside site, use water-proof double-layer colorful stripes (or impermeable membrane) to lay the ground and use plastic cloth to cover the wall;</li> </ol>	Contractor	Chongqing PMU, Chongqing EPB, and environmental supervision entity
<p>Transportation process of Contaminated Soil</p>	<p>Impacts during the transportation process of contaminated soil mainly include noise, tail gas, traffic and impacts generated by scattering of contaminated soil and its impact scope does not go beyond 20-50m at both sides of road; population affected by it are mainly residents along the road and transportation driver. Specific details are depicted as follows:</p> <ul style="list-style-type: none"> <li>● Impacts of noise, tail gas and fugitive dust discharged during the driving process of vehicle on the surrounding residents;</li> <li>● Loading and unloading of contaminated soil may block the surrounding road;</li> <li>● Tyres of transportation vehicle may carry contaminated soil;</li> <li>● There may be volatile pollutants affecting the health of</li> </ul>	<ol style="list-style-type: none"> <li>(1) Transportation vehicle is under good condition and passes annual inspection successfully. Release of tail gas by transportation vehicle is up to standard and driver possesses vehicle license and driving license;</li> <li>(2) Loading and unloading and transportation of contaminated soil by transportation vehicle shall avoid peak traffic hour;</li> <li>(3) Vehicle routing is designed inside construction site to prevent cross contamination. When leaving the construction site, vehicle must be washed and shall not carry mud for avoiding the fugitive dust;</li> <li>(4) Transportation vehicle shall avoid driving at night for minimizing the impacts of noise on the surrounding residents;</li> <li>(5) Transportation driver shall wear glove, mask and protective garment;</li> <li>(6) Emergency program shall be formulated for accidents and contaminated soil will be collected and disposed of in time;</li> <li>(7) Trucks for soil transportation shall be covered with tarpaulins and shields. Overspeed is forbidden, so as to avoid falling and fugitive dust of</li> </ol>	Contractor	

	<p>driver during the transportation process of contaminated soil;</p> <ul style="list-style-type: none"> <li>● In case of accidents in transit, contaminated soil will be scattered, leading to dispersion of pollutants;</li> </ul>	<p>the contaminated soil;</p> <p>(8) Special training about BHC-contaminated soil and emergency measures will be provided.</p>		
Temporary Storage Of contaminated soil	<p>Affected scope of temporary storage of contaminated soil is only confined to storage warehouse. Its environmental impacts are mainly soil, water and atmospheric impacts and the scope of its impacts is within 50-100m of remediation demonstration area. Population affected by it is mainly warehouse keeper. Specific details are described in the following:</p> <ul style="list-style-type: none"> <li>● Hermetic bag is damaged during the storage process of contaminated soil, leading to scattering of contaminated soil, flowing of leachate and overflow of volatile gas and endangering the people's health.</li> </ul>	<p>(1) Inspect the conditions of hermetic bag used for storing contaminated soil on a regular basis. Once hermetic bag is found to be damaged, replace it in a timely manner;</p> <p>(2) Use hermetic bag to collect scattered contaminated soil in time;</p> <p>(3) Provide ventilation system inside storage warehouse and contaminant collection device in the air (absorbed by activated carbon);</p> <p>(4) Restrict the access of storage warehouse personnel strictly and implement safety protection measures, such as wearing gas mask, protective garment and gloves;</p> <p>(5) Examine the health of warehouse keeper on a regular basis;</p> <p>(6) Provide special training about BHC-contaminated soil and emergency measures</p>	Storage site	
Impacts of Lafarge cement production on remediation demonstration engineering	<p>Impacts of Lafarge cement production on remediation program I are mainly represented as follows:</p> <ul style="list-style-type: none"> <li>● Dust caused by Lafarge cement production falls on the leaves of vegetation, thereby lowering the physiological index of vegetation;</li> <li>● Noise caused by Lafarge cement production may overlap with noise generated by the implementation of program I, thereby increasing the noise;</li> <li>● Lafarge cement production does not cause waste water, exhaust gas and solid wastes for program I;</li> </ul> <p>In the remediation Scheme II, cement kiln incineration technology is used, which is consistent with cement production process. Therefore, cement production and remediation program II do not have impacts on the each other.</p>	<p>(1) Build simple greenhouse and conduct phytoremediation of contaminated soil inside the greenhouse;</p> <p>(2) Keep remediation demonstration site away from noise source of Lafarge cement production;</p>	Contractor	
Remediation program I: anaerobic biodegradation and phytoremediation	<p>As scope of impact brought by two kinds of environmentally friendly technology, namely anaerobic biodegradation and phytoremediation, is confined to Lafarge cement plant, scope of impact of its waste water, noise, tail gas and solid waste is within 50-100m of remediation demonstration area; population that are likely to be affected by it are mainly workers of cement plant and staff responsible for</p>	<p>(1) Follow the specified route for the transfer of contaminated soil inside Lafarge cement plant and arrange workers to clean the soil scattered along the road;</p> <p>(2) Establish drainage ditch and rain collection system inside remediation site of contaminated soil;</p> <p>(3) Build sewage treatment unit at remediation site of contaminated soil to dispose of waste water containing BHC and arsenic (rainwater</p>	Contractor	

	<p>remediation with specific details in the following:</p> <ul style="list-style-type: none"> <li>● Contaminated soil undergoes rain leaching during the phytoremediation process, thereby generating the waste water containing pollutants;</li> <li>● The waste water containing BHC that is produced in the anaerobic biodegradation remediation may cause the pollution to the surface water;</li> <li>● Cleaning of equipment, tools and devices during the remediation construction process of contaminated soil may lead to waste water;</li> <li>● After the screening of contaminated soil, it is necessary to clean the stone of which surface is covered by contaminated soil and waste water generated may contain BHC and arsenic pollutants;</li> <li>● Fugitive dust caused by engineering machinery construction of phytoremediation of contaminated soil and anaerobic organism remediation may cause pollutants to spread or diffuse with it;</li> <li>● Tail gas discharged by transportation vehicle and excavator used during the remediation process may give rise to atmospheric pollution;</li> <li>● Transportation vehicle and excavator used during the remediation process may give rise to noise;</li> <li>● During the handling process of contaminated soil inside Lafarge cement plant, hermetic bag used for the storage of contaminated soil may be damaged, thereby making contaminated soil scattered;</li> <li>● If residual materials of auxiliary materials used for the remediation of contaminated soil, such as dried blood, zero-valent iron and activated sludge, are not disposed of properly, it may cause pollution to surrounding environment;</li> <li>● Soil disposal after the remediation: although its environment and health risks have reached the controlled level, it still poses certain environment and health risks.</li> </ul>	<p>and waste water generated by cleaning). Use treated waste water to irrigate phytoremediation area and do not discharge such waste water to outside area; furthermore, collect the sediment caused by disposal of waste water for phytoremediation;</p> <p>(4) Machinery equipment used during the remediation process shall meet corresponding discharge standards of tail gas;</p> <p>(5) Keep remediation demonstration site away from office area and living quarters of Lafarge cement plant and dense area of surrounding residents to minimize the impacts of noise on the workers of Lafarge cement plant and surrounding residents;</p> <p>(6) Arrange the construction procedure reasonably. Night work shall be avoided generally under the premise of ensuring the construction progress, thus preventing influences the neighboring residents and workers of Chongqing Lafarge Cement Plant at night;</p> <p>(7) Operators near the machine with high noise are required to use relevant articles to control noise, such as wearing earplug. Shorten working hours at high-noise area and arrange workers to work at high-noise area in turn;</p> <p>(8) Select the construction equipment with little noise as much as possible, apply sound insulation measures at the boundary of construction site, preserve the original vegetation as much as possible and conduct afforestation and take noise control measures, such as adding resilient cushion member, cladding and acoustic shield;</p> <p>(9) Remediation construction shall avoid high wind weather and dust control measures shall be applied during the construction process, such as wet painting or covering; conduct phytoremediation at simple greenhouse to minimize the diffusion of pollutants caused by fugitive dust;</p> <p>(10) Manage and control the auxiliary materials used during the remediation process of contaminated soil in a standard manner, establish corresponding storage area, recycle and preserve remaining materials for avoiding the pollution to surrounding environment;</p> <p>(11) After the remediation, soil has reached the target value and environment and human health risks brought by it are controllable. However, from the conservative perspective, use soil after remediation for resuming plantation or for building roads. It is not suggested to backfill such soil and use as agricultural soil;</p> <p>(12) Require remediation workers to wear glove, mask and protective garment;</p> <p>(13) Set warning sign and guardrail at the remediation area and restrict the</p>		
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		access of non-remediation workers to it; (14) Provide special training about BHC-contaminated soil and emergency measures		
Remediation program II: incineration at cement kiln	<p>When contaminated soil is sent into and incinerated at cement kiln, health of workers may be affected;</p> <ul style="list-style-type: none"> <li>• During the handling process of contaminated soil inside Lafarge cement plant, hermetic bag used for the storage of contaminated soil may be damaged, thereby making contaminated soil scattered;</li> <li>• When contaminated soil is mixed and ground with cement raw materials, fugitive dust may be caused;</li> <li>• Dust caused by incineration of contaminated soil and discharged to atmosphere is likely to lead to pollution;</li> <li>• After the co-disposal of contaminated soil at the cement kiln, pollutants may be transferred to finished cement;</li> <li>• Incineration of contaminated soil at cement kiln does not generate new waste water, waste residue and noise;</li> </ul>	<p>(1) Ensure that project concerning incineration and treatment of contaminated soil at cement kiln passes environmental impact assessment and feasibility of contaminated soil processed by it, accessibility of remediation goal and environmental compatibility are reviewed by environmental protection bureau;</p> <p>(2) Ensure that dust-removing equipment is provided for incineration treatment of contaminated soil and quick cooling system is capable of reducing the temperature of high-temperature flue gas to be lower than 200°C for avoiding the occurrence of Dioxin;</p> <p>(3) Follow the specified route for the transfer of contaminated soil inside Lafarge cement plant and arrange workers to clean the soil scattered along the road;</p> <p>(4) Use machine to conduct feeding process of cement kiln automatically;</p> <p>(5) Conduct the mixing and grinding of contaminated soil and cement raw materials inside sealing equipment;</p> <p>(6) Provide dust-collection device for incineration at cement kiln;</p> <p>(7) Detect the exhaust gas caused by incinerator of cement kiln on a regular basis;</p> <p>(8) Conduct product testing before finished cement leaves the factory to detect whether pollutants have transferred or not;</p> <p>(9) Establish strict working procedure and rules and regulations for the incineration disposal of contaminated soil at cement kiln;</p> <p>(10) Require the operators responsible for incineration disposal of contaminated soil at cement kiln to use personal protective equipment, such as mask, protective garment and glove;</p> <p>(11) Deal with waste water, waste residue and noise caused by incineration treatment of contaminated soil at cement kiln according to process measures of cement production;</p> <p>(12) Provide special training about BHC-contaminated soil and emergency measures</p>	Lafarge Cement Plant	
II Community health and safety				
Society	<ul style="list-style-type: none"> <li>• Impact on daily life of the local residents</li> <li>• Impact of transportation of contaminated soil at site on</li> </ul>	(1) Negotiate with the local residents and the those influenced, listen to their opinions and suggestions carefully, respect and protect their legal rights and benefits, take actions for compensation and resettlement	Contractor	Chongqing PMU, Chongqing

	<p>road traffic</p> <ul style="list-style-type: none"> <li>• Temporary relocation of one household, thereby affecting its normal life</li> <li>• Protection of Historical Relics: there is no remain or underground historical relic with archaeological research value in the contaminated site.</li> <li>• Folk custom and religion: as population at Ganshui site are mainly Han Chinese, companies and workers will not have different folk custom, living customs or religious faith with those in the local area and will not lead to misunderstanding or contradiction during the remediation construction of Ganshui site</li> </ul>	<p>according to the applicable policies, regulations and the actual conditions.</p> <p>(2) Erect barriers around the construction site, limit the range of construction strictly. Hang the construction light at a height and in a direction without influencing rest of the surrounding residents at night. Plan the transportation route of construction materials reasonably.</p> <p>(3) Make sure there is no planting zone, culture zone, simple shed/house, water well/motor-pumped well or other structures and crops around the site, thus preventing loss of the surrounding residents or impact on their income. In case of unexpected property loss of some resident during construction, compensate him/her according to applicable national and local policies and regulations.</p> <p>(4) No permanent immigration and relocation will occur for this project, but it will cause the temporary immigration and formulate feasible resettlement plan, so the compensation work shall take into full consideration various aspects, such as, financial compensation, the improvement of living conditions, etc.</p> <p>(5) As for the damage or blocking of access roads of the residential area or residents, repair the road damaged after completion of the project, and reserve roads for the passengers and public vehicles during construction.</p> <p>(6) Avoid the transportation of contaminated soil at the peak traffic hour.</p> <p>(7) Formulate public participation plan during the construction period, solve social problems caused by construction; furthermore, set complaints hotline, e-mail and feedback mechanism;</p> <p>(8) If underground cultural relic is found during the remediation construction process, stop construction immediately and report to local cultural relic department according to relevant national requirements.</p>		<p>EPB, and environmental supervision entity</p>
<p>III Occupational health risk</p>				
Dust	<ul style="list-style-type: none"> <li>• Fugitive dust generated during the excavation, crushing, screening and mixing process of soil may lead to respiratory diseases of operators</li> </ul>	<p>(1) Follow the construction flow and technical requirements strictly;</p> <p>(2) Conduct wet method operation;</p> <p>(3) Strengthen individual protection. Wear dustproof devices when it is difficult to decrease the dust concentration to a level below the national standard level with the dust control and prevention actions.</p> <p>(4) Intensify education and training for the worker, field inspection and comprehensive management for dust control.</p>	Contractor	<p>Chongqing PMU, Chongqing EPB, and environmental supervision entity</p>
Toxic substance	<ul style="list-style-type: none"> <li>• Target pollutants in the soil of Ganshui site are BHC and arsenic with high toxicity. If operators contact with them accidentally during the remediation process, it may cause</li> </ul>	<p>(1) Define specific personal health protection regulations and provide protective articles for operations with exposure to toxic substances, e.g. ventilate coveralls, canister respirators, chemical protective gloves,</p>	Contractor	

	human poisoning.	chemical protective shoes and so on. (2) Arrange professional doctors to examine and check the health of operators contacting with toxicants at predetermined time interval. If any abnormal physical change is found, receive treatment in time; (3) Provide education and training on specific knowledge for the operators before commencement, so as to get them familiar with the knowledge on hazards and the safety protection and grasp the protection methods;		
Physical properties Hazard	<ul style="list-style-type: none"> <li>• Damage to human health caused by noise and vibration generated after excavation and transportation at Ganshui site and construction at remediation site as well as unforeseeable and abnormal metrological conditions</li> </ul>	(1) Take actions to eliminate or reduce the noise and vibration, e.g. welding instead of riveting, isolation materials of rubber, cork wood and sand, and to eliminate or reduce transfer of noise and vibration, such as noise absorption, insulation, vibration isolation, damping and so on. (2) Restrict the operation time and vibration intensity, improve the operation environment, and strengthen individual protection. (3) The workers shall keep away from the heat source or wear heatproof overalls when working in high temperature environment. Adopt open or semi-open operation to take advantage of natural ventilation for cooling, and provide health protection articles. Take actions for cold protection and thermal protection, and intensify use of personal protection articles.	Contractor	
Other	<ul style="list-style-type: none"> <li>• Physical fatigue caused by monotonous operation</li> <li>• Chronobiology disorders caused by all-weather work in shifts</li> </ul>	(1) Arrange the work reasonably. (2) Arrange the operators to have rest by turns, and avoid long-term operation at a fatigue state.	Contractor	
IV Safety risk				
Injury caused by vehicle	<ul style="list-style-type: none"> <li>• The motorized vehicles for remediation may strike or crush the human bodies during driving, causing falling, collapse and casualties</li> </ul>	(1) Braking performances, power, operating stability, comfort, physical dimensions, vision and lighting of the vehicles shall meet the requirements of use. (2) Decrease driving speed of vehicle during the driving process and guarantee safe driving; (3) Formulate the Emergency response plan	Contractor	
Mechanical injurie	<ul style="list-style-type: none"> <li>• Casualties caused by crushing, collision, cutting, twisting, bruise, puncture during exposure to various machines and equipment for remediation</li> </ul>	(1) Re-design the machines to make the dangerous parts more visible or attach warning signs to them. (2) Consolidate the skill and safety training of workers and reinforce supervision management; (3) Formulate accident emergency scheme;	Contractor	
Electric shock	<ul style="list-style-type: none"> <li>• Casualty accident of lightning stroke or electric shock that may be caused by current-consuming machinery required for</li> </ul>	(1) Avoid the electric shock accidents caused by direct contact by means of insulation, safe shielding and safe spacing, and prevent the electric shock	Contractor	

	remediation project	accidents caused by indirect contact by means of IT (protective grounding), TT (neutral solidly grounded) or TN (protective connecting neutral) systems. (2) Use explosion-proof electrical devices and circuits, and ensure the enclosure of electrical devices are in good conditions. (3) Equip all lightning protection structures with external and internal lightning protection devices, and take actions to prevent intrusion of lightning surge. (4) Consolidate the skill and safety training of workers and reinforce supervision management; (5) Formulate accident emergency scheme;		
Burn	<ul style="list-style-type: none"> <li>If co-disposal technology at cement kiln is used for contaminated soil at Ganshui site, the temperature of its furnace body is between 1000°C ~2000°C, which may cause burn risks.</li> </ul>	(1) Conduct operation in accordance with provisions strictly, consolidate the skill and safety training of workers and reinforce supervision management (2) Wear the personal protective articles, e.g. head protector, canister respirator, goggles, body protector, hand and foot protection devices, etc. (3) Formulate accident emergency scheme;	Contractor	
Fire	<ul style="list-style-type: none"> <li>Injuries and property loss caused by fire at the remediation site</li> </ul>	(1) Use fire resistant construction materials. (2) Take actions of sun shading for the workshops and warehouses with explosion hazards, and install ground glass on the windows, so as to avoid formation of ignition source. (3) Prepare fire-fighting equipment suitable for the site, and set evacuation route, emergency convergence place, fire lane, emergency lighting and so on.	Contractor	
Collapse	<ul style="list-style-type: none"> <li>Earthwork collapse during the dredging of contaminated soil, scaffold collapse during the contaminant removal of buildings(structures), collapse of stockyard materials on the construction site, etc.;</li> </ul>	(1) Operate on a flat and rigid ground when possible. (2) Strengthen and reinforce the structure of existing wall of Ganshui warehouse; (3) The operators shall have certain work experience and wear safety helmet and other protective equipment; (4) Set warning signs to prevent unauthorized approaching. (5) Formulate the Emergency response plan	Contractor	Chongqing PMU, Chongqing EPB, and environmental supervision entity
Physical fatigue	Physical fatigue caused by monotonous operation or chronobiology disorders caused by all-weather work in shifts	(1) Arrange the work reasonably, avoid long-term operation at a fatigue state.	Contractor	

## 6.6 Public consultation and information disclosure

### 6.6.1 Public survey

75. For the Ganshui site, the published survey has been carried out for three times as follows:

- The first public survey was conducted in November of 2012 in form of questionnaires, and 3 persons (2 female and 1 male) participated into the survey;
- The second public survey was conducted in March of 2014 in form of questionnaires, and 50 persons (24 male and 26 female) participated into the survey;
- Survey on the affected household with two people was conducted on July 13th of 2014, Chongqing PMU and Beijing Municipal Research Institute of Environmental Protection participated into the survey;

76. The survey results showed that more than 70% of the respondents knew the history and usage of the site, and more than 90% persons agreed upon the government's decision on cleanup of the site, and the income sources of surrounding residents were irrelevant to Agricultural Material Warehouse, and the resident health was not affected by the Ganshui site.

### 6.6.2 Public consultation for draft EA report

77. Public consultation ( a public meeting) was conducted on July 13<sup>th</sup> of 2014 for the draft EA report, as shown in [Figure 9](#), the personnel participating included the Chongqing PMU, the Ganshui Supply and Marketing Cooperative (owner of the Ganshui Site), the Beijing Municipal Research Institute of Environmental Protection (technological assistance of China-GEF project) and 25 public representatives around the site within 500 m. All the representatives supported the sub-project for remediation of the Ganshui site. In addition, traffic and noise during site remediation are their main concerns, and all the representatives generally accepted the mitigation measure “no construction at night and lunch break”. Please refer to detailed survey results and detailed minutes of meeting for the public consultation meeting in or attached in the EA report for this site.



Figure 9. Scene of public consultation

(1)(2)(3)(4) of discussion at the Ganshui site; (5) survey at state grid of the Ganshui town; (6) survey at local police station of the Ganshui town.

## 6.6.2 Information disclosure

78. The Chongqing PMU published the full EA Report of Ganshui Site (in Chinese and English) on the website of Assessment Centre of Chongqing Municipal Environmental Protection Bureau (<http://113.204.96.35:7890/> website link) on July 11, 2014, and published the environmental impact assessment news of this site in Chongqing Evening News on July 12, 2014.

79. The Chongqing PMU will publish some relevant information on the Ganshui site including: (i) bid information and the bid winner; (ii) results of monitoring and remediation validation after project completion, the evaluation comments of competent government authorities. The information will be disclosed on the local newspaper or the website or in form of information bulletin.

80. The Chongqing PMU arranges specially-assigned persons to be responsible for handling complaints of affected residents if any, disclose the complaint hotline to the public, and receive and process public consultation and complaints. Contact person: Lu Hailin; Telephone: 18523805126; E-mail: Ganshuichangdi@163.com.

81. The Chongqing PMU will also adopt other participation ways acceptable to the public, including in-home interview, playing videos, issuing brochure, holding knowledge lectures, etc. to make sure sufficient information on cleanup of the Ganshui site is provided to the concerned public.

## 7. Summary of World Bank Safeguard Policies and Environmental Health, and Safety Guidelines Applied in Ganshui Subproject

82. The relevant Bank safeguard policies are applicable to the project were precisely summarized as shown in the below table 6, both the World Bank guidelines and national guidelines were taken into consideration for the remediation subproject of Ganshui site.

**Table 6: Comparison of World Bank Safeguard Policies and EHS Guidelines with Measures Applied in Ganshui EA report**

World Bank Safeguards Policies and EHS Guidelines	Compliance of the EA report of Ganshui site
<b>OP4.01 Environmental Assessment</b>	<ul style="list-style-type: none"> <li>- Category A project</li> <li>- ESMF has been developed</li> <li>- Full EA (including EMP) and EA Executive Summary have been prepared for the first pilot site</li> <li>- Two rounds of public consultation conducted as part of EA process</li> <li>- EA documents have been locally disclosed</li> </ul>
<b>OP 4.12 Involuntary Resettlement</b>	<ul style="list-style-type: none"> <li>- Resettlement policy framework has been developed in form of ESMF</li> <li>- A simple resettlement plan has been prepared for temporary relocation of one household in the first pilot site</li> </ul>
<b>OP 4.11 Physical Cultural Resources</b>	<ul style="list-style-type: none"> <li>- Chance-find procedures have been included in the ESMF and the site-specific EA</li> </ul>
<b>OP 4.10 Indigenous Peoples</b>	<ul style="list-style-type: none"> <li>- Ethnic Minority Plan Framework has been included in the ESMF</li> </ul>
<b>Bank's Interim Guidelines on the Application of Safeguard Policies to TA Activities in Bank-Financed Projects and Trust Funds</b>	Environmental and social impacts and mitigation measures will be screened and proposed during the TA activities including (1) feasibility study for constructing a knowledge and remediation center in Chongqing; (2)

<b>Administered by the Bank.</b>	establishing regional soil and groundwater contamination prevention and warning system at the Changshou Industrial Park in Chongqing, and (3) screening cost-effective remediation technologies through small-scale field pilots and reviewing the policy gaps for prevention and control of agricultural land contamination in Hunan. The output reports of these activities will be reviewed by the Bank task team before finalization.
<b>EHS General Guidelines</b>	
Hazardous waste management	- Contaminated soil stored in storage facility designed and managed in line with national standards for hazardous waste storage
Contaminated land	- Risk screening has been conducted through phase I, II and III site investigation; - Risk assessment has been conducted to determine remediation target - Remediation plan has been developed with measures to eliminate the risk of the contaminated site - Occupational health measures taken for staff during site investigation
Occupational health and safety	- Occupational health and safety measures have been developed in the EA (EMP) for site remediation process in terms of workspace safety, physical hazards, personal protection equipment, accident and injury etc.
Community health and safety	- Measures have been developed to address community traffic disturbance, noise and dust nuisance, structure safety, transportation safety, disease prevention, and emergency response measures
<b>EHS Guidelines for Waste Management Facility</b>	
Industrial hazardous waste collection and transportation, storage,	- Proper transportation trucks and trained drivers - Storage warehouse designed and managed for hazardous wastes
Biological and physico-chemical treatment	- Anaerobic biodegradation and phytoremediation technology is selected through alternative analysis for pilot site
Hazardous waste incineration	- Co-incineration in cement kiln which is licensed for hazardous waste incineration, and is equipped with adequate emission control and monitoring facilities
Occupational health and safety	- Safety measures have been developed in EA to address the accidents and injury, chemical exposure
Community health and safety	- Measures have been developed to address garbage management, dust and noise, access control, etc.