Environmental Impact Assessment

Project Number: 43024
December 2010

People's Republic of China: Xinjiang Altay Urban Infrastructure and Environment Improvement Project

Prepared by the Government of Xinjiang Uygur Autonomous Region for the Asian Development Bank (ADB).

ABBREVIATIONS

AADT	-	Annual Average Daily Traffic
ADB	-	Asian Development Bank
AIDS	-	Acquired Immunity Deficiency Syndrome
AP	-	Affected Person
APG	-	Altay Prefecture Government
APMO	-	Altay Project Management Office
ASL	-	Above sea level
AusAID	-	Australian Government Overseas Aid Program
CAREC	-	Central Asia Regional Economic Cooperation
CCF	-	Climate Change Fund
CEIA	-	Consolidated Environmental Impact Assessment
CNY	-	China Yuan
DFR	-	Draft final report
DMF	-	Design and Monitoring Framework
DRC	-	Development and Reform Commission
EA	-	Executing Agency
EFS	-	Engineering Feasibility Study
EHS	-	Environmental Health and Safety
EIA	-	Environmental Impact Assessment
EMDP	-	Ethnic Minority Development Plan
EMO	-	External monitoring organization
EMP	-	Environmental Management Plan
EPB	-	Environmental Protection Bureau
FMAQ	-	Financial Management Assessment Questionnaire
FSR	-	Feasibility Study Report
FYP	-	Five-Year Plan
GEF	-	Global Environmental Fund
GHG	-	Greenhouse Gas

GRM	-	Grievance Redress Mechanism
HDPE	-	High Density Polyethylene
HH	-	Household
HIVS	-	Human Immunodeficiency Virus
IA	-	Implementing Agency
IEE	-	Initial Environmental Examination
IEM	-	Integrated Ecosystem Management
IFC	-	International Finance Corporation
IFO	-	International Financing Organization
IP	-	Indigenous Peoples
IPCC	-	Intergovernmental Panel on Climate Change
IUCN	-	International Union for the Conservation of Nature
LDI	-	Local design institute
MDG	-	Millennium Development Goals
MEP	-	Ministry of Environmental Protection
MIS	-	Management Information System
NDRC	-	National Development and Reform Commission
NGO	-	Non-governmental Organization
NTFP	-	Non-timber forest products
O&M	-	Operation and Maintenance
PAH	-	Project affected households
PAP	-	Project affected persons
PCCP	-	Prestressed Concrete Cylinder Pipe
PE	-	Polyethylene
PLG	-	Project Leading Group
PMO	-	Project Management Office
PPMS	-	Project Performance Management System
PPTA	-	Project Preparatory Technical Assistance
PRC	-	People's Republic of China

PSA	-	Poverty and Social Assessment
RMB	-	Renminbi
RP	-	Resettlement Plan
RRP	-	Report and Recommendation of the President
SAP	-	Social action plan
SEIA	-	Summary Environmental Impact Assessment
SEPP	-	Soil Erosion Prevention Plan
SIA	-	Social Impact Assessment
STD	-	Sexually Transmitted Diseases
STI	-	Sexually Transmitted Infections
TA	-	Technical Assistance
TGR	-	Traffic Growth Rate
TOR	-	Terms of Reference
USD	-	United States Dollar
UV	-	Ultra violet
WS	-	Water Supply
WTP	-	Water Treatment Plant
WWF	-	World Wildlife Fund
WWT	-	Wastewater Treatment
WWTP	-	Wastewater Treatment Plant
XUAR	-	Xinjiang Uygur Autonomous Region
XUARG	-	Xinjiang Uygur Autonomous Region Government
XAUIEIP	-	Xinjiang Altay Urban Infrastructure and Environmental Improvement Project

CURRENCY EQUIVALENTS

(Assumed)

Currency Unit – Yuan (CNY)

CNY1 = $.1515

$1 = CNY6.6

WEIGHTS AND MEASURES

km^2	–	square kilometer
m^2	–	square meter
m^3/day	–	cubic meter per day
mu	–	Chinese unit of area (15 mu = 1 hectare)

NOTES

(i) The fiscal year (FY) of the Government of the People's Republic of China ends on 31 December.
(ii) In this report, "$" refers to US dollars.

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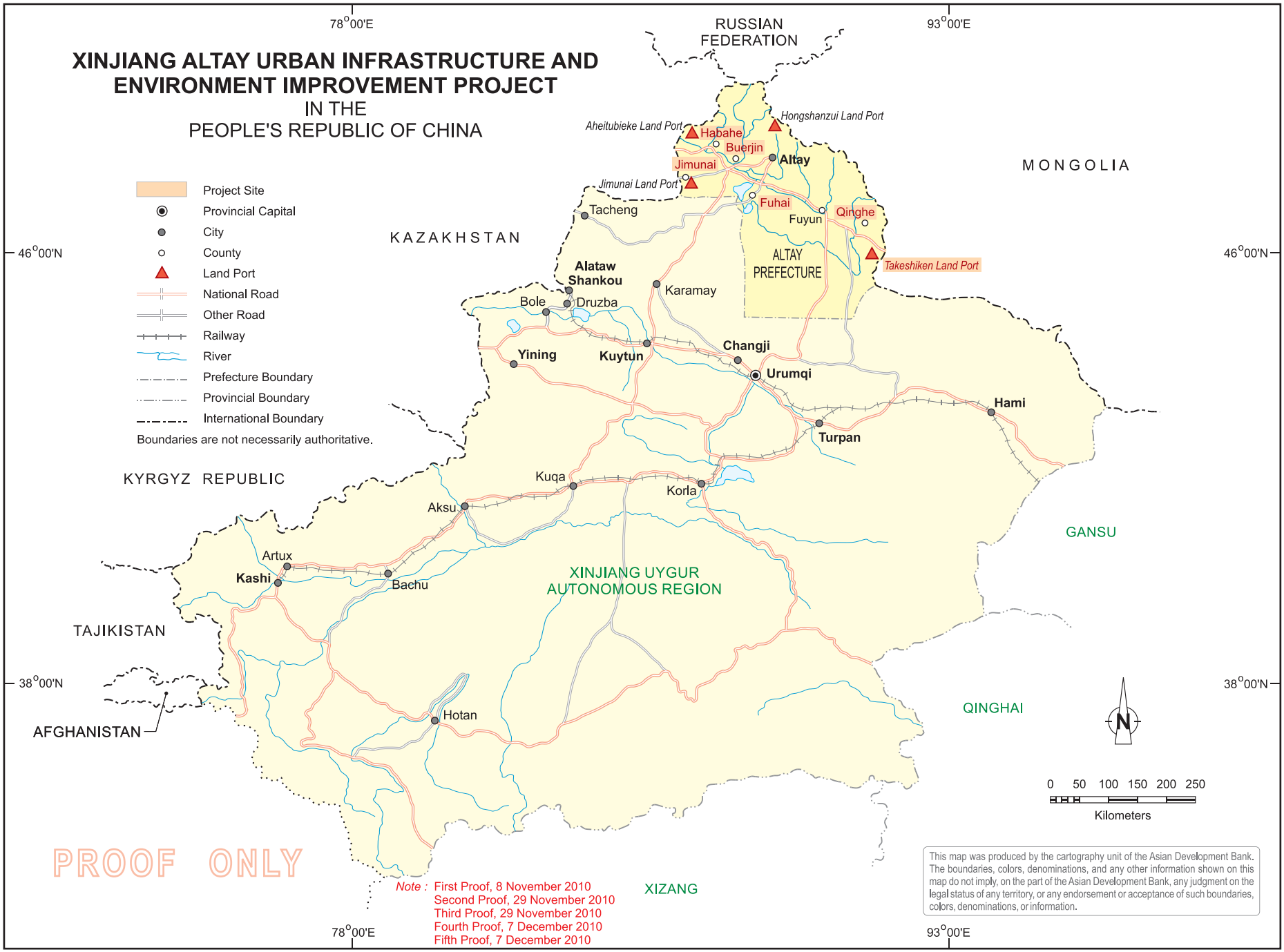
XINJIANG ALTAY URBAN INFRASTRUCTURE AND ENVIRONMENT IMPROVEMENT PROJECT
IN THE
PEOPLE'S REPUBLIC OF CHINA
Project Site
Provincial Capital
City
County
Land Port
National Road
Other Road
Railway
River
Prefecture Boundary
Provincial Boundary
International Boundary
Boundaries are not necessarily authoritative.
78°00'E
93°00'E
46°00'N
38°00'N
RUSSIAN FEDERATION
MONGOLIA
KAZAKHSTAN
KYRGYZ REPUBLIC
TAJIKISTAN
AFGHANISTAN
GANSU
QINGHAI
XIZANG
XINJIANG UYGUR AUTONOMOUS REGION
ALTAY PREFECTURE
Aheitubieke Land Port
Habahe
Hongshanzui Land Port
Buerjin
Altay
Jimunai
Jimunai Land Port
Tacheng
Fuhai
Fuyun
Qinghe
Takeshiken Land Port
Alataw Shankou
Bole
Druzba
Karamay
Yining
Kuytun
Changji
Urumqi
Hami
Turpan
Kuqa
Korla
Aksu
Artux
Kashi
Bachu
Hotan
0 50 100 150 200 250
Kilometers
N
PROOF ONLY
Note : First Proof, 8 November 2010
Second Proof, 29 November 2010
Third Proof, 29 November 2010
Fourth Proof, 7 December 2010
Fifth Proof, 7 December 2010
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CHAPTER A. EXECUTIVE SUMMARY

A. Background

1. The Xinjiang Altay Urban Infrastructure and Environmental Improvement Project has been planned to assist the people of five counties in northern Xinjiang, two of which are declared poverty counties, to raise their standard of living and economic prospects by the provision of essential urban and peri-urban infrastructure. The 25 infrastructure subcomponents have also been selected and designed to provide significant environmental and socio-economic benefits for the target counties.

2. All 25 components will support approved development master plans. New roads, water supplies, sewerage and wastewater treatment plants, centralized heating facilities and landfills for solid wastes are planned for implementation in the counties of Buerjin, Habahe, Qinghe (including the Takeshiken Land Port), Jimunai and Fuhai where local governments have shown interest and commitment.

3. The project is classified as environment category A in ADB's environmental categorization and requires a consolidated environmental impact assessment (CEIA), which will be circulated to ADB's Board of Directors and posted on the ADB website. The completed county EIAs for PRC approvals comply with ADB's policies and requirements including ADB's Environmental Assessment Guidelines (2003) and the ADB safeguard policy document (*Safeguard Policy Statement (2009)*). The methods and standards applied in the preparation of EIAs for the project sub-components are in accordance with the guidelines of the Ministry of Environmental Protection (formerly State Environmental Protection Administration), and also meet national and autonomous region laws and regulations. The potential environmental impacts arising from the implementation of the Project have been identified in the individual domestic EIAs and their findings integrated in this CEIA.

B. Project Scoping

4. According to the ADB criteria for the EIA categorization of projects[1], waste water treatment and landfill, with their potential to pollute surface and groundwater resources and possibly heating boilers due to their emissions are adjudged to require a Category A EIA, and the remainder Category B. On the other hand, the PRC legislative provisions of the EIA of these same sectors requires the highest standard of EIA documentation (EIA Report) for roads and landfill and a lower level (EIA Table) for wastewater treatment, heating and water supply. Thus, a combination of the two sets of guidelines would require a high level of assessment for all except water supply subcomponents. However, due to the water scarcity of the region and the consequent obligation to consider upstream and downstream uses to ensure sustainability, water supply subcomponents also warrant attention to these environmental risk areas.

5. Thus, in scoping of the sectors and environmental setting for this Project, the following subcomponent sector risk factors have been identified:

i. Waste water treatment – all aspects, with special attention to effluent management
ii. Solid waste management – all aspects, with special emphasis on leachate management
iii. Heating – gaseous emissions
iv. Water supply – downstream water users, water security and sustainability
v. Roads – noise and sensitive receptors

[1] ADB 2009, *Safeguard Policy Statement,* Asian Development Bank, Manila.

6. While the full range of potential environmental impacts will be discussed in this CEIA, these risk factors will be the main emphasis.

C. CEIA Features and Findings

1. Project Benefits

7. Cities of northern Xinjiang are centered on the sources of available water. Due to the concentration of urban and commercial development which is characteristic of these settlements, the new and upgraded roads, water supply, sewerage and wastewater treatment, heating and landfill facilities planned for the counties will bring benefits to all the city-dwellers. The majority of beneficiaries will receive multiple benefits from the combination of all subcomponents developed in their area.

8. The new water sources, treatment plants and expanded piped water supply coverage It is estimated that up to 19,000 households will have new access to wastewater services and 11,500 households will have new access to water supply. Because of the need to structure a network of connections focusing on specific neighborhoods, fewer household will benefit from new centralized heating connections (over 6,000 households). However all will benefit from improved garbage disposal and the increased capacity of urban roads to cope with traffic volumes.

9. The new water sources, treatment plants and expanded piped water supply coverage areas will reduce many households' dependence on potentially contaminated well water, improving water quality and creating a more reliable supply of domestic water. The improved wastewater disposal systems will result in cleaner and healthier living environment for town residents, and reduced contamination of the underground water supply and/or of rivers. Improved road networks will reduce traffic congestion, improve road safety conditions, facilitate the movement of residents, and, in some county seats, open up new areas for urban expansion. Improved and expanded heating systems will result in energy savings, reduced air pollution, and reduced heating costs for those currently dependent on coal fires. Improved solid waste disposal will clean up urban areas and close down existing unsanitary landfills.

2. Project Impacts and Mitigations

10. During the feasibility and design phases of the subcomponents, many potentially significant impacts have been solved by design features and operating regimes which avoid or minimize negative environmental effects. Construction impacts exist, but these are of a temporary nature and are covered by stringent site management and procedural provisions in the EMP. Finally, the monitoring of subcomponents in the construction and operational phases will check that the environmental performance of the Project remains high.

11. The implications of the project for the water sector in the counties have been examined to ensure the sustainability of water supplies and waste water treatment approaches which will be implemented. The "open loop" of water extraction for water supply but treated wastewater going to irrigation rather than return waters has been carefully examined via river basin analyses and water balances. Sensitivity analyses of the water balances for critically dry years have also been undertaken. The sustainability of the reuse of treated effluent for to irrigate wind-break forests to combat land degradation has been critically evaluated.

12. The Project Environmental Management Plan (EMP) sets out the procedures and plans to carry out mitigation measures and monitoring requirements during sequential stages of the Project (Pre-construction, Construction and Operational phases). It consists of two

plans, one for implementing mitigation measures and the other for carrying out environmental monitoring. For each impact, appropriate mitigation measures are described. Parties responsible for implementing each mitigation measure are listed. Supervising agencies for each mitigation measure have also been listed. The EMP includes a set of Performance Indicators for implementation of mitigation measures and monitoring results which are a simple way of evaluating the performance of the EMP.

13. Local environmental protection bureaus will support the implementing agencies in undertaking the environmental management plans. Capacity building in environmental management, a detailed training program for which has been developed in the environmental management plan, will be provided for the executing agency, implementing agencies, implementing units, and county environmental protection bureaus, to ensure the borrower's institutional capacity in managing environmental impacts and risks.

3. Safeguard Measures

14. The designs of all sub-components also address a range of climate change issues. Substantial savings in greenhouse gas emissions will accrue from the rationalization of urban road transport and connectivity of roads; the replacement of aging centralized heating facilities and numerous domestic sources; and the carbon sequestration provided by the irrigated forest plantations. The built infrastructure of subcomponents incorporate adaptation features for future changed climates.

15. During the course of EIA preparation, three rounds of public consultation has been undertaken in the Project counties: the first for information dissemination; the second to elicit and incorporate public views of mitigation measures; and the third to publicize and explain the Project's grievance redress mechanism.

16. A Grievance Redress Mechanism (GRM) has been developed for the Project. It parallels the GRM for the Resettlement and Compensation component of the Project and complies with the existing PRC legislative framework for "Letters and Visits". The primary contact for complaints is with the county PMOs and EPBs. By having the county and Altay Prefecture PMOs central to the scheme it ensures that grievances and their resolution will be included in the PMO's reporting function to ADB.

17. Biodiversity issues for the Project have focused on the Xinjiang Beurgen River Beaver Natural Reserve at Takeshiken. Significant changes occurred in the analysis of alternatives for the WWTP in this town, and an alternative location for the plant was chosen to avoid the reserve. The Takeshiken water supply subcomponent which uses the Buergen River waters has been assessed for potential to sustain downstream water uses and has also been moved to a safer locality.

18. The consideration of environmental health and safety combined occupational health and safety of staff/workers at the subcomponent facilities and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities. The considerations of environmental health and safety in this CEIA include (i) an assessment of traffic accident hazards, including spillages of transported substances into waterways and emergency response planning; (ii) the on-site formulation, storage and handling of disinfection chemicals at WTPs, including staff emergency procedures; (iii) appropriate siting of WWTPs away from settlements; (iv) appropriate siting of landfills away from settlements; (v) CH_4 monitoring of landfill surface atmosphere and downwind areas; (vi) personal noise protection gear for heating plant staff; and (vii) training and awareness programs for community (e.g. road safety in schools) and facility operating staff.

19. The only potential economic displacement was the effect of new solid waste disposal subcomponents on the informal scavenging industry. Latest investigations by PMO report no scavenger activity at current landfills, due to their significant distance from population centres. The county PMO advised that salaried landfill workers often separate “useful” waste for reselling and these activities will not be curtailed by the operational management of new landfills.

D. Conclusions

20. The CEIA concludes that the project will have substantial environmental and socioeconomic benefits resulting from improvements in urban transportation, water supply, sewage collection and treatment, urban refuse and solid waste treatment and management, and heating facilities, all of which have lagged behind the demands placed upon them by the growth of the county seats and major towns.

21. The new infrastructure will be environmentally sound in its design, siting, construction and operation. It will also replace aging, inefficient and polluting infrastructure and ensure environmentally appropriate closure and decommissioning of the replaced facilities.

22. Potential environmental impacts can be mitigated through the implementation of the environmental management plan. Although adverse environmental impacts are anticipated during the construction of the project, mitigation measures set out in the environmental management plan and closely scrutinized following the environmental monitoring plan are expected to fully mitigate these potential impacts.

CHAPTER B. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

A. Overview

23. The subcomponent environmental assessment documents upon which this consolidated EIA is based have been prepared under the provisions of PRC Environmental Impact Assessment Law of 2003 and the PRC Management Guideline on EIA Categories of Construction Projects (2008). These have strengthened existing environmental impact assessment requirements and expanded their application to cover development plans. The release of the 2006 Interim Guideline on Public Participation in EIA has also been a significant development that provides for opportunities to involve the public in the EIA process.

24. This legislative framework lists the actions required to undertake effective Environmental Impact Assessment: (i) Collect and monitor environmental quality conditions of the project's location and its neighboring regions; (ii) Analyze and evaluate the project to assess pollution sources and discharge of pollutants; (iii) Predict beneficial and adverse effects on surface water, ground water, atmosphere, ecological environment, acoustic environment, environmental hygiene of the affected areas during periods of construction, and operation of the project; (iv) Present pollution prevention measures that reduce the adverse effects, and estimate the costs of mitigation and environmental management of the project; (v) Analyze the existing environmental risk during the period of construction and operation of the project; (vi) Collect public views and comments on the construction of the project; (vii) Analyze environmental economic impacts, especially related to auxiliary projects and cumulative pollution loads; and, (viii) Draw up a program for environment control, supervision and training.

25. The Environmental Impact Assessment under PRC law is also supported and guided by the following legislative provisions.

B. Laws, Regulations, Guidelines and Standards

1. Laws

26. The following laws of the People's Republic of China govern the way in which the environmental management of the project must be implemented, in order to proceed. This suite of laws includes:

i. Environmental Protection Law of the People's Republic of China, adopted on December 26, 1989;
ii. Law of the People's Republic of China on Evaluation of Environmental Effects, adopted on October 28, 2002;
iii. Law of the People's Republic of China on Prevention and Control of Water Pollution, adopted on February 28, 2008;
iv. Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution, adopted on April 29 2000;
v. Law of the People's Republic of China on Noise Pollution of the Environment, adopted on October 29, 1996;
vi. Law of the People's Republic of China on Prevention of Environmental Pollution Caused by Solid Waste, adopted on December 29, 2004;
vii. Land Administration Law of the People's Republic of China, adopted on January 1, 1999;
viii. Law of the People's Republic of China on Promoting Clean Production, adopted on January 1, 2003.

2. Regulations and Proclamations

27. The following regulations of the People's Republic of China support the environmental laws, particularly as they relate to, and are administered by the government of the Xinjiang Uygur Autonomous Region:

i. Decision of Implementing Scientific Development View and Strengthening Environmental Protection by the State Council, issued on December 3, 2005;
ii. Management of Environmental Protection in Construction Projects, promulgated by Decree No. 253 of the State Council of the People's Republic of China on November 29, 1998;
iii. Enforcement Regulations of Law on the Prevention and Control of Water Pollution of the People's Republic of China, promulgated by Decree No. 284 of the State Council of the People's Republic of China on March 20, 2003;
iv. Policy on Treatment of Urban Domestic Garbage and Technology of Pollution Prevention, Jiancheng [2000] No. 120, issued on May 29, 2000 by Ministry of Construction;
v. Compendium of China's Ecological Construction and Environmental Protection, issued on June 1, 2004;
vi. Circular of Conducting Environmental Supervision of Traffic Engineering, Jiaohuanfa ［2004］No. 314;
vii. Circular of Strengthening Management of Environmental Protection in Traffic Construction Projects in Transportation Trade, ［1995］No. 297 issued by Department of Communications and Bureau of Environmental Protection of Xinjiang Uygur Autonomous Region;
viii. Circular of Environmental Impact Assessment of Highway and Railway Construction Projects (light standard rail included) on Issues Concerning Environmental Noise ［2003］No. 94 issued by State Environmental Protection Administration of China;
ix. Circular of Strengthening Management of Environmental Impact Assessment against Risks, ［2003］No. 152 issued by State Environmental Protection Administration of China;
x. Interim Measures on Public Participation in Environmental Impact Assessment, promulgate on March 18, 2006 by State Environmental Protection Administration of China;
xi. Management of Environmental Protection in Traffic Construction Projects, ［2003］No. 5 issued by Ministry of Communications;
xii. Function Zoning of Ecology in Xinjiang, issued by Bureau of Environmental Protection of Xinjiang Uygur Autonomous Region in September, 2003;
xiii. Function Zoning of Water Environment in China's Xinjiang, issued by Bureau of Environmental Protection of Xinjiang Uygur Autonomous Region in October, 2003;
xiv. Proclamation of Xinjiang Uygur Autonomous Region on Zoning of Key Protective Conservation Zones for Xinjiang's Soil and Water Protection, adopted on October 31, 2003;
xv. Environmental Protection Law of Xinjiang Uygur Autonomous Region adopted on May 27, 2005.

3. Guidelines and Standards

28. The following guidelines and national standards of the People's Republic of China support the implementation of environmental laws and set the levels of environmental performance required for relevant activities:

i. Technical Guidelines for Environmental Impact Evaluation General Principles (HJ/T2.1-93) ;
ii. Technical Guidelines for Environmental Impact Evaluation - Air Environment (HJ2.2-2008);
iii. Technical Guidelines for Environmental Impact Evaluation - Surface Water Environment (HJ/T2.3-93);
iv. Technical Guidelines for Environmental Impact Evaluation - Acoustic Environment (HJ/T2.4-2009);
v. Technical Guidelines for Environmental Impact Evaluation - Non-polluting Ecological Impact (HJ/T19-1997);
vi. Specifications for Environmental Impact Evaluation of Highways (JTG B03-2006);
vii. Technical Code for Municipal Solid Waste Sanitary Landfill (CJJ17-2004);
viii. Standard for Pollution Control on the Landfill Site for Domestic Waste (GB16889-2008).

C. PRC Institutional Framework

29. The institutional framework for the EIA approval process in the PRC is summarized in the matrix below.

Responsible Departments	Scope of work
XJ Autonomous Region EPB	(i) EIA evaluation, including compliance with appropriate laws, regulations and standards. (ii) Final EIA Approval
County EPB and Altay Prefecture EPB	Environmental management and supervision during project cycle, including the management and supervision of the implementation and fulfillment of the environmental protection/mitigation measures and environmental monitoring.

Source: PMO

D. Asian Development Bank Environmental Requirements

30. Until recently, the ADB's requirements for environmental assessment and management of projects were set out in the *Environmental Assessment Guidelines (2003)*. The project underwent initial appraisal using these guidelines and was classified as Category A on the basis of ADB's Rapid Environmental Assessment. This is the highest category, requiring a full EIA document. Subsequently, the ADB produced its safeguard policy document (*Safeguard Policy Statement (2009)*) which requires a number of additional considerations, including: (i) project risks and respective mitigation measures and project assurances; (ii) project level Grievance Redress Mechanism including documentation in the EMP; (iii) definition of the project area of influence; (iv) physical cultural resources damage prevention analysis; (v) climate change mitigation and adaptation; (vi) occupational and community health and safety requirements (including emergency preparedness and response); (vii) economic displacement that is not part of land acquisition; (viii) biodiversity conservation and natural resources management requirements; (ix) provision of extensive sufficient justification if local standards are used; (x) ensuring adequate consultation and participation; and (xi) ensuring that EMP includes implementation schedule and (measurable) performance indicators.

31. The use of local standards warrants some discussion here. The PRC domestic EIAs have been prepared initially for PRC approval processes and therefore are required to use PRC standards throughout for water quality, air quality, noise and effluents. The ADB Safeguards Policy promotes the use of Country Safeguard Systems (CSS), however the

application of CSS requires an equivalence and acceptability assessment followed by ADB Board approval. Accordingly, in order to follow the spirit of this policy, this Consolidated EIA will compare the critical PRC impact standards (effluents and emissions from subcomponents) with the World Bank Group Environmental Health and Safety Guidelines[2] to provide an international good practice context.

E. International Agreements

32. China is a signatory of a large number of international agreements relevant to environment protection. Those with direct application to the project, along with the date of signing by China, include:

i. *Convention on Biological Diversity,* 29 December 1993. To develop national strategies for the conservation and sustainable use of biological diversity;
ii. *Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat,* 21 December 1975. To stem the progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value;
iii. *Kyoto Protocol to the United Nations Framework Convention on Climate Change,* 23 February 2005. To further reduce greenhouse gas emissions by enhancing the national programs of developed countries aimed at this goal and by establishing percentage reduction targets for the developed countries;
iv. *Montreal Protocol on Substances That Deplete the Ozone Layer,* 1 January 1989. To protect the ozone layer by controlling emissions of substances that deplete it;
v. *United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification,* 26 December 1996. To combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements;
vi. *United Nations Framework Convention on Climate Change,* 21 March 1994. To achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system.

F. Scoping the Assessment

33. The PRC Environmental Impact Assessment regulations classify different sectors on the basis of anticipated potential impacts and assigns different levels of EIA. For the sectors involved in this project, and at the scales planned, roads and landfill subcomponents require a full "EIA Report" while heating, wastewater treatment and water supply subcomponents require a lower level of EIA treatment, the "EIA Table".

34. The ADB guidelines for the EIA categorization of projects provides the following criteria: (i) Category A. A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.
(ii) Category B. A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.

[2] IFC/World Bank Group 2007, *Environmental, Health, and Safety (EHS) Guidelines*, Washington April 30, 2007.

35. According to the ADB criteria, waste water treatment and landfill, with their potential to pollute surface and groundwater resources and possibly heating boilers due to their emissions would require a Category A EIA, and the remainder Category B. On the other hand, the PRC legislative provisions of the EIA of these sectors requires the higher standard of EIA documentation for roads and landfill and a lower level for wastewater treatment, heating and water supply. Thus, a combination of the two sets of guidelines would require a high level of assessment for all except water supply subcomponents. However, due to the water scarcity of the region and the consequent obligation to consider upstream and downstream uses to ensure sustainability, water supply subcomponents warrant attention in this area.

36. Thus, scoping of the sectors and environmental setting for this Project, the following subcomponent sector risk factors have been identified:

vi. Waste water treatment – all aspects, with special attention to effluent management
vii. Solid waste management – all aspects, with special emphasis on leachate management
viii. Heating – gaseous emissions
ix. Water supply – downstream water users, water security and sustainability
x. Roads – noise and sensitive receptors

While the full range of potential environmental impacts will be discussed in this CEIA, these risk factors will be the main emphasis.

G. Area of Influence and Evaluation Standards for Subcomponent Sectors

1. Road Subcomponents

37. The scope of investigation are the areas 200 meters on both sides of central line of roads. This covers the critical acoustic environment and includes the sensitive receptors of dense residential areas, schools and hospitals. The Environmental Quality Standard for Noise Acoustic Environment (GB3096-2008) will be the relevant PRC impact standard. During construction, Noise Limits for Construction Site (GB12523─1990) will be the relevant assessment standard.

38. Similarly the investigation and evaluation of ambient air is determined 200 meters by both sides of the proposed road's central line. The Ambient Air Quality Standard (GB3095-1996) and its Standard grade II standard shall be implemented within the area in the evaluation.

39. Wastewater produced during road construction will be assessed against the Standard grade III of Environmental Quality Standard for Surface Water (GB3838-2002) to ensure its suitability for draining into rivers and channels. Grade III of Quality standard for Ground Water shall be implemented for any wastewater which might escape to the ground water where the project is located. Access roads to new water supply extraction points and the new WWTPs have the potential to also facilitate unintended developments or the exploitation of natural resources that were previously inaccessible.

2. Water Supply Subcomponents

40. Based on environmental features of the project sites and characteristics of the projects themselves, the scope of the environmental assessments includes: The existing function and quality of source water bodies and the uses; the water resource users, ecological system and habitat of aquatic animals and plants in the downstream reaches; and, the water security and quality protection issues in the upstream areas. Standards pertaining to this scope of assessment include:

- Grade III of Standards for the Quality of Surface Water Environment (GB3838-2002);

- Standards for the Quality of Water Resource for Domestic Drinking Water (CJ3020-93);
- Hygienic Standards for Drinking Water Quality (GB5749-2006);
- Grade III of Ground Water Quality Standard (GB/T14848-93);
- Integrated Wastewater Discharge Standard (GB8978-1996);
- Discharge Standard for Municipal Wastewater (CJ3082-1999).

41. Additionally, the acoustic environment within the range of the project will be assessed against the grade II of Environmental Quality Standard for Noise (GB3096-2008), ensuring that sensitive receptors are not impacted. Standards pertaining to this scope of assessment include:

- Grade II of Environmental Quality Standard for Noise (GB3096-2008).
- Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008).

3. Waste Water Treatment Subcomponents

42. The construction of the pipeline network will be in residential areas and other public areas, therefore, dust pollution caused by construction shall be controlled to keep the quality of ambient air. The standard pertaining to this scope of assessment is Grade II of Ambient Air Quality Standard (GB3095-1996). Pipe-laying will also temporarily affect the acoustic environment, which will extend to sensitive receptors along the pipe alignments (Noise Limits for Construction Site (GB12523—1990)).

43. Quality of water from sewage plant's outlet shall be ensured to come up to the Standards for Irrigation Water Quality (GB5084-2005), or for discharge into a water body (Grade III of Standards for the Quality of Surface Water Environment (GB3838-2002) and Grade III of Standards for the Quality of Groundwater Environment (GB/T14848-93)). In both cases the area of influence will need to cover downstream water quality and its potential impact on downstream users. Additional standards pertaining to noise, odor and air emissions will extend the terrestrial area of influence beyond the site boundary. Relevant standards for assessment include:

- Standard grade II of new pollution source of Integrated Emission Standard of Air Pollutants (GB16297-1996);
- Upland crops of Standards for Irrigation Water Quality (GB5084—2005);
- Standard grade II of Emission Standard for Odor Pollutants (GB14554—93);
- Discharge Standard for Municipal Wastewater (CJ3082-1999);
- Noise Limits for Construction Site (GB12523—1990);
- Standard grade II of Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008);
- Grade II of Emission Standard of Air Pollutants for Coal-burning, Oil-burning, Gas-fired Boiler (GB 13271-2001) will be implemented for waste gas of boilers used in WWTP.

4. Solid Waste / Landfill Subcomponents

44. The scope of the evaluation of air quality is for an area surrounding the landfill site to a radius of 1500m. Grade II of Ambient Air Quality Standard (GB3095-1996) is the relevant standard for the assessment of ambient air quality. The maximum permissible concentration limit of harmful substance in the atmosphere over residential areas is contained in Hygienic Standards for the Design for Industrial Enterprises (TJ36-79). It is also the relevant standard for odour pollutants such as NH_3 and H_2S.

45. The area of influence for impacts on the water environment covers groundwater as an essential element (quality, direction of flow and recharge areas) and surface water flow as a safeguard consideration (against flood or snow-melt runoff). Surface waters downstream of the sites, which may be intermittently fed by groundwater will also be part of

the scope of assessment. For protection of the groundwater environment, grade III of Standards for the Quality of Groundwater (GB/T14848-93) will be used. Standard grade III of Standards for the Quality of Surface Water (GB3838-2002) will also be used for assessment.

46. The area of influence for assessment of the acoustic environment is at a series of points 1m beyond the boundary of proposed landfill projects, in both upwind and downwind directions. The odour levels at these points need to meet grade II of Environmental Quality Standard for Noise (GB3096—2008).

5. Heating Subcomponents

47. The area of influence for ambient air quality for centralized heating facilities is within a radius of 6km from the plant. In this area, Class II standard stated in Ambient Air Quality Standard (GB3095-1996) is the relevant standard. For point source air emissions during operation, Time Period II of Category II in *Atmospheric Pollutant Discharge Standard for Boilers* (GB13271-2001) is the relevant standard and is measured at the smokestack. The concentration limits for uncontrolled discharge of new pollution sources covered *Comprehensive Discharge Standard of Atmospheric Pollutants* (GB16297-96) will be followed for dust emission from coal stockpiles and ash yards.

48. During construction, noise assessment will follow the standards in *Noise Limits at Plant Side of Building Operation* (GB12523-90), and during operation the assessment standard will be Category-II Standard stated in *Ambient Noise Emission Standard at Plant Side of Industrial Enterprises* (GB12348-2008). Construction noise is evaluated at sensitive receptor sites and operational noise is evaluated within 1m out of boundary of heating plants and heat-exchange stations.

49. Category I standard of *Pollution Control Standard for Storage and Disposal Site of General Industrial Solid Waste* (GB 18599-2001) shall be followed for the handling and disposal of ash and extracted flue particulates.

6. White Birch Forest Subcomponent

50. The White Birch Forest scenic area sub-component comprises roads, water supply and wastewater subcomponents. Standards used in construction and operation will therefore be those associated with those sectors which have been outlined above. The area of influence of the development is significantly restricted in comparison with subcomponents in the county seats because of the lack of sensitive receivers to noise and dust during construction. However because of high visitor numbers and the natural and scenic values which bring them to the area, the natural amenity needs to be protected from odours and effluent overflow from the wastewater facilities. Safeguards are discussed in Chapter C and Chapter E.

H. EHS Guidelines

51. The principles and standards of the World Bank Group Environmental, Health and Safety Guidelines (2007) are used by the ADB's Safeguards Policy. The general guidelines, in company with the Industry Sector Guidelines, will provide the context of international best practice and will contribute to establishing targets for environmental performance. The sector guidelines referenced were: General EHS Guidelines (covering occupational health and safety and community health and safety); Waste Management Facilities sector guidelines; Water and Sanitation sector guidelines; and Plantation Crop Production sector

guidelines[3]. The air, noise and water quality standards in the EHS guidelines will also provide justification for the use throughout of PRC standards.

52. All new/rebuilt central heating coal fired boiler stations financed under the Project will meet (i) the national standards for emission and air quality; and (ii) the applicable requirements laid out in the World Bank Group's Environment, Health and Safety (EHS) Guidelines.

53. The design and technology of the proposed landfills will meet the national standards and the requirements laid out in the EHS sector guidelines for Waste Management Facilities. The design and technology of the proposed water supply and wastewater treatment plants will meet the national standards and the requirements laid out in the EHS sector guidelines for Water and Sanitation.

54. Occupational and community health and safety, as laid out in the EHS guidelines, will be a cross-cutting assessment element for all infrastructure subcomponents.

[3] IFC/World Bank Group 2007, *Environmental, Health, and Safety Guidelines Waste Management Facilities*, Washington December 10, 2007.
IFC/World Bank Group 2007, *Environmental, Health, and Safety Guidelines Water and Sanitation*, Washington.
IFC/World Bank Group 2007, *Environmental, Health, and Safety Guidelines Plantation Crops*, Washington.

CHAPTER C. DESCRIPTION OF THE PROJECT

A. Justification and Rationale for the Project

1. The Need for the Project

55. Altay Prefecture, which covers all the counties with infrastructure subcomponents in the project, is the northern portion of the Xinjiang Uygur Autonomous Region, and is one of the most important tourism areas of Xinjiang with its rich and unique tourism resources. With implementation of the national western development strategy, some of the county seats in this area have gradually become important sightseeing destinations and open cities in Northwest China. They have all witnessed rapid economic development, expanding city size and increasing population. However, construction of infrastructure such as urban transportation, water supply, sewage collection and treatment, urban refuse and solid waste treatment and management facilities, and heating facilities has lagged behind significantly, limiting sustained social and economic development of the prefecture. All project counties have poverty levels above 10% and two counties, Qinghe and Jimunai, are declared national poverty counties.

56. All components will support approved development master plans. New roads, water supplies, sewerage and wastewater treatment plants, centralized heating facilities and landfills for solid wastes are planned for implementation in the county seats of Buerjin, Habahe, Qinghe, Jimunai and Fuhai counties where local governments have shown interest and commitment.

57. The project complies with the two main development agendas of environmentally sustainable growth and inclusive economic growth promoted in ADB's long-term strategic framework 2020[4]. It is also in line with and supports the PRC country partnership strategy (2008-2010) which promotes efficient infrastructure, strengthens environmental management, and supports inclusive growth and balanced development[5]. The project supports Millennium Development Goal 7 by improving the environmental sustainability of the participating counties through appropriate treatment and disposal of wastewater and solid waste.

58. Screening of the subcomponents was undertaken based on pre-selection criteria at fact-finding stage and during the project preparatory TA stage. All counties in which components are proposed are autonomous, with ethnic minorities making up the majority of the population.

59. The Project is designed to improve the conditions of infrastructure and public amenities, increase employment and reduce the incidence of poverty, support tourism development to promote economic growth, and protect the environment in the participating counties. It is supportive of ADB's Country Strategy for the PRC to make markets work more efficiently through infrastructure development and to promote environmental sustainability. It is also designed in line with PRC's development priorities for the Western Region, XUAR's 11FYP, and a number of county Master Plans to improve local living conditions.

60. The function of some urban roads is unclear within the county seat networks, cross sections are often inadequate, and the mutual interference of pedestrians, non-motorized traffic and motorized traffic is substantial. The standards of some road structures and roadbase treatments are low and many road surfaces are seriously damaged. The connectivity of branch roads is poor, and they cannot adequately function in traffic distribution and segregation of traffic between the arterial roads and secondary roads.

[4] ADB 2008, *Strategy 2020, The Long-Term Strategic Framework of the Asian Development Bank 2008-2020*. Manila.
[5] ADB 2008, *Country Partnership Strategy, People's Republic of China 2008-2010*. Manila.

61. Present water supply facilities are weak and unlikely to be able to satisfactorily service predicted future growth. In summer when water usage is at its peak, many areas receive low or no water supply, with potential health hazards. The pipe networks in many cases are several decades old and some have reached the end of the design life and require urgent improvement. At present many residents in the urban fringe cannot access the urban water supply facilities. In the poorer areas, drinking water is from pressure water wells and the water quality is often poor. In many places, leachate generated from pit toilets and garbage not promptly treated seeps underground, and contaminates the water table.

62. Many county seat sewerage pipelines and pipeline-connected septic tanks as well as sewage check wells have leakages, causing frequent surface discharge of sewage in flood periods in summer and higher sewage plant operation cost. Existing pump stations are old, and much of the equipment is becoming difficult to maintain in efficient working order. There are numerous breakdowns at plants and sewage from urban areas is sometimes discharged without adequate treatment. This has resulted in pollution of surface water and drinking water sources.

63. A number of solid waste sub-components are planned either adjacent to or conjoined with existing unmanaged landfill areas or dump sites with no safeguards. Current landfill sites in the counties are being operated without environmental safeguards. While the exigencies of operating in extended freezing conditions can explain some management shortcomings, overall the current sites provide graphic evidence of low design and operating capacities. The existing landfills lack anti-seepage measures, fencing or garbage filling and compaction equipment, causing a number of environmental problems. Among these are odour and air pollution, wind-blown garbage, and contamination of soil and underground water. This can result in the spread of diseases, degradation of the surrounding grassland, and threats to the quality of drinking water downstream and consequently the health of people using the water.

64. The centralised heating infrastructure of the county seats varies in quality, efficiency and environmental performance. A number of existing boilers are nearing the end of their operational life, are highly polluting and have low energy efficiency. Additionally there are large settlements in the low income areas with no service from central heating facilities and use small domestic stoves for household heating (in addition to cooking stoves). Taken together, the county seat heating sources currently produce significant air pollution (including greenhouse gases).

2. Integration of Development and Sustainability

65. Cities of northern Xinjiang are centered on the sources of available water (called “oasis cities”). Due to the concentration of urban and commercial development which is characteristic of these settlements, the new and upgraded roads, water supply, sewerage and wastewater treatment, heating and landfill facilities planned for the counties will bring benefits to all the city-dwellers.

66. The increased connectivity and clear separation of arterial and neighborhood roads implicit in the selection of road subcomponents will ensure transport flow-on effects reach the people who have also been provided with a sustainable water supply and wastewater and solid waste management. In these cases it is expected that significant development advantages will accrue. The increased water supply will be supported by a stronger capacity for wastewater treatment and waste disposal which will ensure that the strengthened water supply will not increase pollution through wastewater, and will also correct a currently increasing surface and groundwater contamination problem. Similarly, strengthened and environmentally sound solid waste disposal and landfill will both support higher levels of urban and commercial development as well as addressing the current logistical problems of waste disposal and pollution from poorly sited and managed landfills.

67. Local authorities will be able to build on the start provided by the physical infrastructure and the supporting demonstrations of appropriate local planning and environmental assessment processes of the Project.

68. To make the water infrastructure development (water supply and wastewater treatment) sustainable, it is necessary to look at environmental/water issues both upstream and downstream of the Project's interventions. Upstream, it has to be ensured that plans and procedures for source water quality protection through watershed management are in place; that water use conflicts for water sources are avoided; and that water supply and demand are reconciled. The primary tool in this instance are "water balances" – for source water bodies covering inflow, extraction volumes and return volumes – as well as flow analyses for the river basins, of which the water source is a part, to show relative magnitude and significance of water extraction.

69. Downstream of the extraction point of water supply subcomponents a meaningful consideration of wastewater collection and treatment has been demanded. Return waters from wastewater treatment, even from land discharge via surface and groundwater linkages, must not impair the water quality of receiving water bodies. This EIA includes a special section on water resource utilization and management, with detailed assessment of both direct and indirect environmental impacts of proposed water supply and WWTPs.

70. An important downstream consideration is the reuse of discharge water to provide irrigation for sand-stabilizing plants and windbreaks. In the dry desert environment, which pertain on the outskirts of the country seat urban areas, water for vegetation growth to combat desertification and to shelter residential areas from sand-laden winds has always been the limiting factor. Wastewater reuse in this way is therefore a valuable element to the region's sustainable development.

3. Demonstration Benefits

71. The Project will support the comprehensive mode of urban development and expansion considering the availability of natural resources. Water and land are the most precious resources and are intricately interconnected. The project will provide integrated transport, water and solid waste infrastructure to underpin urban development and expansion.

72. Other demonstration features of the Project include: (i) the physical integration of urban-rural linkages with subproject road, water supply, wastewater and solid waste management, and heating infrastructure to facilitate economic and social integration and growth; (ii) strengthening of subproject districts/counties' capacity in integrated project planning, design, implementation and O&M; (iii) strengthening the project management of small-scale and diversified components, from project selection, prioritization, and design to implementation and O&M to ensure replicability; and (iv) promoting responsiveness of the subproject districts/counties to climate change adaptation and mitigation.

73. The Project will also provide institutional capacity-building measures in infrastructure development and environmental management and policy reforms to ensure sustainability of the Project. The demonstration features with particular resonance for the environment include: (i) strengthening project environmental management capacity of small-scale and diversified components, from selection, environmental assessment, and design through to implementation with environmental management and monitoring; and, (ii) addressing environmental sustainability.

4. Climate Change

74. Northwest China appears to be sensitive to changes in climate through increased desertification, increased variability in rainfall patterns (such as extreme precipitation events and longer droughts), and increased rate of glacial melt and nivation which feed a number of

river systems in the region. The nationwide annual mean air temperature is predicted to increase by 1.3-2.1°C in 2020 and 2.3-3.3°C in 2050 (over 2000 levels) [6]. The warming will mainly occur in north-western and north-eastern China where significant temperature rise is projected. The National Climate Change Programme concludes that the arid areas in China will therefore probably become larger and the risk of desertification will increase, since the temperate grasslands in Northern China are on the verge of degradation and desertification because of drought and environmental deterioration. Snow cover is also expected to reduce with significantly larger inter-annual variation. Recent trends show a significant decrease in annual precipitation in most of Northern China, averaging 20-40 mm per 10 year period. In the next 50-100 years, the mean annual runoff is likely to decrease in the northern arid provinces, and the National Programme indicates the possibility of a consequent gap between water resource supply and demand in Inner Mongolia Autonomous Region, Xinjiang Autonomous Region, Gansu, and Ningxia Autonomous Region.

75. Altay Prefecture is significantly vulnerable to climate change. Project initiatives in both climate mitigation and adaptation will introduce approaches and activities for developing climate resilience and low-carbon emissions. The designs for the sub-components address climate change issues primarily in the significant net reduction of greenhouse gases which will be achieved by the heating and road subcomponents. Adaptations for a range of possible future climate changes (including greater risk of floods and droughts) have been included in designs. The following elements of subcomponent design and planned implementation are relevant to the local conditions and developmental environment.

Limiting Greenhouse Gas Emissions

76. The subcomponent sectors with potential to have greenhouse gas emissions are roads (fossil fuel combustion of vehicles), heating (fossil fuel combustion for boilers), landfill (methane discharge from compacted garbage), and indirectly through water supply to new industries. However, for roads and heating subcomponents, the application of new design and the replacement of inefficient facilities will result in CO_2 savings.

77. The Project's road components have the potential to reduce greenhouse gas emissions at the local level through the implementation of the following measures: (i) the individual subproject roads will promote increased energy efficiency through higher quality road surfaces, grades and curve radii, road network connectivity and reducing travel time; and, (ii) PRC programs on vehicle emissions, fuel quality regulations and fuel economy standards will support road connectivity benefits. The heating subcomponents will also replace inefficient boilers and many small domestic heaters, thus also making CO_2 savings. This will significantly reduce the CO_2 emissions from that component.

78. Design elements to limit emissions from landfill include airway gabions to provide more aerobic conditions in the landfill base. In the climatic conditions prevailing in Altay Prefecture, with extended frozen periods underground methane production is expected to be low, and gases emerging from these airways will be monitored to ensure that emissions stay below 5% methane concentration at any time. Methane emissions from the landfills have been calculated and converted to CO_2 equivalents (CO_2e)[7]. CO_2 emissions from landfills have also been calculated and these have been added.

79. The cumulative greenhouse gas emissions from all subcomponents are tabulated below as CO_2e. They comprise CO_2 emissions from fossil fuels (including ancillary boilers used in WTPs and WWTPs) as well as methane produced from landfills. In the case of

[6] National Development and Reform Commission 2007, *China's National Climate Change Programme*, Beijing June 2007.

[7] The impact of one ton of CH_4 has 21 times more impact on global warming than a ton of CO_2 using the conversion factor (global warming potential, or GWP) adopted by the Kyoto Protocol, or 23 times more if the most recent value calculated by the Intergovernmental Panel on Climate Change (IPCC) is used. This project will use the IPCC figure.

roads and heating subcomponents, the figure will be net CO_2 reductions. Methodologies for calculating CO_2 savings for roads and for heating subcomponents are in Appendix 2. Predicted gas emissions from landfills are given in Chapter E, Section C, "Impacts and Mitigation Measures during the Operational Phase" as part of the consideration of air pollutants from these facilities.

Table C.1: Total CO_2e Emissions from Project Subcomponents

Sub-component	Total GHG Emissions (in CO_2e)
Road	-479,401 t/year*
Water Supply	+507 t/year**
Wastewater	+152 t/year**
Heating	-95,512 t/year
Solid Waste/Landfill	+25,216 t/year***
Total	*-549,038 t/year*

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

* 2015 traffic volumes.

** Ancillary heating boilers

*** Combined CH_4 and CO_2 emissions (converted to CO_2e)

80. While this is necessarily a coarse analysis, the order of magnitude of emissions from the different components is indicative of significant savings in greenhouse gas emissions from the implementation and operation of the planned project infrastructure components.

81. The selection and planning of water supply components will not indirectly contribute to greenhouse gas emissions by facilitating new industries. The majority of water is to be provided to domestic areas. An aggregate total of 70% of water from all subcomponents is planned for domestic water use, plus landscaping and public water use. Although 17% is for industrial water use, no new industrial developments are wholly dependent upon the subprojects for their development. The remaining 13% is for water leakage and unforeseen water use.

82. Also in water supply subcomponents, watershed management policies and activities for water source protection will promote increases in vegetated areas (carbon sinks) and decreases in polluting activities. Carbon sequestration would also be achieved by the irrigated forest plantations which reuse treated effluent from the WWTPs. These measures have not been quantified in Table C.1, but would add to the level of CO_2e savings of the whole project.

Adaptation to Future Climate Change Effects

83. At a minimum, the Bellagio Declaration on transportation and climate change[8] recommends that adaptation strategies contain the following aspects:

- A long term perspective (building climate resilient infrastructure from new);
- Requirements for fixing and adapting what already exists (maintenance);
- Recognition of the need to respond to climate emergencies (a "preparedness" approach).

[8] UNFCCC, 2009. Draft Bellagio Discussion Paper – Strategies for bringing land transport into the climate change negotiations

84. These approaches are also in line with the ADB's CCF Implementation Guidelines' specific criteria and scope for adaptation[9] which, for transport and urban development, requires "Climate proofing of road, rail, port, and subway projects to ensure adequate resilience to changing climatic conditions (e.g., future extreme events, changes in rainfall patterns, and changes in drainage patterns)" and for water supply "Activities to promote the resilience of integrated water resources management projects to future climate changes, e.g., temperature, rainfall, glacial melt, drainage patterns and flow, sea level rise, or an increase in the frequency or intensity of extreme weather events".

85. The Project subcomponents generally conform to these principles. During the design phase, the issue of seasonal urban flooding and frost heave of soil have been taken into account. Urban flooding from rising temperatures causing early snow melt is a major factor and roads have been aligned, designed and culverted to ensure that (i) they are not impacted by flooding, and (ii) that they don't exacerbate flooding elsewhere by channeling or redirecting overland flows. All project roads will be designed to a standard of a 1 in 50 year flood or better (42% of the total length of roads will be on flatter terrain and designed to 1 in 100 year flood levels). Culverts will also be sized for a 1 in 100 year flood to ensure that flood drainage is uninterrupted. Access roads to new WTPs, WWTPs and landfills will be constructed with benches for snow drift disposal to ensure that these services are not cut off in harsh winters.

86. Additionally, the water supply components will use a conservative co-efficient of runoff for design inflow amounts (95 percentile of a dry year) to cover the eventuality of lower rainfall in the future. The loss by evaporation has been based upon calculations from large reservoirs and is therefore a precautionary over-estimation for river water sources. Additionally, a sensitivity analysis of inflow for significantly drier periods (including critically dry periods) shows that even in the most critical water shortages, water will be available for domestic use and downstream users (see Chapter E; Section A, "Occupational Health and Safety (Construction and Operational Phases)").

87. A summary of project features, by subcomponent, addressing greenhouse gas emissions and climate change adaptations is given in Table C.2 below.

Table C.2: Project Features Addressing Climate Change

Sub-component	Climate Change	
	GHG Emission Reduction	Adaptation/Resilience
Road	▪ Road engineering (surface quality, curve radii, gradients) which reduce GHG (mainly CO_2) emissions through fuel savings	▪ Design avoiding disasters from extreme weather events (flood proofing, snowdrift protection) ▪ Connectivity for disaster response
Water Supply	▪ Appropriate engineering approaches and cleaner production which reduce carbon emissions from treatment plant ▪ Water source protection which increases vegetation growth and carbon sequestration	▪ Water balances based upon dry year with additional sensitivity analysis to ensure viability in significantly drier times ▪ Flexible pipes ▪ Decentralized sources and plants
Wastewater	▪ Appropriate engineering approaches and cleaner production which reduce carbon emissions from treatment plant	▪ Planned overflow and shut-down measures ▪ Elevated freeboard of settlement and

[9] ADB 2008, Climate Change Fund: Implementation Guidelines, 5.

		aeration ponds to avoid flood levels
Heating	▪ Appropriate engineering approaches and cleaner production which reduce CO_2 and SO_2 emissions ▪ Monitoring and management of installations emitting > 100,000 t CO_2 equivalent (as per safeguards policy) ▪ Increased heating efficiencies ▪ Seek opportunities to augment heating supply with cogeneration and heat exchange with other enterprise boilers	▪ Engineering standards and design avoiding disasters from extreme weather events
Solid Waste/Landfill	▪ Appropriate engineering approaches which reduce greenhouse gas emissions (mainly CH_4 leachate gas) and which facilitate diffusion and dispersion of gases which do occur.	▪ Siting considerations ▪ Avoid areas where increasing snow melt may cause local flooding
Afforestation	▪ Atmospheric carbon absorbed and reduced (CO_2 sequestration)	▪ Plantation species selection: wide environmental amplitude or planned successional growth ▪ Full canopy species to increase shade and moderate microclimate

Source: PPTA Team

5. Lessons Learnt – Best Practices in Water Supply and Sanitation

88. An ADB study of 18 water supply and sanitation projects between 1990 and 1997 [10] found that projects with successful wastewater components, in particular, had a strong positive environmental impact due to the reduction of untreated wastewater allowed to flow back into the ecosystem. The better water quality due to the treatment contributed to improvements in freshwater ecosystems. The more rational use of water resources in water supply components also had a positive effect on aquifers and groundwater in the project areas. A more recent project in 2009-2010 in Chongqing [11] found water supply and sanitation projects required assessment both upstream and downstream. Upstream, the issues of water security and watershed management are important; and downstream, the water users (both ecological and livelihood) need to be considered. The main tools used for these assessments were water balances (which include downstream irrigation, domestic and ecology requirements) and river basin analyses (which place the source waterbody and receiving waters in the context of basin dynamics). Both techniques will be employed in the present project.

6. Lessons Learnt – (Xinjiang Roads and Environmental Improvement)[12]

89. These projects recognized the difficulties in co-ordinating the planning contracting and implementation of integrated infrastructure in order to gain the maximum benefits from them. The main project risks identified included the low institutional capacity for environmental management; the failure of the PMOs, IAs, and O&M organizations to monitor environmental impact and implement the EMP during the construction and operation of the Project; and delay in building the project-associated facilities. They recommended as risk-management strategies: (i) extensive training in environmental management under the

[10] Gatti, M 2007 *Best Practice in Water Supply and Sanitation: Learning from Successful Projects*, Asian Development Bank, Manila.
[11] Chongqing Urban-Rural Infrastructure Development Demonstration Project, SEIA (TA 42012-PRC).
[12] Xinjiang Regional Road Improvement Project (TA 42012-PRC) and Xinjiang Urban Transport and Environmental Improvement Project (TA 40643-PRC)

Project, (ii) the appointment of qualified project implementation consultants, and (iii) appropriate project implementation monitoring and mitigation arrangements.

B. Project Subcomponents

90. The infrastructure facilities planned for each county are listed in Table C.3 below. All together, there are 25 subcomponents in five counties. The implementing agencies are all government agencies and the operation and maintenance units are a mix of state owned enterprises, public institutions and private enterprise.

Table C.3: Project Subcomponents

Component	Sub-component	Implementing Agency	Operation and maintenance unit
Buerjin	Road	Buerjin County Urban and Rural Construction Bureau	Buerjin County Public Facilities Maintenance Center
	Water supply	Buerjin County Urban and Rural Construction Bureau	Buerjin County Jincheng Water Supply and Wastewater Company
	Wastewater	Buerjin County Urban and Rural Construction Bureau	Buerjin County Jincheng Water Supply and Wastewater Company
	Solid Waste	Buerjin County Urban and Rural Construction Bureau	Buerjin County Environmental Sanitation Team
Fuhai	Road	Fuhai County Construction Bureau	Fuhai County Wastewater Treatment Station
	Wastewater	Fuhai County Construction Bureau	Fuhai County Wastewater Treatment Station
	Solid waste	Fuhai County Construction Bureau	Fuhai County Environmental Sanitation Team
	Heating	Fuhai County Construction Bureau	Fuhai County Zhongsheng Heating Limited Liability Company
Habahe	Road	Habahe County Construction Bureau	Akeqi Town Urban Maintenance Company
	Wastewater	Habahe County Construction Bureau	Habahe County Potable Water Company
	Solid waste	Habahe County Construction Bureau	Akeqi Town Urban Maintenance Company
	Heating	Habahe County Construction Bureau	Akeqi Town Urban Maintenance Company
	Water Supply	Habahe County Construction Bureau	Habahe County Potable Water Company
	White Birch Forest Infrastructure	Habahe County Construction Bureau	Akeqi Town Urban Maintenance Company
Jimunai	Road	Jimunai County Urban and Rural Construction Bureau	Jimunai County Municipal Company
	Water supply	Jimunai County Urban and Rural Construction Bureau	Jimunai County Municipal Company
	Wastewater	Jimunai County Urban and	Jimunai County Municipal

Component	Sub-component		Implementing Agency	Operation and maintenance unit
			Rural Construction Bureau	Company
	Solid waste		Jimunai County Urban and Rural Construction Bureau	Tuoputiereke town environment & sanitation team
	Heating		Jimunai County Urban and Rural Construction Bureau	Jimunai County Municipal Company
Qinghe	County seat	Water supply	Qinghe County Construction Bureau	Qinghe County Fuyuan Water Supply and Wastewater Company Limited
		Wastewater	Qinghe County Construction Bureau	Qinghe County Fuyuan Water Supply and Wastewater Company Limited
		Solid waste	Qinghe County Construction Bureau	Qinghe Town Environmental Sanitation Team
		Heating	Qinghe County Construction Bureau	Qinghe County Ankang Heating Limited Liability Company
	Takeshiken Land Port	Water supply	Qinghe County Construction Bureau	Qinghe County Fuyuan Water Supply and Wastewater Company Limited
		Wastewater	Qinghe County Construction Bureau	Qinghe County Fuyuan Water Supply and Wastewater Company Limited

Source: PPTA DFR, August 2010

1. Water Supply

91. Five water supply components are planned in three counties (one each in Buerjin, Habahe and Jimunai, and two in Qinghe (Qinghe county seat and Takeshiken Land Port)). The water supply subcomponents are summarized in Table C.4. The majority of water provided by the subcomponents (70% overall) is for domestic water use – providing for increased local population growth and replacing aging infrastructure.

92. The implementation of the water supply subcomponents will (i) meet local increasing potable water demand; (ii) improve drinking water quality and local public health conditions; and (iii) maximize water security.

Table C.4: Water Supply Subcomponents

County	Status	Capacity (m^3/d)	Source and Water Quality Class	Capture and Transmission			Water Distribution
				Capture Structures	Transmission design	Pipe	Pipe Length
Buerjin	New WTP	9,000	Buerjin River II	Prismatic Box-type Structure	Double transmission pipes, by gravity	67 km, including 36.8 km of DN500 and 30.2 km of DN400 single pipe; Ductile Iron Pipe	7.4 km, including 1 km of DN300, 3.4 km of DN315, 1.4 km of DN200, and 1.6 km of DN400

County	Status	Capacity (m^3/d)	Source and Water Quality Class	Capture and Transmission			Water Distribution
				Capture Structures	Transmission design	Pipe	Pipe Length
Habahe	New pipelines only		The source and water quality class for the existing WTP: Shankou Reservoir in the upstream of Habahe River II				New construction 5.6km pipes, including 2.3km of DN200, 1.9km of DN300 and 1.4 km of DN400.
Habahe County White Birch Forest	New WTP	90	Habahe River II	1 large opening well (the well locates adjacent to the river bank, and the extraction water from the well is the penetration water from the river)			New construction 8.5 km pipes, including 3.5km of DN100, 5.0km of DN50
Jimunai	New pipelines only		The ground water under the river bed in the upstream of Lasite River III				New construction 30.0km pipes, including 0.4km of DN150, 4.8km of DN200, 17.1km of DN300, and 7.6km of DN400.
Qinghe	Upgrade WTP	6,000	Baixing Reservoir on Daqing River II				New construction 13.9km pipes, including new construction of 6.6km of DN300 and 2.7km of DN200; and upgrading of 0.9km of DN200, 2.9km of DN300 and 0.8km of DN400.
Takeshenken LP	New WTP	1,800	Buergen River II	1 large opening Well (the well locates adjacent to the river bank, and the extraction water from the well is the penetration water from the river)	Double transmission pipes, by gravity	New construction 0.55km, DN300, glass reinforced pipes	New construction 15.8km pipes, including 3.8km of DN100, 8.5km of DN200 and 3.5km of DN300.

Source: PPTA DFR, August 2010

93. Environmental and water security issues, both upstream and downstream of the Project's interventions, have been taken into account. This approach, though standard international practice in impact assessment, is innovative for small urban-rural infrastructure projects in PRC and enhances the Project's demonstration value.

94. Upstream, statutory plans and procedures for source water quality protection through watershed management will be confirmed and strengthened according to PRC legislation. Downstream, potential water use conflicts for water sources (for both livelihood and in-stream ecological uses) have been examined.

95. Water supply and demand have been reconciled at both the local level and at the sub-regional (cumulative) level. The primary tools in this instance are (i) the water balance for source water body covering inflow, extraction volumes and return volumes, and (ii) river basin analysis to show relative magnitude and significance of the water extraction. These are discussed in Chapter E, Section A, "Impacts Associated with Project Location, Planning, and Design".

96. The water treatment method selected for the water supply subcomponents includes disinfection by chlorine dioxide. Dosage will be adapted to water quality, requiring on-site laboratory facilities and operational skills. Issues of occupational health and safety associated with the preparation, use and storage of this chemical and its constituents are examined in Chapter E, Section D, "Occupational Health and Safety (Construction and Operational Phases)".

2. Wastewater Treatment

97. Wastewater components are planned in all project counties. The specifications of the wastewater treatment subcomponents are summarized in Table C.5 below. The sites of the project components are shown in the maps presented at the beginning of this CEIA.

98. The implementation of the wastewater subcomponents will (i) meet local increasing wastewater collection and treatment requirements; (ii) improve local health and living environment; (iii) alleviate groundwater pollution, and downstream area water pollution; (iv) provide irrigation (through water reuse) for plantations and soil stabilizing vegetation; (v) improve local urban infrastructures and meet the needs of urban development.

Table C.5: Summary of Wastewater Treatment Subcomponents

County	Status	Capacity (m^3/d)	Wastewater Lifting Pumping Stations	Summary of Works	Wastewater Pipeline	
					Pipe Material	Pipe Length
Buerjin	New WWTP	6,000	2	Construction of new WWTP and new wastewater pipeline network. Discharge of treated effluent to irrigation.	PE Double Wall Corrugated Pipe	11.5 km, including 8.7 km of DN300, 1.2 km of DN400, 1.6 km of DN600
Habahe	New WWTP	7,000	1	Construction of new WWTP and associated new wastewater pipeline network	Pipe diameters ＜500 mm, HDPE double-walled corrugated pipe is selected; pipe diameter ≥ 500 mm, reinforced concrete pipe is selected.	8.8 km, including 5.3 km of DN400, 3.2 km of DN500 (including 1.9km PE pressured pipes) and 0.3 km of DN600.
Fuhai	New WWTP	8,000	1	Construction of new WWTP and new wastewater pipeline	The pipe diameter＜500 mm, HDPE double-walled	15.7 km, including 7.7 km of DN300,

County	Status	Capacity (m^3/d)	Wastewater Lifting Pumping Stations	Summary of Works	Wastewater Pipeline	
					Pipe Material	Pipe Length
				network. Discharge of treated effluent to irrigation.	corrugated pipe is selected; the pipe diameter ≥ 500 mm, reinforced concrete pipe is selected.	0.7 km of DN400, 0.5 km of DN500, 1.5 km of DN600, and 5.2 km of DN700.
Jimunai	New WWTP	5,000	-	Construction of new WWTP and associated wastewater pipeline network. Discharge of treated pre-effluent to irrigation.	HDPE double-walled corrugated pipe	7.0km, DN200
Qinghe	New WWTP	5,000	1	Construction of new WWTP and associated wastewater pipeline network. Discharge of treated effluent to irrigation.	The pipe diameter＜500 mm, HDPE double-walled corrugated pipe is selected; the pipe diameter ≥ 500 mm, UPVC double-walled corrugated pipe is selected.	21.8 km, including 6.8 km of DN300, 3.3 km of DN400, 2.2 km of DN500, and 9.5 km of DN600.
Takeshiken	New WWTP	4,000	1	New WWTP and pipeline. Discharge of treated effluent to irrigation.	The pipe diameter＜500 mm, HDPE double-walled corrugated pipe is selected; the pipe diameter ≥ 500 mm, reinforced concrete pipe is selected.	5.8 km, including 5.5 km of DN300 (including 2.0km PE pressured pipes) and 0.3 km of DN600.

Source: PPTA DFR, August 2010

99. The influent quality across the counties varies. The poorest quality influent from all project counties within the Altay Prefecture (advised by the Altay Prefecture EPB) is summarized in Table C.6 below, and all the proposed wastewater treatment plants have been designed for this quality of influent.

Table C.6: Worst Case Influent Quality

Parameter	BOD5	CODcr	SS	PH	TP	TN
mg/L	251	323.82	180	7-8	8.0	35

Sources: Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

100. The designed secondary treatment process is “aerated oxidation pond treatment process after pre-treatment (primary sedimentation). The selected treatment process is illustrated in Figure C.1 below.

Distribution Structure → Coarse Screen and Lifting → Fine Screening → Primary Sedimentation → Aerated Oxidation Pond → Secondary Sedimentation → UV Disinfection → Flow Meter → Irrigation

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

Figure C.1: WWTP Process Flow

101. In winter Altay is cold, and the average outdoor temperature is about -18°C. This affects the selection of treatment method. The floating aerator arrangement is more efficient in low temperatures and has been selected for the subcomponents in the Project area. Low temperature also affects microbial activity and the efficiency of pollutant removal. With falling water temperature, the treatment efficiency decreases until at water temperatures of 4°C, the treatment efficiency is almost zero. However, with appropriate building arrangements , the water temperature can be kept at 8°C and, by raising the concentration of the mixing liquid in the aeration pond, reducing the sludge load, and increasing the sedimentation time, the efficiency of pollutant removal in the aeration pond can reach 40%. This is appropriate for winter operation when, due to the curtailment of many commercial and industrial activities, the quantity of the influent entering WWTP is appreciably reduced and the quality of the influent is slightly improved.

102. The treated effluent will be used for irrigating wind break and sand stabilizing forests and ecological shelterbelts to combat desertification. The plantations will cover a total area of 950 ha in five counties and utilize a total of 1,140,000 m^3 of treated effluent per year. The details of the water use and establishment of these plantings are summarised below in Table C.7 and more fully described with soil characteristics and species in Appendix 3.

103. The wastewater treatment plants are designed to comply with the Water Quality Standard for Irrigation (GB5084-2005). The required effluent quality is listed in Table C.8 below. At and below these levels the uptake of plants will ensure that contaminants will not build up in the soil nor significantly impact surface water or ground water. The project will require assurances, through loan covenants and other avenues, that the wind break and sand stabilizing forests appropriate to the location will be constructed in time, and operated, maintained and monitored to ensure their long-term performance.

Table C.7: Summary of Planned Irrigation Forest

County	WWTP Capacity (m^3/d)	Annual Effluent Discharge Amount ($1\times10^4 m^3$)	Annual Evaporation Amount ($1\times10^4 m^3$)	Annual Irrigation Amount for forest ($1\times10^4 m^3$)	Planned Forest Area (Ha)	Area of existing forest incorporated (Ha)	Area to be planted (Ha)
Buerjin	6,000	219	3.21	215.8	205	68	137
Habahe	8,000	292	3.8	288.2	274	34	240
Jimunai	5,000	182.5	3.4	179	170	0	170
Fuhai	7,000	255.5	3.7	251.8	240	0	240
Qinghe	4,000	146	1.98	144	137	20	117
Takeshiken LP (Qinghe)	1,200	43.8	0.6	43.2	41	0	41
Totals	31,200	1138.8	16.69	1122	1067	122	945

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

Table C.8: Design Effluent Standard for Irrigation Discharge

Parameter	BOD5, mg/l	COD, mg/l	SS, mg/l	pH	Dissolved Solid, mg/l	Chloride, mg/l	Sulfide, mg/l	Coliform Bacteria, number/100ml	Roundworm Eggs, number/l
Value	100	200	100	5.5-8.5	1000 for non-saline-sodic soil area; 2000 for saline-sodic soil area*	250	1	4000	2

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

* Soils in the project area fall into the "saline-sodic" category

104. The planned use of treated wastewater effluents for irrigation has three major benefits: (i) it reuses wastewater - an important initiative in this water-poor region; (ii) it provides a source of water which would otherwise have to be abstracted from natural reserves; and (iii) it enables wastewater treatment to be undertaken to a lower standard (water quality) than would be the case if effluents were to be discharged to open water courses, and therefore puts the management of modern wastewater treatment facilities within the financial reach of the county governments.

105. This proposal to integrate needed wastewater management with reuse of water and the establishment and extension of land-stabilizing vegetation follows the principals of Integrated Ecosystem Management (IEM). IEM is the primary approach currently being planned and implemented by PRC under its GEF funded program for combating land degradation. IEM represents an ecological approach to resource management which aims to ensure productive and healthy ecosystems by integrating social, economic, physical, and biological needs and values. Rather than treating each resource in isolation, IEM treats all elements of an ecosystem together in order to obtain multiple ecological and socioeconomic benefits. Important principles of IEM are that management should be decentralized to the lowest appropriate level, and that management should be undertaken at the appropriate scale and at appropriate levels of technology.

106. It is proposed by the IAs that treated effluent be dispersed over the irrigation area, even in winter where it would freeze on the surface. This is not considered to be an environmentally nor horticulturally sound practice. Instead, it is proposed by this CEIA that bunded storage will be constructed to allow the controlled release of irrigation waters to match crop requirements and soil percolation rates. The bunded storage will have sufficient capacity to store treated effluent over winter when the ground is frozen and water cannot percolate. The risk return period for a severe, prolonged winter must be defined from which the required period and hence volume for wastewater effluent storage will be determined. The irrigation rate to fully consume all available stored final effluents, plus that added on a daily basis, such that the use of storage is at a minimum by the start of ground freezing will determine the minimum area of plantation required. A factor of safety should also be applied.

107. The specific method for irrigation will also need to be determined. A very detailed operational plan must be prepared to ensure that effluent flows are only released in accordance with horticultural needs and the available percolation rate at the time. This will be included as a loan assurance.

108. All county WWTP developments will replace existing aeration and settlement ponds. Size and configuration of these facilities differ among the counties and their closure and rehabilitation plans will need to be finalized on the basis of individual site investigations. The general principles of closure and rehabilitation will include the natural evaporation and land infiltration of the effluent in the ponds (over a period of about 6 months), followed by sun-drying for a period of about one year. Final stages will involve the removal of contaminated soil and sludge at the bottom of the ponds and using the material as cover spoil in the county

landfill sites, followed by appropriate earthworks to achieve a "natural" terrain which can ultimately be re-vegetated. The use of the dried soil and sludge as landfill cover will require that its levels of contaminants comply with PRC standards for landfill (Technical Code for Municipal Solid Waste Sanitary Landfill (CJJ17-2004) and Standards for Disposal of Industrial Solid Waste (HJ/T300).

109. The closure and rehabilitation plans need to be developed and implemented at the time of commissioning of the new plants. The plans will be based upon site investigations and quantity surveying of all materials. The rate of disposal of the polluted pond bottom spoil will be based on the daily operating capacity of the landfill sites. Time-bound closure and rehabilitation plans will be a project assurance through loan covenants.

3. Solid Waste/Landfill Subcomponents

110. The Project will implement solid waste treatment components in all project counties. The specifications of these subcomponents are summarized in Table C.9 below. The sites of the project components are shown in the maps presented at the beginning of this CEIA. The subcomponents include the provision of neighbourhood trash containers, district collection stations, additional garbage haulage vehicles and properly sited, designed and managed sanitary landfills.

111. A number of solid waste sub-components are planned either adjacent to or conjoined with existing unmanaged landfill areas or dump sites with no safeguards. Each county will prepare a time-bound action plan for closure of the existing landfill in accordance with national standard linked to the implementation of the proposed landfill, as well as an environmental monitoring plan to ensure the continued safety of the rehabilitated site. Details of the closure plans are in Chapter E; Section A, "Impacts Associated with Project Location, Planning, and Design".

112. The accumulated town domestic garbage yield for the landfill subcomponent towns has been estimated, and the necessary gross storage capacity of the refuse landfills has been designed (when the garbage compaction density is set at 650kg/m^3, post-garbage-curing compaction density is taken at 90%, and earth covering thickness is set at 0.2m for each 2.8m garbage). The capacity has been aligned against projections of garbage generation in county seats up to 2025. The specifications of the subcomponent are summarized in Table C.9 below.

Table C.9: Solid Waste/Landfill

County	Status	Operation period	Capacity (t/d)	Total Land Area	Design	Garbage Collection Stations	Trash cans
Buerjin	New landfill	15 years	38	34,200 m^2	Bunded landfill Impermeable bottom and sides	52	303
Fuhai	New landfill	15 years	60	99,900 m^2	Bunded landfill Impermeable bottom and sides	70	522
Habahe	New landfill	15 years	60	243,300 m^2	Bunded landfill Impermeable bottom and sides	60	420

White Birch Forest of Habahe						1	180
Jimunai	New landfill	15 years	50	118,700 m^2	Bunded landfill Impermeable bottom and sides	60	450
Qinghe	New landfill	15 years	30	87,200 m^2	Bunded landfill Impermeable bottom and sides	40	399

Source: PPTA DFR, August 2010

113. Domestic garbage will be delivered directly to the refuse landfill in garbage compaction trucks to be dumped in the active landfill area after weighing. It will then be leveled by site equipment (bulldozer), and compacted to no less than 650kg/m^3 density. The spoil preserved from site leveling will then be used to cover the garbage until the landfill depth reaches the designed unit depth (2.8m), with an earth covering thickness of 0.2m. This will complete a landfill unit, and the process will be repeated until the site achieves its designed closure elevation.

114. Design features, as per PRC Technical Code for Municipal Solid Waste Sanitary Landfill (CJJ17-2004), will include: a waste bund to contain the refuse area; flood prevention works and storm-water interception works; land levelling; incorporation of impermeable linings; and refuse gas collection system. These specifications also comply with the World Bank Group EHS guidelines for "properly designed, permitted and operated landfills".[13]

115. The maximum predicted leachate yield in the landfills under extreme weather conditions have been calculated for each county and are listed below in Table C.10. Each includes extra capacity to absorb direct infiltration of surface snow melt during the thaw. Leachate quality predictions have been made based on the nature of the county town domestic garbage and data on the quality of the landfill leachate in comparable cities. These are summarized in Table C.11 below.

Table C.10: Predicted Leachate Volumes from Landfill

County	Daily Leachate Amount (m^3/d)	Maximum Daily Leachate Amount under Extreme Weather Conditions (m^3/d)	Leachate Collection Tank (m^3)
Buerjin	4.46	278	350
Habahe	10.41	418	450
Jimunai	9.23	953	960
Fuhai	7.73	507	550
Qinghe	2.9	273	300

[13] World Bank Group 2008, *Environmental, Health, and Safety (EHS) Guidelines, General EHS Guidelines: Environmental Waste Management*, World Bank, Washington.

Table C.11: Predicted Leachate Quality

pH	BOD_5	CODcr	NH_3-N	TP
≥7	12000 mg/L	20000 mg/L	700 mg/L	5.0 mg/L

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

116. Leachate collection pipes at the bottom of the landfill will guide leachate to a leachate diffusion cell. The collected leachate will be back-sprayed to the garbage landfill to maintain a closed leachate system where the toxic elements of the leachate are gradually broken down. Toxic organic compounds are broken down by microbial biotransformation over time. In parallel, a macro-molecular humus is generated from the refuse during degradation, which binds heavy metal ions in a stable chelate. Leachate back-spraying technology has been used internationally since the 1980s, and has been successfully used in China since 1995.

117. Gas will be generated from the microbial biochemical degradation of the organic fraction of the waste in the landfill. The main gaseous components are CO_2 and CH_4 (methane), accounting for about 40% and 50% of the gas respectively. Methane can be recycled and used as energy, but due to its unstable yield and quality in this situation (its yield and purity vary greatly with the increase in the age of the landfill and with the extreme changes in temperature throughout the year) and other gaseous components such as N_2, NH_3, H_2, CO_2 and H_2S, its recycling and utilization is not considered feasible. Additionally, the low yield of methane under the prevailing climatic conditions (see Table E.20, Chapter E) does not require flaming, since atmospheric dispersal is sufficient to mitigate any methane build-up. Special methane monitoring will be installed to ensure occupational and community safety.

118. The landfill designs will include gas collection systems comprising gas transmitting gabions, collecting pipes and gas diffusion chimneys. The generated CH_4 should not exceed 5% concentration of surface air, a limit set by the Sanitary Landfill Technical Specification of Municipal Solid Wastes (CJJ17-2004). The requirement is reflected in the environmental monitoring program (EMP, Chapter I).

119. The landfill will receive waste from the following sources: (i) municipal solid waste collected by the environment sanitation departments; (ii) fly ash from city boilers, including heating plants; (iii) Residues from domestic waste composting; (iv) non-hazardous industrial solid wastes from clothes processing, foods processing and other manufacturing with characteristics similar to domestic solid waste. Medical waste will only be accepted if it complies with the provisions of HJ/T228 (chemical disinfection treatment); HJ/T229 (microwave disinfection treatment); and HJ/T2769 (hyperthermia vapour treatment). General industrial solid wastes can enter the landfill when their levels of potentially hazardous chemicals after treatment are within the limit values stipulated in HJ/T300. These constraints have been included in the EMP.

120. The implementation of the solid waste subcomponent will (i) Increase the coverage of solid waste collection facilities in the county seat, improve the urban environmental hygiene and amenity, and improve the residents' health and living environment; (ii) Increase the capability for transfer of garbage, and reduce the pollution cause by uncollected or inappropriately disposed garbage in the county seats; (iii) Enable implementation of confined collection and transfer of garbage and reduce the pollution currently caused by spreading and leaking of garbage; (iv) Enable sanitary landfilling of the domestic garbage, reduce pollution to the atmosphere, underground water and soil, and surface grassland caused by garbage filling, and prevent these from endangering the health of residents; and (v) Improve local urban infrastructures and meet the needs of urban development.

4. Road Components

121. The Project includes roads in all project counties. Most of the road subcomponents (60% in length) are upgrades and widening of existing alignments. The remainder are new

roads. An additional 15.5 km will be new access roads to the Project's landfills, water supply and wastewater treatment plants. The specifications of the subcomponent are summarized in Table C.12 below. The proposed road works, comprising small sections of numerous roads, generally complete or strengthen existing road networks in county seats.

122. Road subcomponents have been designed with pedestrian crossings, road lighting, greening and bilingual traffic signs. The establishment of traffic signs and markings will segregate pedestrians and vehicles, improve traffic safety, and reduce the incidence of traffic accidents. In the design of the road cross sections the passage of non-motorized vehicles was considered. However, according to the road safety management regulations of the local government, livestock is not allowed to enter the county seat, so the road subcomponents do not include provision for herdsmen traffic.

123. The implementation of the roads subcomponent will (i) facilitate safe and smooth travel for residents; (ii) increase connectivity of the urban road network system; (iii) improve vehicular energy efficiency and reduce air emissions from improved road conditions; and (iv) increased access to public transport nodes and introduction of public transport services to areas with no services at present, which will be considered in the transport planning of the project counties.

Table C.12: Summary of Roads

County	Road name	Road Class	Construction Nature	L(Km) Length of Road
Buerjin	Youyifeng	Principal	Expansion	0.68
	Yueliangwan	Secondary	Rebuilding	1.47
	Shuanghubei	Secondary	Expansion	1.03
	Wolongwan	Principal	Expansion	0.83
	Hebin	Secondary	Rebuilding	1.08
	Kanas	Principal	Expansion	0.21
	Wucaitan	Principal	Rebuilding	1.69
	Shenxianwan	Secondary	New	0.11
	Baihuayuan	Secondary	New	0.38
	Xingjiang	Secondary	New	1.30
	Xingsheng	Secondary	New	1.35
	Minzu	Principal	New	1.61
Fuhai	Huancheng East	Secondary	Expansion	1.53
	Beixin	Collector	Expansion	0.46
	Zhenxing East	Principal	Expansion	0.88
	Xingfu	Collector	Expansion	2.33
	Tuanjie	Principal	Expansion	0.82
	Wenxing	Principal	New	1.40
	Zongsi	Secondary	New	1.20
	Hengsan	Secondary	New	0.94
Habahe	Beihuan	Secondary	New	1.88
	Guihuasan	Secondary	New	1.87
	Tuanjie	Secondary	New	0.62

County	Road name	Road Class	Construction Nature	L(Km) Length of Road
	Wenhua	Principal	New	0.62
	Xingfu	Secondary	New	0.62
Jimunai	Guanghui	Principal	Rebuilding	2.76
	Caigang	Principal	Rebuilding	2.16
	Bian'an	Principal	Rebuilding	2.04
	Tuanjie	Secondary	Rebuilding	2.75
	Xingfu	Secondary	Rebuilding	1.26

Source: PPTA DFR, August 2010

Table C.13: Access Road Summary

County	Sub-component	Access Road
Buerjin	WTP	1.5km
	Landfill	0.95km with 7 m wide bituminous surface
Fuhai	WWTP	2km
	Landfill	8.6km with 7 m wide bituminous surface
Habahe	WWTP	0.8km
	Landfill	1km with 7 m wide bituminous surface
Jimunai	WWTP	0.60km
	Landfill	1.5km with 7 m wide bituminous surface
Qinghe	WWTP	1km
	Landfill	0.70km with 7 m wide bituminous surface
Takeshiken	WWTP	1.3km

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

5. Heating Component

124. The heating components include the construction of new centralized heating plants, distribution pipes and heat exchange stations to either replace or upgrade existing aging facilities in Jimunai and Qinghe counties. Elsewhere, the installation of heating pipelines and a new heat exchange station (in Habahe) will service new areas, which are currently using local and domestic heating. The sites of the project components are shown in the maps presented at the beginning of this CEIA.

Table C.14: Heating Subcomponents

County	Status	Heating Source	Heating Pipelines	Heating Exchange Station
Fuhai	Upgrading	-	Upgrading of 2.9km primary heating pipeline network including: DN500 1.6km, DN400 0.4km, DN250 0.9km; Upgrading of 4.4km secondary heating pipeline	-

			network including: DN300 0.6km, DN250 1.3km, DN200 1.9km, and DN150 0.7km.	
Habahe	New construction		New construction 2.4km primary heating pipeline network including: DN250 1.8km, DN300 0.1km and DN400 0.5km (in the north of the county seat).	New construction 4 heating exchange stations
Jimunai	New construction	New construction of 1 boiler house with 2×14 MW boilers at the existing boiler house located at the north of county seat (demolish existing 2×7 MW boiler house located at the south of county seat and existing 1×7 MW boiler house located at the north of county seat, and reserve the existing 1×14 MW boiler house located at the north of county seat), and total capacity is 3×14 MW	New construction 6.6km primary heating pipeline network including: DN200 1.9km, DN250 2.5km, DN300 1.4km, DN400 0.5km and DN450 0.4km.	New construction 8 heating exchange stations
Qinghe	Upgrading and New construction	Upgrading of the existing heating plant (the existing 1 x 29MW high-temperature boiler will also be included in the heating source, 2 x 14MW and 1 x 10.5MW low-temperature boilers are not functional any more) with 1 x 46 MW boiler, the total capacity is 75MW	New construction 3.8km of primary heating pipeline network including: DN250 1.3km, DN300 1.1km, DN350 1.3km, and DN500 0.1km.	New construction 3 heating exchange stations

Source: PPTA DFR, August 2010

125. Details of the coal fuel characteristics of each county heating subcomponent, the predicted emissions, and the range of heating units (both centralized and domestic) which the new heating subcomponents will replace are at Appendix 4, and are discussed in Chapter E, Section C "Impacts and Mitigation Measures during the Operational Phase".

6. White Birch Forest

126. The White Birch Forest scenic area sub-component comprises vehicle tracks, water supply and wastewater subcomponents. The location is shown in the map presented at the beginning of this CEIA. The total length of the proposed tracks is 11.4 km, including the widening of one principal road from the entrance to the parking lot, a secondary road and a number of maintenance and recreation branch tracks. The works also include bridges and ancillary facilities. The provision of these roads will promote safe and controlled park usage by an increasing tourist population.

127. At present, White Birch Forest scenic area has no water supply. Water abstraction in the scenic area for watering is drawn from tributaries of the Habahe River on an ad hoc basis. There are no wastewater facilities. There is a clear need for safe, reliable domestic water for visitors and working personnel in the scenic area and to safeguard public health. The collection and treatment of wastewater will reduce pollution to the scenic area's ecological environment and improve the tourism amenity.

128. Visitation is currently high and expected to increase significantly. The forecast of water demand is 90.7 m^3/day in 2015, rising to 228.5 in 2025. The proposed works include a WTP with a capacity of 90 m^3/day increasing to 250 m^3/day to match future demand, plus 8,470 m of water supply pipeline network. The water quality of the source water is found to be good, and only disinfection is required. Water purification is added for when the turbidity does not meet the standards. Chlorine dioxide generator is selected as the disinfection method.

129. Based on a wastewater coefficient of 0.8, the wastewater generated in White Birch Forest scenic area is predicted to be 72 m^3/day in the short term and 200 m^3/day in the long term. The planned response to this demand is a 150m^3 septic tank and a network of wastewater pipelines delivering wastes from toilets and other facilities. It is planned that wastewater will be pumped from the tank daily and transported to the sewerage system of the Habahe WWTP by truck.

130. This wastewater management system therefore depends upon a high level of management and maintenance to prevent overflow to the environment. The shortcomings of this subcomponent proposal and recommendations for changes are included in Chapter E, Section C "Impacts and Mitigation Measures during the Operational Phase".

7. Associated Developments

131. A number of developmental activities will occurs as a consequence of the implementation of Project subcomponents, or as complements to them. These are "associated developments" and the consideration of their environmental due diligence is included in this CEIA. These comprise: (i) demolition of replaced boilers (see Chapter E, Section C); (ii) irrigation schemes for reuse of WWTP effluent (see Chapter E, Section C); (iii) closure and restoration of existing landfills (see Chapter E, Section B, subsection 4); and (iv) closure and restoration of existing aeration and settlement ponds (see Chapter E, Section B, subsection 5).

8. Institutional Component

132. Project management and capacity building is an important aspect of the ADB loan. There will be a need to provide support and training to the PMO and the IAs on ADB procedures, environmental impact assessment, social assessment, environmental management and monitoring, resettlement plan monitoring, risk management, and operation and maintenance of project facilities.

133. The IAs, supported by local EPBs, will undertake the environmental management activities prescribed in this EIA and EMP. Environmental responsibilities in different phases of the Project are listed in Table C.15.

Table C.15: Institutional Responsibility for Environmental Management

Phase	Responsible Agencies	Environmental Responsibility
Preparation	Design institutes on behalf of IAs	Prepare domestic EIAs and EMPs for subprojects
	County EPBs	Review and approve the domestic EIAs and EMPs
	ADB, PMO	Review and approve the Consolidated EIA including the integrated EMP
Design	Design Institutes on behalf of County IAs	Incorporate mitigation measures in the EMPs in engineering detail designs, and contracts
Construction	IAs and district/county EPBs	Advise on implementation of mitigation measures
	Contractors	Implement mitigation measures

Phase	Responsible Agencies	Environmental Responsibility
	Environmental Monitoring Companies, on behalf of County IAs	Undertake internal inspection and monitoring
	County EPBs as well as Environmental Monitoring Companies, on behalf of EPBs	Undertake external monitoring and inspect implementation of mitigation measures
Operation	IAs, County governments and City Committees	Undertake and supervise internal environmental monitoring and inspection
	County EPBs	Undertake periodical and random environmental monitoring and inspect environmental compliance

Source: PPTA Team

ADB = Asian Development Bank, EIA = environmental impact assessment, EMP = environmental management plan, EPB = environmental protection bureau, IA = implementing agency, PMO = project management office,

134. From Table C.14 it is apparent that the IAs and local EPBs carry a substantial responsibility and workload if they are to ensure the environmental soundness of their components. The largest part of the capacity building in environmental management has therefore been in this direction. During the course of the TA, IAs and their EIA Institutes have been assisted in EIA preparation through written critiques of their EIA drafts, training sessions, and workshops where specific environmental issues were examined. IAs, EIA Institutes have been further instructed in EMP preparation and implementation in an interactive workshop where actual EMPs for subprojects were developed.

135. An ongoing capacity building program necessary to achieve a successful project implementation and eventual outcome of the Project has been designed by the TA. It has three objectives: (i) Support during project implementation; (ii) Strengthening of O&M agencies to give assurance on project sustainability, and (iii) Creating "value added" from the Project. In addition there is an extensive training need that is cross-cutting across all aspects of the capacity building. The capacity building program will cover all aspects of project management and administration. Areas which will directly support strengthened environmental performance include the following:

136. Support during project implementation will cover design review and support to local design institutes, advice on environmental monitoring and updating of EMPs., advice on resettlement plan implementation (including internal monitoring), and the implementation of PPMS and support in progress reporting to ADB.

137. Strengthening of O&M agencies to give assurance on project sustainability will cover WWTP operations (including monitoring and control systems), wastewater source control (including permitting systems), landfill operations (including monitoring and control systems), preparation of operational procedures, and establishment of planned preventative maintenance plans.

138. Creating "value added" from the Project will promote behavior change in looking after the local environment, enhancement of community health awareness (including HIV and STD), enhancement of gender awareness, energy efficiency programs for district heating, identification and implementation of 3R initiatives (reduce, reuse, and recycling of waste), and traffic management and road safety.

139. Training will support this by providing opportunities to see best practice in other cities and on the job training (such as on the O&M of new project facilities) and extended training or work placements within the PRC (e.g. at technical training schools in larger cities, or work placements at operational WWTP or sanitary landfills).

CHAPTER D. DESCRIPTION OF THE ENVIRONMENT - BASELINE

140. The description of the pre-project environment (biophysical and socio-economic) establishes (i) the environmental setting within which the project will be implemented, and therefore needs to be designed to suit, and (ii) the environmental values which will be changed (either negatively or positively) by the project. Both these roles are encompassed by the concept of the "baseline" environment.

141. The baseline environmental surveys undertaken for subcomponents were determined by the kinds of subcomponent sectors proposed and the environmental parameters which were relevant to their impact assessment.

A. Regional Environmental Setting

142. About 40 percent of China's total land mass comprises dryland areas and these are mostly in the northern and western regions of the country. An estimated 100 million people live in these dryland areas. As a result of decades of deforestation, communal grazing, intensive farming, and uncontrolled exploitation of natural resources, particularly the forest cover and groundwater, the environment in this region is fast deteriorating and faces serious land degradation and severe water loss.

143. XUAR, located in the north-western part of PRC XUAR is one of the most remote regions in the PRC. Around 97% of the population lives in an oasis belt that covers only 8% of the region's total land area. Water availability is a critical concern to the fragile ecology of XUAR, which is predominantly a desert territory with a fragile ecology, strong winds, low rainfall and high evaporation rate.

1. Landform

144. Most of Xinjiang is young geologically, having been formed from the collision of the Indian plate with the Eurasian plate. Older geological formations occur principally in the far north where the Junggar Block is geologically part of Kazakhstan, and in the east which is part of the North China Craton. The landform comprises three east-west mountain ranges embracing two basins in between. The three mountain ranges are Altay Mountain in the north, Tianshan in the center, and Kunlun Mountain in the south. The two basins are the Junggar Basin between Altay and Tianshan, and the Tarim Basin, which is the largest in the PRC, is between Tianshan and Kunlun. In the center of the Tarim Basin stretches the Taklimakan Desert, the largest shifting desert in the PRC and the second largest in the world.

145. Xinjiang has within its borders the point of land which is most remote from the sea. This is the so-called "Eurasian pole of inaccessibility" in the Dzoosotoyn Elisen Desert, 2648 km from the nearest coastline (straight-line distance).

146. About 68 million ha or 41.2% of Xinjiang's total area are considered suitable for the development of agricultural, forestry and animal husbandry. Of this there are some 48 million ha of natural grassland for grazing, 9 million ha of degraded grassland where reclamation is possible, over 4 million ha under cultivation and 666,700 ha of man-made pastures. Xinjiang is one of China's five major grazing areas. In addition there are some 4.8 million ha of land available for forestry including 1.5 million ha in production with reserves of some 250 million cubic meters of timber.

2. Climate

147. The climatic conditions and the landform shape the environment of the region. The climatic features of the project's counties are summarised below.

Monthly Average Temperatures (°C)

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Altay City													3.5 – 4
Buerjin County	-14	-8.1	-2.1	12	15.6	21	23.9	21	15.8	5.4	-1.4	-9.4	6.6
Fuhai County	-21.9	-14.3	2.8	9.1	19.6	24.3	25.7	21.7	14.5	7.6	-2.9	-13.4	6.1
Habahe County	-11.1	-15	-2.5	10.3	15.5	17.8	22.4	20.5	13.8	7.3	-4.7	-14.3	5
Qinghe County	-22.9	-11.4	-7.9	4.5	12	17	18.4	16.6	10.8	2.4	-10.3	-20	0.1
Jimunai County	-12.2	-11.0	-5.6	5.7	13.0	18.5	20.6	18.8	12.8	4.5	-4.9	-9.8	4.2

Monthly Precipitation (mm)

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Altay City													130 – 250
Buerjin County	4.1	7.1	5.4	4.4	31.7	28.9	23.8	20.2	7.8	17	14.5	5.3	170.2
Fuhai County	4.4	2.5	4.3	10.5	1.8	3.0	23.6	6.6	12.4	7.1	7.5	4.1	87.8
Habahe County	23.9	16.1	9.8	35.6	12	22.9	4.5	17.2	39.2	16.2	40.2	31.9	269.5
Qinghe County	7.1	7.2	8	10.8	15.1	18.6	27.6	16.4	16.8	11.6	15.6	10.2	165
Jimunai County	9.8	7.4	10.4	17.7	24	21.3	26.3	18.5	16.7	16.1	20.4	14.2	204

Monthly Evaporation (mm)

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Altay City													1,814.9
Buerjin County	150.6	176.6	224.3	263.2	356.0	322.1	355.9	308.5	233.3	199.4	137.3	108.6	2,839.8
Fuhai County	8.1	18.7	88.5	158.7	193.0	814.7	189.6	171.5	92.7	87.5	23.9	9.6	1,256.5
Habahe County	29.7	20.5	79.3	159．2	166.1	153.0	184.9	159.7	94.7	86.9	48.7	23.6	1,206.3
Qinghe County	9.1	17.5	55.7	145.5	251	262.4	247.8	220.4	161.3	80.4	20.6	8.1	1,479.8
Jimunai County	20.2	26.5	57.0	178.8	313.9	380.6	401.1	350.4	235.2	116.3	39.1	21.3	2,140

Source: Xinjiang Statstical Yearbook, 2009

148. The National Climate Change Programme[14] speculates that the arid areas in China will probably become larger since the temperate grasslands in Northern China are on the verge of degradation and desertification because of drought and environmental deterioration. Snow cover is also expected to reduce with significantly larger inter-annual variation. Recent trends show a significant decrease in annual precipitation in most of Northern China, averaging 20-40 mm per 10 year period.

3. Drainage

149. Xinjiang has an annual runoff of some 88 billion m^3 of surface water together with 25 billion m^3 of exploitable groundwater. Glaciers covering 24,000 km^2 currently store over 2,580 billion m^3 of water. The Erqisi River Basin is a central feature of the project area

[14] National Development and Reform Commission 2007, *China's National Climate Change Programme*, Beijing June 2007.

(although it does not affect all counties). This is a transboundary river. From its source in the Mongolian Altay mountains in Xinjiang, China, the Erqisi flows north-west through Lake Zaysan in Kazakhstan, meeting the Ishim and Tobol rivers before merging with the Ob in western Siberia, Russia after 4,248 kilometres. In its journey through Russia it is called the Irtysh River.

150. Other major rivers in the prefecture include: the Buerjin and Habahe Rivers, which are both tributaries of the Erquis River; and the Wulungu River and its major tributaries, the Daqing and Buergen Rivers. Xinjiang's other major river, the Tarim, does not flow through the prefecture.

Figure D.1: Main River Systems in the Project Area

4. Natural Features

151. The XUAR government focuses significant development attention on its natural resources, cross-border trade with Central Asia republics, and tourism. The Altay Prefecture is located on the northern end of XUAR with land ports bordering Kazakhstan and Mongolia and scenic tourism resources, but suffers from poor infrastructure. Altay Prefecture possesses scenic mountains and lakes with 56 rivers of various sizes, an arable area of 11,000 km^2 and meadows of 98,000 km^2, making tourism one of its pillar industries. The present focus is on the national top-ranked tourist destination of Kanas Scenic Zone. Other developing tourist destinations include "Sandao Haizi" ("Three Seas") in Qinghe, White Birch Forest in Habahe, places along the major rivers (Erqisi and Wulungu Rivers) and their tributaries, and the four land ports, two open to Mongolia and two open to Kazakhstan. Whilst tourism has the potential to contribute significantly to economic growth in the region, by its spending power and job creation, it also relies on good accommodation, excellent delivery of municipal services, safe and available transport and a pristine environment.

5. Biodiversity

152. The Xinjiang Uygur Autonomous Region covers nearly one sixth of the territory of China, with various landscape patterns, environmental conditions and three key regions of biodiversity of China[15]. The ecosystem here has a relatively simple structure and fragile ecological stability. The coverage of sparse vegetation here is only 2.1% which is far lower than the average coverage all over the country (of 14%). Although the species numbers of Xinjiang are few, the diversity of taxa is high. The flora abounds in genera with one or few species and one-genus families. Also, the fauna includes a number of endangered and endemic species, of which 108 species of vertebrates are listed as nationally protected species.

6. Socio-Economic Conditions

153. **Poverty incidence.** Xinjiang is among the poorest of the Western Region provinces. Table D.1 shows that on a number of key economic indicators, Xinjiang ranks low in comparison to other regions in the PRC. In 2008, it was 30th out of 31 regions in terms of *per capita* annual disposable income of urban households, and 25th in terms of *per capita* annual disposable income of rural households.

Table D.1: Ranking of Xinjiang Economic Indicators in Context of Other Regions in China, 2008

Region	Rank (across 31 Regions)	Per Capita Annual Disposable Income of Urban households (CNY)	Rank (across 31 Regions)	Per Capita Annual Disposable Income of Rural Households (CNY)	Rank (across 31 Regions)	Per capita GDP (CNY)
China		15,781		4,760.6		22,640
Shanghai	1	26,675	1	11,440.3	1	72,554
Xinjiang	28	11,432	30	3,502.9	25	19,725

Source: Xinjiang Statstical Yearbook, 2009

154. Over the last few decades, the PRC has made remarkable progress in reducing poverty. Measured in terms of the World Bank poverty standard, between 1981 and 2004 the fraction of the population consuming below this poverty line fell from 65% to 10.3%. By 2007, the percentage of China's population below this poverty line was estimated to have fallen still further to 4.0%. However, as poverty has fallen, it has become increasingly difficult to eliminate the poverty of the remaining poor households, found mostly in remote, mountainous and minority areas. Poverty has now become concentrated in the Western Region of China. Since the mid- 1990s, poverty rates in these Western provinces, including Xinjiang, have fallen, but they fell by less than rates elsewhere. As a consequence, there has been a pronounced increase in the share of China's poor who live in these provinces. The Western provinces now account for about half of China's poor, well above their 29% share of the country's population. If poverty is assessed by a measure that is sensitive to how poor the poor are, then the Western provinces account for about two-thirds of China's poverty. In the North West, the incidence of poverty is estimated to be 20%.

155. In Xinjiang, in 2007, about 8% of the urban population, and 10% of the rural population were living below the official poverty line, compared with the national average poverty incidence of 4% and 4.7%, respectively. The 2008 annual per capita disposable income of XUAR urban households at CNY11,432 ($1,681), was 28% lower than the

[15] Pan B and Y Zhang 2002, Characteristics and conservation of biodiversity in Xinjiang, *Science in China (Series D)*, 45, December 2002.

national average (CNY15,781 ($2,321)). Of the 101 cities and counties in XUAR, 27 counties are categorized as national poverty counties. At the same time, the Region has one of the highest population growth rates in the PRC. As a consequence, serious challenges that are arising from unemployment and urbanization, and land degradation in rural areas compound the impact of its overall poverty on the local standard of living.

156. Despite the economic potential of the Project counties, they all have relatively high poverty incidence rates, compared to China's overall poverty incidence rate of 4% (Table D.2). These rates range from 10.3% in Fuhai to 33.2% in Jimunai – in each case higher than the average poverty rate for the XUAR as a whole (10% in rural areas, and 8% in urban areas). Qinghe and Jimunai are both national poverty counties. The poverty is said to be concentrated in rural areas, near the borders, where the majority of the population are from ethnic minority groups. However there are still significant numbers of poor people in the county urban population. Official figures were not available on the ethnic composition of poor households in the county seats. However, the proportion of ethnic minority households among the MLSG recipients in the socio-economic household survey ranged from 60% to 70% – more than the proportion of ethnic minority people in the overall county seat population.

Table D.2: Indicators of Poverty in Project Counties

Poverty Indicator	County				
	Buerjin	Fuhai	Habahe	Qinghe	Jimunai
Poverty incidence rate for county, 2008*	14.35%	15.15%	10.91%	22.29%	33.24%
Poverty incidence rate in urban population	13.6%	11.9%	12.4%	39.6%	14.0%
% of MLSG recipients from ethnic minority groups in socio-economic survey 'poor' sample	70%	60%	60%	57%	70%

Source: Poverty incidence figures supplied by Altay and County PMOs
* Poverty line = CNY1,292 ($190)

157. **Ethnic minorities.** Buerjin County is an ethnic minority county. In the other Project-affected counties, ethnic minority people represent between 45% and 81% of the total county population. The majority of ethnic people in these counties are Kazakh, who, in 2008, represented over 80% of the ethnic minority population in the Project counties. The other main ethnic minority groups present in these counties are the Hui, the Uygur and the Mongols. A number of other minority groups are also present, but in very small numbers.

158. In the county seats, the ethnic minority population made up between 37% and 52% of the total population. Kazakhs again are predominant among the ethnic minority population in all the county seats. The poverty incidence rates ranged from 12% to 14% in the urban populations of four of the Project counties, and were significantly higher in Qinghe (39.6%). No official figures are available on the ethnic composition of the poor urban population. The household surveys did not provide any evidence to the effect that the ethnic minority households in the county seats, in general, had lower incomes than the other households. However, the proportion of ethnic minority households among the MLSG recipients in the socio-economic household survey ranged from 60% to 70% – that is, figures higher than the proportion of ethnic minority people in the individual county seat populations.

159. Like the rest of XUAR, the Project counties have a large ethnic minority population. In all counties but Fuhai, ethnic minority people represent more than 50% of the county population (Table D.3). More than 20 different ethnic minority groups reside in the area. However, unlike XUAR, in the Project counties, Kazakhs are the most numerous of the ethnic minority groups. There are also small percentages of Hui, Mongols and Uygurs in each county. The remaining groups, together, make up less than a few per cent of the population in any one county.

Table D.3: County Ethnic Minority Population

Ethnic Minority Population	County				
	Buerjin	Fuhai	Habahe	Qinghe	Jimunai
Total county population, 2010 (10,000)	6.97	7.35	8.45	6.15	3.91
Total ethnic minority population	48,448	32,984	58,261	49,941	25,567
Total ethnic minority population as % of total county population	69%	45%	69%	81%	65%
Kazakh population as % of total county population	57.5%	39.6%	60.4%	76.3%	62.6%
Kazakh population as % of total ethnic minority population in county	82.7%	88.2%	87.6%	93.9%	95.7%

Source: Total population figures supplied by County Statistical Bureaus; ethnic minority figures compiled from Xinjiang Statistical Yearbook 2009.

B. Component Localities Environmental Setting

1. Buerjin County

160. Buerjin County is located at the southern foot of the western section in mid-Altay Mountains. Buerjin County is located at the confluence of Erqisi River and Buerjin River, about 620 km from Urumqi, capital city of Xinjiang. Highways connect Buerjin County with Urumqi, Habahe County, Jimunai County, Beitun City and Altay City by highway, making it a traffic hub in West Altay Prefecture. With a total area of over 10,350 km^2, Buerjin County administers one town, six townships and 55 administrative villages. Buerjin Town is the administrative center of Buerjin County.

161. **Geology.** The geological structure of Buerjin County consists of the Altay geosyncline fold system in the north and the Zhungar geosyncline fold system in the south, with Erqisi Great Rift as their boundary. Soil in the project area is brown calcic soil. According to soil analyses, the soil has a salt content of 0.13%, belonging to non-salinization soil; content of relevant heavy metals is under standard specified. Soil nutrient has higher phosphorus content. Overall, soil nutrient has lower organic matter, less valuable for agriculture and animal husbandry.

162. **Wind.** Strong winds are a feature of Buerjin and will have an effect on the design and operation of its infrastructure facilities. Wind speed and directions recorded at the Buerjin Meteorological Station/Observatory are summarised below.

Table D.4: Wind Velocity from Buerjin Meteorological Station/Observatory

Item \ Month	1	2	3	4	5	6	7	8	9	10	11	12	Year
Average wind velocity (m/s)	4.9	4.7	4.6	5.0	4.5	3.8	3.2	3.1	3.3	3.9	4.7	4.9	4.2
Max wind velocity (m/s)	17.0	16.0	17.0	20.0	19.0	16.0	14.0	15.0	20.0	18.0	18.0	18.0	

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

Table D.5: Average Wind Direction, Velocity and Temperature in Four Seasons from Buerjin Meteorological Station

Season	Dominant Direction	Average wind velocity (m/s)
Spring	NW	4.75
Summer	NW	3.4
Autumn	NW, ESE	3.63
Winter	ESE	4.76
Full year	NW	4.2

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

163. **Water resources.** Buerjin County is very rich in water resources, with annual surface water runoff up to 7.472 billion m^3, ranking top in Altay Prefecture. Its main river, the Erqisi River, is an international transboundary river, passing through northern Xinjiang from east to west and traversing Kazakhstan and Russia. It finally empties into the Arctic Ocean. Downstream of its confluence with the Buerjin (a major tributary) the Erqisi has an average annual flow of 7.453 billion m^3, a maximum recorded annual runoff 10.525 billion m^3 (1969), and minimum annual runoff of 3.701 billion m^3 (1974). The average daily flow is 92.0 m^3/s, with a maximum recorded flow of 1640 m^3/s (on June 2, 1969), and minimum flow of 1.79m^3/s (on Dec. 5, 1974).

164. The Buerjin River is a major tributary of the Erqisi River, providing over half of its annual average volume as it passes through the western part of Buerjin County. It rises in Youyi Peak, passes through the entire county from the north to the south and enters Erqisi River at Buerjin Town. It has a total length within the county of 269.6km, with a basin area of 9960km^2. It is fed by both rainfall and snow melt. Year-to-year runoff changes greatly. Additionally, runoff is not evenly distributed in a year. Runoff for the period June to August accounts for 74.9% of a year's total flow. The Buerjin River has a maximum annual runoff of 6.33 billion m^3 (in 1969), and a minimum annual runoff 2.64 billion m^3 (1974). The river basin analysis is at Table D.6 below and illustrated in Figure D.2.

Table D.6: Buerjin / Erqisi River Basin

Annual Average Flow within Buerjin County		Proportion of Buerjin River Flow to Total Erqisi River Flow
Buerjin River	Erqisi River	
4.273 billion m^3	7.453 billion m^3	57%

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

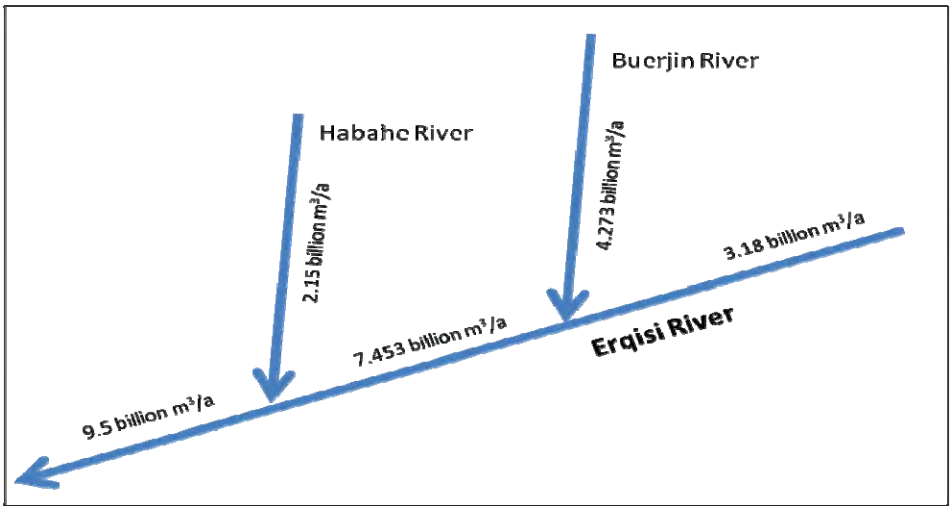


Figure D.2: Configuration and Flows of the Erqisi, Buerjin and Habahe Rivers

165. **Water quality.** Recorded monitoring of the Erqisi River at Buerjin County seat by the Altay Prefecture Central Environmental Monitoring Station gives the following averaged results. They have been evaluated against Class II Category of the national surface water quality standard (B3838-2002) and the results shown as S_i (where $S_i < 1$ indicates compliance)[16].

[16] China's surface water quality standards divide water bodies into 5 classes: Class I being the best and Class V being the worst in terms of water quality standards. Water bodies that are Class III or better could be used for drinking water supply (after treatment).

Table D.7: Water Quality Monitoring and Evaluation Results – Erqisi River

Items	pH	Suspended matters	DO	BOD_5	Petroleum class	COD_{MN}
Monitoring value	7.62	30	8.78	na	na	1.36
Standard value	6-9	/	6	3	0.05	15
S_i	0.31	/	0.31	/	/	0.09

Notes: na = not available.

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

166. A recent one-off sampling of the Buerjin River water quality (by the Altay Prefecture Central Environmental Monitoring Station) at the current water supply extraction point on the outskirts of Buerjin County seat also found that the quality complied with Class II Category of the national surface water quality standard (B3838-2002).

167. The county's surface water and groundwater are all characterized by low mineralization, low suspended matter and good water quality. Domestic water mainly comes from groundwater. The river bench gravel zone in the piedmont plain area is the main groundwater recharge zone. River bed infiltration has become the main vertical supply water source in the region. The depth to ground water around the county seat is usually greater than 8m.

168. Groundwater monitoring data from the Altay Prefecture Environmental Monitoring Station shows the average background values for the main parameters evaluated against the water quality standard for Class III Groundwater Quality (GB/T14848-93). Table D.8 shows that the levels of all parameters comply with this class, which equates to permissible water quality for production and domestic water use.

Table D.8: Groundwater Quality Monitoring and Evaluation Results （mg/L）

Item	pH	Permang. Index	Total Hardness	NH_3	Nitrate	Sulfate	Volatile Phenol	Arsenium	Cr	Cyanide	Fluoride	Cadmium
Result	8.05	2.2	77.77	0.025	0.091	24	0.0018	0.00028	0.002	0.004	0.15	0.0001
Standard	6.5-8.5	3	450	0.2	20	250	0.002	0.05	0.05	0.05	1	0.01

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

169. **Air quality.** Daily average concentrations of SO_2, NO_2 and TSP in the atmospheric environment are all lower than the limited value of daily average specified in Class II standard of the Environmental Air Quality Standard (GB3095-1996). These results show that the project area has very good atmospheric environment quality.

Table D.9: Ambient Air Quality

	SO_2	NO_2	TSP
Average ambient air concentration	<0.006 mg/m³	0.013 mg/m³	0.121 mg/m³
Class II standard	0.15 mg/m³	0.12 mg/m³	0.3 mg/m³

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

170. **Acoustic environment.** Baseline noise analyses were undertaken by the Altay Prefecture Environmental Monitoring Station within the county seat developed area. Noise levels at sensitive receptors near planned roads, waste haulage routes and proposed pipeline works were found to be in line with Class II standard of GB3096-2008, but with little capacity for increased noise. In rural areas, where other facilities are planned, day noise

monitoring values are in line with Class II standard limited value of GB3096－2008, but night sound environment quality is poor, with noise monitoring values of the three points exceeding the Class II standard limited value This is because the project area is in a valley, where wind is strong during night, and over-standard noise is highly related to winds.

171. **Soil salinity and permeability.** In the area of the county where treated effluent is to be reused as irrigation water for soil-stabilizing plantations, the background soil salinity and local water infiltration rates are important factors in irrigation planning. Table D.10: shows these factors for Buerjin, which has a high percolation capacity and high salinity.

Table D.10: Salinity and Infiltration Rates at the Irrigation Site

Irrigation Site	Soil Type	Salinity	Percolation
Buerjin	Sandy brown desert soil	0.13%	1×10^{-1}—1×10^{-2}cm/s

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

172. **Biodiversity.** The area around the county seat is a semi-desert low-mountain hills area. Here vegetation is sparse and wildlife populations are low. According to preliminary survey and secondary data, the area has a total of 18 species of animals (one reptile species; 13 bird species; two rodent species and two mammals). Of these, birds dominate in terms of ecological distribution and population size. They are predominantly resident species. The rodent *Cricefulus griseus* (Chinese hamster) is common while the marmot is quite rare. The lone reptile, the Sunwatcher lizard, is common. The two mammals, the wolf and red fox, are both uncommon in the area. None are protected species under PRC law. Natural vegetation in the project is a grassland desert community, dominated by *Artemisa* and *Stipa*. Herb stratum mainly comprises *Salsola gobica* (Russianthistle), *Peganum* sp., *Atriplex patens*, *Ceratocarpes arenarius* and *Achnatherum splendens*. Vegetation coverage is under 5% increasing to 10% in some areas.

173. Currently 27 species of fish live in the Buerjin River, of which native fish species account for 77.8%, including four rare fish varieties of *Acipenser baerii*, red salmon, fine-scale salmon, and long-neck white salmon. White-spotted pike, perch and *Abramis brama* are a cold water native fisheries resource. The fine-scale salmon is a class 2 protected species under the PRC Wild Animal Protection Law (1989).

174. **Physical cultural resources.** The Cultural Relic Bureau of Buerjin County has confirmed that the area on and surrounding the project has no recorded values for natural, historical and cultural heritage.

2. Habahe County

175. Habahe County is located at the southern foot of the Altay Mountains on the northwestern edge of Xinjiang. It adjoins Buerjin County and Jimunai County in east and south respectively, and also borders the Republic of Kazakhstan in west and north.

176. **Topography.** The county contains both mountainous and plains areas. The mountainous areas cover about 40% of the county. The elevation of the north mountainous area is between 1200-3248m. The highest peak, Mount Jiageertawu has a height above sea level of 3866 meters. The lowest point, the Ertix River, has a height above sea level of 409 meters. The plains incline from southeast to northwest with gradients between 3 and 8%.

177. **Climate.** The climatic features of Habahe County are as follows: No apparent summer; with spring and autumn grading into one another. The mean annual temperature is 4.0^{o}C; the extreme maximum temperature is 38.7 ^{o}C; and the extreme minimum temperature is -44.8 ^{o}C.

178. **Water resources.** The county contains, either wholly or partly, four rivers: the Erqisi River, Habahe River, Bieliezi River, and Alakebieke River. Their total length in the county is 433km, with a cumulative yearly runoff 11.6 billion cubic meters. The river within the direct

area of influence of a number of project subcomponents is the Habahe River, which is a tributary of the Erqisi River. The average annual flow of the Habahe River is 2.15 billion m^3, which is 23% of the flow of the Habahe/Erqisi river basin (see Table D.11 below and Figure D.1 above). The average dry season flow of the Habahe is 1.103 billion m^3.

Table D.11: Habahe / Erqisi River Basin

Annual Average Flow within Habahe County		Proportion of Habahe River Flow to Total Erqisi River Flow
Habahe River	Erqisi River	
2.15 billion m^3	9.5 billion m^3	22.6%

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

179. **Water quality.** Monitoring results of the Erqisi River, as it flows through Habahe County, by the Altay Prefecture Central Environmental Monitoring Station have been evaluated against Class II Category of the national surface water quality standard (B3838-2002). The average values for all parameters comply with this standard.

180. The Habahe River has also been sampled for water quality by the Altay Prefecture Central Environmental Monitoring Station in 2010 at the Haba Bridge and evaluated against Class II Category of the national surface water quality standard (B3838-2002). This is a one-off sample which provides only a "snapshot" of water quality. The evaluation results for 28 water quality parameters show that all indexes of surface water within the area accord with Class II standard of Quality Standard of Surface Water Environment (GB3838—2002), and water is of high quality. Among the parameters, ammonia /nitrogen is on the high side (although still within limits) probably due to low level contamination from domestic waste. The full analysis results are included in Appendix 5.

181. **Groundwater.** The shallow groundwater of the project area belongs to porous ground water type. The depth of groundwater is between 2.20-3.80m and the elevation of the fixed water level is between 516.7-537.2m. The underground water is mainly replenished by the snow melting water infiltration and atmospheric precipitation, and its discharge is in forms of underground runoff and evaporation from land, the groundwater level is in seasonal change, and in general the yearly variation range is 0.50-1.00m. Groundwater monitoring data from the Altay Prefecture Environmental Monitoring Station, measured in 2010, shows the background values for main parameters evaluated against the water quality standard for Class III Groundwater Quality (GB/T14848-93). This class equates to permissible water quality for production and domestic water use.

182. **Air quality.** Daily average value single pollution indexes of pollutants SO_2, NO_2 and TSP in atmospheric environment in the project area are less than the daily average concentration as specified in Class II standard of Environmental Air Quality Standard (GB3095-1996). These results show that the project area has very good atmospheric environment quality.

Table D.12: Ambient Air Quality - Daily Mean Values of Parameters

Pollutants	Daily mean value	Standard value
SO_2	<0.006	0.15
NO_2	0.0072857	0.12
TSP	0.0175714	0.3

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

183. **Acoustic environment.** Baseline noise analyses were undertaken by the Altay Prefecture Environmental Monitoring Station within the county seat developed area. Noise levels at sensitive receptors near planned roads, waste haulage routes and proposed pipeline works were found to be in line with Class II standard of GB3096-2008. In rural areas, where other facilities are planned, day and night noise monitoring values are also in line with Class II standard limited value of GB3096－2008.

Table D.13: Monitoring results of noise background dB(A)

Sensitive Receptor Locations	Monitoring results		Class II Standard	
	daytime	nighttime	daytime	nighttime
Teaching building of kindergarten	47.9	47.3	60	50
Residential area Luyuan	46.2	47.3	60	50
Residential area Yueguang	45.7	48.4	60	50
Residential area Xinfuyuan	47.0	50.3	60	50
Teaching building of the County	49.8	44.5	60	50
Dormitory	49.2	44.6	60	50

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

184. **Soil salinity and permeability.** In the area of the county where treated effluent is to be reused as irrigation water for soil-stabilizing plantations, the background soil salinity and local water infiltration rates are important factors in irrigation planning. Table D.14: shows these factors for Habahe, which has very low percolation capacity and low salinity.

Table D.14: Salinity and Infiltration Rates at the Irrigation Site

Irrigation Site	Soil Type	Salinity	Percolation
Habahe	Brown calcic soil	0.084%～0.109%	1×10^{-7}cm/s

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

185. **Biodiversity.** Meadow totally covers 663,000 ha in the county. The county has a natural meadow area of 663,000 ha and forest and woodlands totaling 49,200 ha, with a percentage of forest cover of 14%. The major forest types are mountainous coniferous forest (among which Siberian fir, Siberian spruce and Siberian cedar are rare species in China), and broad leaved forest along river valleys. There are twelve major plant communities such as birch, grey poplar and white willow. There are 66 families, 237 genera and 470 species of wild vascular plants. The forest habitats include 200 animal species on the CITES lists or on national protection lists. Another 74 bird species are protected by international agreements between China and Australian (CAMBA) or China and Japan.

186. **Physical cultural resources.** Habahe County is one of the major activity places for the grassland culture of Western Regions, historically it was ever the place for north grassland silk, the nomadic people left a great deal of typical grassland cultural remains of stone age culture, petroglyphs, deer stones, and ancient tombs. These features attract tourists from China and foreign countries. Through the investigation and confirmation of the Cultural Relic Bureau of the Habahe County, the project location is in 'construction planning land', and the area surrounding the project has no recorded values for natural, historical and cultural heritage.

3. Fuhai County

187. Fuhai is in the northern part of Xinjiang Uyghur Autonomous Region and in the middle part of Altay District. Fuhai County borders Fuyun County on its east and Hebukesai'er Mongolian Autonomous County and Jumunai County on its west and looks across Zhunge'er Basin to Changji Hui Autonomous Prefecture to its south and its northern boundary borders The People's Republic of Mongolia.

188. **Topography.** Fuhai County is located on the alluvial plain at the lower reaches of Wulungu Lake. Its terrain descends from the north to the south in a series of terraces. With an elevation ranging from 496 to 550m, Fuhai County is topographically tilted from the mountainous area of the Erqisii Great Fracture Zone towards the southwest and has a relatively flat terrain.

189. **Climate.** Located in the central region of Euroasia Continent, Fuhai County meteorologically belongs to the continental mesothermal climate zone with more plains than mountains and more deserts than oases. Such a climate features springs with significantly changeable temperatures, brief summers and cold and long winters. There is little precipitation and strong evaporation. The yearly average temperature is 4.0^{o}C; with a maximum extreme temperature of 41^{o}C and minimum extreme temperature of -42.7 ^{o}C. The yearly average wind velocity is 3.4m/s.

190. **Water resources.** Fuhai County lies on the river plain between the Erqisi River and the Wulungu River. Four large and medium-sized reservoirs dominate the hydrology: Hashiwen Reservoir, a medium-sized reservoir built up in 1975, is replenished by water from the Erqisi River and has a reservoir capacity of 15 million m^3; Fuhai Reservoir, a large reservoir built up in 1976 on the northern banks of Wulungu River is a large injection-type plain reservoir with a normal impounded level of 574m and a total reservoir capacity (after expansion in 2002) of 220 million m^3; Halahuoying Reservoir on the southern bank of the Wulungu River and replenished by water from the Wulungu River. It has a total reservoir capacity of 59 million m^3; Tuanjie Reservoir with a total reservoir capacity of 11 million m^3 is a medium-sized regulation reservoir built up in 1994 through water diversion from the Erqisi River. Eighty percent of the irrigation area in the county is served by these reservoirs.

191. The Erqisi River and Wulungu River have an annual runoff of approximately 3.488 billion m^3 and 565 million m^3 respectively in Fuhai County. The Halaerqisi River is the next most important with an annual runoff of 1.937 billion m^3 and a multi-year average flow of 61.4m^3/s.

192. **Water quality.** Both Erqisi River and Wulungu River are replenished by snowmelt water from Altay Mountain. For the Wulungu, two surface water monitoring sites, including the Dingshan Section of Wulungu River (upstream) and the connecting point of the large and small lakes of Wulungu Lake (downstream) were sampled. Twenty five separate water quality parameters were sampled and the average results over multiple samplings were assessed against the Class III standard of "Surface water environment quality standard" (GB3838-2002). The results showed that the cyanide content in the surface water in the upper reaches exceeds the standard while the other indices comply. For the lower reaches, cyanide content reaches critical levels while the permanganate index, CODcr, chloride, sulfate, total nitrogen and fluoride all exceed the standard. It is suggested in the domestic EIA that the non-compliance of cyanide, permanganate index, CODcr, chloride, sulfate, total nitrogen and fluoride is related to water pollution from farm land and residents distributed along the water diversion trunk canal. No water supply subcomponent is proposed for Fuhai County. The full analysis results are included in Appendix 5.

193. **Groundwater.** Fuhai County is known for its abundance of ground water. The fissure water or outcrop springs in Chunqiu Pasture to the north of Erqisi River have a maximum water yield of 1 liter per second. Rich groundwater resources are found in the area from Suosuogou to Sangequan on the northern edge of Zhunge'er Basin and to the south of Wulungu River. The delta area at the lower reaches of Wulungu River has shallow groundwater storage of very high volume. The annual ground water yield here is up to 60 million cubic meters.

194. The groundwater in the area proposed for the landfill site was sampled via 13 monitoring wells. The groundwater monitoring results in Table D.14 show that no parameter among the monitoring sites exceeds the limit for Class-IV standard in "Quality standards for ground water" (GB/T14848-93). This quality of groundwater may be used for agricultural purposes and industrial purposes.

Table D.15: Average Groundwater Quality from Multiple Monitoring Sites

	pH	COD	TH	Cr^{6+}	Pb	Ar-OH	Cl^{-}	Min	NH^{3}-N	Hg	Cd	As	CN^{-}

Analysis result	6.97	0.75	460	0.002	0.005	0.003	3.97	959	0.181	nd	0.0005	0.0002	0.002
Standard (Class IV)	6.5-8.5	≤20	≤550	≤0.1	≤0.1	≤0.01	≤350	≤1000	≤0.5	≤0.001	≤0.01	≤0.05	≤0.1

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

nd = not detected

TH = Total Hardness

195. **Air quality.** Ambient air quality has been measured in and around the Fuhai county seat. The assessment of concentrations of SO_2, NO_2 and TSP was on the basis of Class II standard of the "Ambient Air Quality Standard" (GB3095-1996). The results show that the levels of TSP, SO_2 and NO_2 at the various monitoring sites in the assessed region comply with Class II standards of GB3095-1996, and that the air quality in and around Fuhai County seat is very good.

Table D.16: Ambient Air Quality Fuhai

	Concentration in mg/m^3 (level of compliance with standard)		
	SO_2	NO_2	TSP
Fuhai County seat	<0.006 (0.15)	<0.005 (0.12)	0.048 (0.3)
Upwind of County seat	<0.006 (0.15)	<0.005 (0.12)	0.044 (0.3)
Downwind of County seat	<0.006 (0.15)	<0.005 (0.12)	0.05 (0.3)

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

196. **Acoustic environment.** Baseline noise analyses were undertaken by the Altay Prefecture Environmental Monitoring Station within the county seat developed area. Noise levels at sensitive receptors near planned roads and waste haulage routes were found to be in line with Class II standard of GB3096-2008. These figures also comply with The World Bank Group EHS guidelines (55/45 dBA for residential areas).

Table D.17: Monitoring results of noise background dB(A)

Sensitive Receptor Monitoring Site		Noise value dB(A)	Class II standard
Xingfu Road residential area	Day	51.2	60
	Night	39.5	50
School	Day	52.4	60
	Night	42.0	50
Hospital	Day	52.2	60
	Night	51.8	50
Kindergarten	Day	41.2	60
	Night	40.7	50

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

197. It can be seen from the monitoring results and a comparison with the assessment standard that the noise value at the noise sensitive sites of the 4 monitoring sites satisfy Class II standard specified in Environmental Quality Standard for Noise (GB3096-2008), indicating that the project area has a relatively good noise environment. In rural areas, where other facilities are planned, day and night noise monitoring values are also in line with Class II standard limited value of GB3096─2008.

198. **Soil salinity and permeability.** In the area where the County seat is located, the soil mainly comprises light brown calcic soil with a parent material of gravel-diluvium. Another common soil in the area is an alkalinized brown calcic soil. Gobi desert areas, natural meadows and farmland are distributed around the project sites. Where treated effluent is to be reused as irrigation water for soil-stabilizing plantations, the background soil salinity and

local water infiltration rates are important factors in irrigation planning. Table D.18: shows these factors for Fuhai, which has low percolation rate and high salinity.

Table D.18: Salinity and Infiltration Rates at the Irrigation Site

Irrigation Site	Soil Type	Salinity	Percolation
Fuhai	Sandy brown desert soil	0.67%	4.15×10^{-5}—1.024×10^{-4}cm/s

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

199. **Biodiversity.** Fuhai County has abundant wildlife resources and is the habitat for 15 species of Class 1 national protected animals[17] including wild ass, Saiga antelope, snow leopard, beaver, red-crowned crane and Mongolian and Xinjiang wild horses. Twenty species of Class 2 national protected animals include red deer, lynx, wild goose and ibex. There are more than one thousand types of wild plants, including more than 200 types of widely distributed and high-yield medicinal plants. Plant species identified as rare and endangered plants of the Autonomous Region include Siberian fir, spruce, Euphrates poplar, wild olive and edelweiss. The Project Area is located in rural areas where there are no traces of large wild animals apart from cattle, sheep and camels. There are only a small number of rodents such as hares, house mice and amphibious reptiles such as forest frogs, forest viviparous lizards and the arctic viper. According to the site survey and collected data, the subcomponent localities are mainly residential, agricultural and animal husbandry areas without any endangered animals and plants.

200. **Physical cultural resources.** The siting of the project components in Fuhai County does not threaten any significant heritage or historic items.

4. Jimunai County

201. Jimunai County seat is 631km from Urumqi to the southeast and 198km from Altay City to the northeast. The county borders Fuhai County and Altay County in the east, Hoboksar Mongol Autonomous County of Tacheng District in the south, with Habahe County and Burqin County in the north and The Republic of Kazakhstan in the west.

202. **Topography.** The county is mainly centered on the alluvial plain of the Lasite River and plain and gobi land systems occupy 4,996.6km^2 (60.9% of the total county area). It also includes mountainous areas of 1838.4km^2 (22.3%). Other major land systems are: desert (12.9%), upland (2.4%), marshland (0.9%) and water surface (0.6%).

203. **Climate.** The average annual temperature in Jimunai County is 3.5°C. The average temperature in the coldest month is -12.5°C. The extreme maximum temperature is 37.2°C and the extreme minimum temperature is -38.8°C. The average precipitation is 200mm while the evaporation volume is 2196.9mm. The average wind speed is 4.0m/s. The frost-free season is 137 days and, in recent years, winter snow cover is 10cm.

204. **Water resources.** The mean annual runoff of surface water is 91 million m^3 in Jimunai County. The main surface runoffs in the county include the Ulekun Ulasitu River, a Sino-Kazakh border river with an annual average runoff of 28 million m^3, Ulaste River with an annual runoff of 31 million m^3; and the Tast River with an annual runoff of 35 million m^3. In addition, there are 8 rivers with annual runoff of less than 10 million m^3. All these rivers are recharged by melt water of ice and snow in addition to rainfall, so the runoffs are largely influenced by season and temperature factors and have high yearly variability. The Muz Taw glacier in the southwest is the water source for much of the county. While the surface water is abundant in southern mountainous area; comparatively, surface water is deficient in the north and middle part of the area, which seems to be one of the major factors restricting the husbandry production in the county.

[17] Under the PRC Wild Animal Protection Law (1989).

205. The Lasite River Basin, lying about 6km to the south of the county seat provides water resources for the town and surrounding areas. The Lasite River originates from the modern glacier of the southern Saur Mountains and flows from the south to the north. Its total length is 28km and it drains an area of 272km^2. The average runoff is 37.87 million m^3 (runoff reliability P=75% is 30.67 million m^3, and 36.35 million m^3 when P=50%). The lower reach of the Lasite River is usually dry except in flood periods since the completion of reservoir construction in the upper reaches in 1986.

206. Ground water resource in Jimunai County is mainly concentrated in the lower reaches of Lasite River and Tasite River. Ground water yield in the whole county is around 4 million m^3 which is mainly used for domestic water and drinking water for livestock in the irrigation areas.

207. **Water quality.** The current water source of Jimunai County seat is the subsurface water under the river bed in the upstream of Lasite River. The thickness of the water aquifer is about 20 m, and the subsurface water storage is about 20 million m^3 /year. Monitoring data on water quality of the water source implemented by the Altay Environmental Monitoring Station in 2008 tested 24 water quality parameters. All the detected indices were found to comply with Class III standards of the Standards for Surface Water Quality (GB3838-2002).

208. **Air quality.** Ambient air quality monitoring was undertaken by the Altay Prefecture Environmental Monitoring Station, collecting multiple sample in the period 14-20 June, 2010 at three relevant receptor sites. The results are at Table D.18. The evaluation shows that daily average single-item concentrations for NO_2, SO_2, TSP in the atmosphere of the project zone comply with Class II standards of the Standards on Environmental Atmosphere Quality (GB3095-1996).

Table D.19: Ambient Air Quality (mg/m^3)

Monitoring Sites	NO_2		SO_2		TSP	
	Daily average	Compliance Index	Daily average	Compliance Index	Daily average	Compliance Index
Jimunai County People's Hospital	0.005	0.15	0.006	0.12	0.047	0.3
Jimunai County People's Government	0.005	0.15	0.006	0.12	0.051	0.3
Planned heating station in Jimunai County	0.005	0.15	0.006	0.12	0.049	0.3
Atmospheric quality standard	Class II		Grade II		Grade II	

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

209. **Acoustic environment.** The Altay Environmental Monitoring Station implemented practical monitoring to the noise sensitive points near planned roads, waste haulage routes and proposed pipeline works between 17th and 18th Jun, 2010. The results are shown in Table D.20. The results show that ambient noise levels comply with Class II standard of the Acoustic Environment Quality Standard (GB3096-2008). For a number of the receptor sites the values exceed the World Bank Group EHS guidelines (55/45 dBA for residential areas).

Table D.20: Ambient Noise at Sensitive Receptor Sites (dB(A))

Monitoring Location	Monitoring result		Standard value	
	Day	Night	Day	Night
Central residential zone	51.8	39.5	60	50
Jimunai County Middle School	56.4	42.0	60	50
Jimunai County Hospital	52.2	51.8	60	50
Jimunai County Kindergarten	39.2	40.7	60	50

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

210. **Soil salinity and permeability.** In the area of the county where treated effluent is to be reused as irrigation water for soil-stabilizing plantations, the background soil salinity and local water infiltration rates are important factors in irrigation planning. Table D.21 shows these factors for Jimunai, which has a very high percolation rate and low soil salinity.

Table D.21: Salinity and Infiltration Rates at the Irrigation Site

Irrigation Site	Soil Type	Salinity	Percolation
Jimunai	Brown calcic soil	0.084%-0.109%	15-20m/d (1.7×10^{-2}cm/s—2.3×10^{-2}cm/s)

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

211. **Biodiversity.** All project subcomponent sites are in and around the Jimunai County seat, where the main vegetation is artificially planted greening vegetation, composed mainly of pine, white poplar, and willows. Because of the proximity of dense human habitation there are no rare wildlife species recorded.

212. **Physical cultural resources.** The siting of the project components in Jimunai County does not threaten any significant heritage or historic items.

5. Qinghe County

213. Qinghe County is located on the northeastern part of XUAR. It borders Mongolia on the east and northeast, and Fuyun County on the west. Its southern boundary is the southern border of Altay Prefecture.

214. **Topography.** Qinghe County is located at the eastern end of the Altay Mountain range; Qinggeliheyuan Peak is its highest point with an altitude of 3,712 m, and the general altitude is between 2000 and 3000m. The county seat is located on an alluvial-diluvial dip plain. Here the Wulungu River, Buergen River and Qinghe River run, and the geomorphology is characterised by many small-sized alluvial fans. The river valley is about 2-5km wide, where the land is flat and even, abundant in water sources, bottom land forest flourishes, lush vegetation growing in fertile land, which provides an excellent producing area for agriculture and animal husbandry. Desert and gobi land systems distribute in the south alternatively; the desert consists of small semi-fixed lunate dunes, and the gobi consists of bedrock terrace of drying denudation and plains covered with thin-layer sandy gravels.

215. **Climate.** Qinghe County belongs to the north temperate zone continental climate. The characteristic of its climate is: great disparities between maximum and minimum temperatures, long winters, almost no spring and autumn, and a short summer. Its meteorological data are as follows: Annual average temperature: 0.3°C; highest temperature under extreme circumstance: 34.3°C; lowest temperature under extreme circumstance: -49.7°C. The direction of wind is predominantly from the northwest. The rainfall has an annual average of 170.6mm. The thickest accumulated snow on record is 420mm.

216. **Water resources.** The water source for the Qinghe water supply subcomponent is the Baixing Reservoir. This existing reservoir is formed by the run-of-river impoundment of the Daqing River, which then flows into the Wulungu River. The relative contribution of the Daqing to the Wulungu River is shown below.

Table D.22: Daqing/Wulungu River Basin

Annual Average Flow within Qinghe County		Proportion of Daqing River Flow to Total Wulungu River Flow
Daqing River	Wulungu River	
4.54 billion m^3	10.00 billion m^3	45.4%

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

217. The inflow data of the reservoir, on the upper reaches of the Daqing River, is shown below.

Table D.23: Average Annual Inflow of Baixing Reservoir

	Various frequency (P%) for annual runoff (100 million m^3)								
Yearly Average	0.5	1	2	5	10	50	75	90	95
3.46	7.37	6.92	6.37	5.67	5.04	3.36	2.4	1.97	1.85

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

218. **Water quality.** In March 2008, the Environmental Supervision Station of Altay Prefecture tested the water quality of Baixing Reservoir, testing for the levels of 12 separate parameters (see Table D.24). Also in March 2008 the Xinjiang Water Environmental Monitoring Station reported on water quality of the reservoir. In July 2009 an additional test of water quality at the proposed extraction point was made by the Environmental Supervision Station of Altay Prefecture. All results showed that the water quality met Class II of the Surface Water Environmental Quality Standard (GB3838-2002).

Table D.24: Baixing Reservoir Water Quality (mg/L)

	pH	Mn	Hg	Fe	hardness	turbidity
Monitoring result	7.5	0.02	0.000032	0.24	60.7	0
Class II standard	6-9	≤0.1	≤0.0001	≤0.3	/	/

	SO_4	fluoride	arsenic	nitrate	chloride	chrome	permanganate
Monitoring result	10.5	0.14	<0.007	0.04	1.97	<0.004	1.5
Class II standard	≤250	≤1.0	≤0.05	≤10	≤250	≤0.05	≤6

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

219. In June 2010, the environmental quality of groundwater was monitored and sampled. The average levels found were compared with Category III standard in Standard for Groundwater Quality (GB/T14848-93). From the results, the existing groundwater quality meets the requirements of Category III standard in Standard for Groundwater Quality (GB/T14848-93) except for ammonia nitrogen. The Zhonglanlianhai EIA Institute advises that this is due to the shallow depth of the groundwater, which receives infiltration from the Small Qinghe River where treated waste water is currently discharged, resulting in elevated ammonia nitrogen levels.

Table D.25: Average Groundwater Quality from Multiple Monitoring Sites

Monitoring item	pH	TH	Permanganate index	NH_3	Nitrate	Arsenic	Cadmium	Sulphate	Chloride
Surveyed result	6.73	270.68	1.2	0.44	4.154	0.00005	0.00005	104.4	0.23
Class III Standard value	6.5-8.5	≤450	≤3.0	≤0.2	≤20	≤0.05	≤0.01	≤250	≤1.0

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

TH = Total Hardness

220. **Air quality**. Baseline ambient air quality monitoring in June 2010 by the Environmental Monitoring Station of Altay Prefecture show that the SO_2, NO_2, and TSP concentrations at two sites in the vicinity of proposed garbage haulage routes and pipeline laying comply with the standard of Class II of the Environment Air Quality Standard (GB3095—1996). These levels also easily comply with the World Bank Group EHS guidelines for SO_2, NO_2, and PM_{10}.

Table D.26: Ambient Air Quality Monitoring

	Concentration in mg/m^3 (level of compliance with Class II standard)

	SO_2	NO_2	TSP
Hospital #1	<0.006 (0.15)	<0.005 (0.12)	0.046 (0.3)
Hospital #2	<0.006 (0.15)	<0.005 (0.12)	0.047 (0.3)

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

221. **Acoustic environment.** Ambient noise level monitoring conducted in June 2010 by the Environmental Monitoring Station of Altay Prefecture found that ambient noise in both the water treatment plant site and the landfill site easily met category II under Sound Environment Quality Standards (GB3096-2008) for both day and night samples.

Table D.27: Ambient Noise Monitoring

Monitoring Location	Monitoring result WTP		Monitoring result Landfill		Class II Standard	
	daytime	night	daytime	night	daytime	night
Eastern site boundary	49.1	47.3	37.2	33.2	60	50
Southern site boundary	40.7	40.1	35.0	34.4	60	50
Western site boundary	42.5	35.5	31.4	30.9	60	50
Northern site boundary	38.4	41.2	32.7	32.6	60	50

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

222. **Soil salinity and permeability.** In the area of the county where treated effluent is to be reused as irrigation water for soil-stabilizing plantations, the background soil salinity and local water infiltration rates are important factors in irrigation planning. Table D.28 shows these factors for Qinghe, which has moderate percolation rates and low salinity.

Table D.28: Salinity and Infiltration Rates at the Irrigation Site

Irrigation Site	Soil Type	Salinity	Percolation
Qinghe	Brown calcic soil	0.084%-0.109%	5×10^{-6}cm/s

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

223. **Biodiversity.** Qinghe County is one of the major grazing areas of Xinjiang, with grasslands of over 1.082 million ha. The grasslands have rich herbaceous biodiversity with over 400 plants, including 318 grasses. In the northern mountainous area, meadow and grassland vegetation are dominant; in the southern hills and gobi area, desert pasture is dominant. Grasslands of both types make up 23.1% of the county area and meadow vegetation makes up another 16.43%.

224. The total area of forest in Qinghe County is 31,700 ha, distributed in the northern and north-eastern mountainous areas of the county. The majority of upland forests are Siberian larch. In the forests of the low hills and valleys, there are larch, spruce, birch and plantations. The forests cover only 2.03% of the county land area.

225. Qinghe County boasts a variety of wild plants, with more than 100 medicinal plants in the area. Wildlife resources include beaver, sable, wild donkey, snow leopard, wild sheep (argal), black-tailed gazelle, saker falcon and red falcon. The beaver and snow leopard are class 1 protected species under the PRC Wild Animal Protection Law (1989). The wild sheep (argal), black-tailed gazelle, saker falcon and red falcon are class 2 protected species.

226. **Physical cultural resources.** The siting of the project components in Qinghe County does not threaten any significant heritage or historic items.

6. Takeshiken Land Port

227. The Takeshiken Land Port is located at Buergen Village, Chaganguole Township in east Qinghe County. Buergen Village lies on the north bank of the Buergen River, with a

mean height above sea level of 1180m. The village is surrounded by Queergong Mountain, Bayanchagan Mountain and Mengqike Mountain. Takeshiken Land Port is 101km from Qinghe County seat, 380km from Altay City and 570km from Urumqi City with easy access to all via sealed roads. The Land Port is 15 km from the border with Mongolia and 46 km to the nearest Mongolian town.

228. **Climate.** The climatic characteristics are long and cold winters, short summers and cool autumns. The annual mean temperature is 0°C, annual precipitation is 130-200mm, and evaporation capacity is 1476mm. Takeshiken Land Port is in the middle-latitude continental temperate-frigid climatic region, where the precipitation is low. Annual average precipitation is 173.9mm (300-400mm in north mountainous area, but less than 80mm in the south of the area). Dry hot winds are a feature of the short summer, usually from late June to middle July.

229. **Water resources.** The Buergen River flows through Buergen Village. It originates in Qinghe County and flows from east to west and finally into the Wulungu River. The Wulungu River is the major river of the Junggar Basin and plays an important ecological role in the region. There are more than 60 dams for irrigation along the river, which ultimately flows into Jili Lake in Fuhai County. The water source of Buergen River is mainly precipitation in mountainous areas and snow melt. Snowfall in the mountains makes up about 60% of annual precipitation. . Half of the annual precipitation concentrates during the period June to September. The annual average flow of the Buergin is 2.572 billion m^3, and its relative contribution to the Wulungu river basin is shown in Table D.29 below.

Table D.29: Buergen/Wulungu River Basin

Annual Average Flow within Takeshiken Land Port, Qinghe County		Proportion of Buergen River Flow to Total Wulungu River Flow
Buergen River	Wulungu River	
2.572 billion m^3	10.00 billion m^3	25.7%

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

230. **Water quality.** Water quality of the Buergen River was sampled by the Altay Environmental Monitoring Station. The average results for multiple samples in summer 2010 are shown in Table D.30. The Buergen River belongs to Class II functional water bodies, and the results of recent monitoring confirm that its water quality complies with this standard. The maintenance and improvement of these water quality values will determine the long-term sustainability of the Xinjiang Buergen River Beaver Natural Reserve and will be one of the objectives of the water supply and wastewater treatment subcomponents.

Table D.30: Buergen River Monitoring Result (mg/L)

Parameter	Monitoring Results	Class II Standard	Parameter	Monitoring Results	Class II Standard
pH	7.76	6-9	Cadmium	0.00019	≤0.005
dissolved oxygen	11.6	≥6	COD	13.6	≤15
BOD5	2.2	≤3	Oil	0.010	≤0.05
NH-N	0.360	≤0.5	TP	0.05	≤0.1
Phenol	0.002	≤0.002	Sulfide	0.020	≤0.1
Cyanide	0.004	≤0.05	Fecal coliform (pc/L)	790	≤2000
Arsenic	0.00308	≤0.05	TN	0.252	≤0.5
Hexavalent chromium	0.004	≤0.05	Fluoride	0.76	≤1.0

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

231. The Altay Environmental Monitoring Station also undertook monitoring of the groundwater in the vicinity of the existing wastewater treatment plant. A total of ten water quality parameters were tested. The results indicate that except for ammonia nitrogen levels,

the groundwater quality conforms with Grade III standard of the Quality Standard for Ground Water (GB/T 14848-93). The elevated ammonia nitrogen is reported in the PRC Landfill EIA to be the result of agricultural and domestic runoff.

Table D.31: Groundwater Sampling Results at Takeshiken (mg/l)

	Groundwater at the Takeshiken Sewage Treatment Plant	
Parameter	Result	Standard
pH Value	6.83	6.5~8.5
Total Hardness	250.68	450
Permanganate Index	1.2	3.0
Ammonia Nitrogen	0.44	0.2
Nitrate	3.554	20
Arsenic	0.00005	0.05
Cadmium	0.00005	0.01
Sulfate Radical	93.4	250
Salt	344	—
Fluoride	0.230	1.0

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

232. **Air quality.** The Altay Environmental Monitoring Station carried out a monitoring of ambient air quality over the period from 1 to 7 June, 2010. Air quality at three sensitive receptor sites was sampled. The results show that all daily average value of NO_2, SO_2 and TSP levels comply with Class II standard of the national Ambient Air Quality Standard (GB3095-1996).

Table D.32: Ambient Air Quality Monitoring

	Concentration in mg/m^3 (level of compliance with Class II standard)		
	SO_2	NO_2	TSP
Takeshiken Hospital	Daily average 0.006 (0.15)	Daily average 0.005 (0.12)	0.042 (0.3)
Takeshiken School	Daily average 0.006 (0.15)	Daily average 0.005 (0.12)	0.047 (0.3)
Residential Area	Daily average 0.006 (0.15)	Daily average 0.005 (0.12)	0.051 (0.3)

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

233. **Acoustic environment.** Ambient noise levels at the proposed site for the WWTP are typical rural levels and comply with Class II standard of the Environmental Quality Standard for Noise (GB3096-2008). At the existing water treatment plant, the following results were obtained (Table D.33). These results show that the existing plant, close to the residential area, exceeds night time noise levels set for the Class II standard on the eastern boundary.

Table D.33: Ambient Noise Levels at Existing WTP Site

Monitoring points	Monitoring Results		Evaluation Standards	
	Daytime	Night time	Daytime	Night Time
Eastern boundary	55.8	55.3	60	50
Southern boundary	50.6	50.0	60	50
Western boundary	56.6	45.8	60	50
Northern boundary	53.9	46.7	60	50

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

234. **Soil salinity and permeability.** In the area of the county where treated effluent is to be reused as irrigation water for soil-stabilizing plantations, the background soil salinity and

local water infiltration rates are important factors in irrigation planning. Table D.34 shows these factors for Takeshiken Land Port, which show high percolation capacity and low soil salinity.

Table D.34: Salinity and Infiltration Rates at the Irrigation Site

Irrigation Site	Soil Type	Salinity	Percolation
Takeshiken Landport	Brown calcic soil	0.084%-0.109%	3.8m/d（4.39×10^{-3}cm/s)

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

235. **Biodiversity.** Vegetation in the project areas includes tarragon, goldball onion, bunch grass and wormwood (Artemisia); the vegetation growing along both banks of the Buergen River in the Takeshiken Town area are mainly larkspur, grasses and cultivated alfalfa. Wildlife recorded in the surrounding countryside include ruddy sheldrake, sheldrake, common crane, peccary pig, beaver, Mongolian gazelle, wild sheep and red deer. The beaver is a class 1 protected species under the PRC Wild Animal Protection Law (1989). The wild sheep (argal), Mongolian gazelle and red deer are class 2 protected species.

236. **Protected sites.** The major protected site in the district is the habitat of the Asiatic or Mongolian beaver (Castor fiber birulai), which is endemic to the Wulungu River system, but has retreated to main habitat areas on the Buergen, a tributary of the Wulungu. The protected site is called the Xinjiang Buergen River Beaver Natural Reserve. The reserve was established in 1980 following the approval of the Xinjiang Autonomous Region Government It is continuously managed by the Buergen Beaver Natural Protection Reserve Management Committee, under the Xinjiang Autonomous Region Forestry Department. There is a beaver protection management station located within the reserve.

237. The reserve is located on 50 km of the downstream reaches of the Buergen River, virtually from the Mongolian border to its confluence with the Wulungu River. Its total area is 50km^2. The functional zones comprise: (i) core area, (ii) buffer area and (iii) scientific experimental area. The core area of the reserve extends 300m either side of the river, and 45 km along the river. Its area is around 27km^2, centred on the river valley forests. The area between 300 and 500m either side of the river forms the buffer zone, and its area is 18km^2. The scientific experimental area is located on the upstream part of the reserve abutting the boundary between PRC and Mongolia. The scientific area measures 5km in an east-west direction. Its width is 1km, and total area is 5km^2.

238. The Asiatic-Mongolia beaver is a national class one protected animal in PRC. It is an herbivorous animal, and its food comprises mainly river herbs and (in winter) the leaves and barks of riparian vegetation (poplar and willow species, including *Salix turanica*, *S.caspica*, and *Populus laurifolia*).

239. **Physical cultural resources.** The siting of the project components in and around the Takeshiken Land Port does not threaten any significant heritage or historic items.

CHAPTER E - ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Positive Impacts and Environmental Benefits

1. Direct Positive Impacts

240. The Project will bring significant benefits to up to 19,000 households in 5 counties by improving living conditions, urban environment, public health, and employment and incomes.

241. New water sources, WTPs and expanded piped water supply coverage areas will reduce many households' dependence on potentially contaminated well water, improving water quality and creating a more reliable supply of domestic water. Improved wastewater disposal systems will result in cleaner and healthier living environment for town residents; elimination of occasional backflow of wastewater into buildings in some county seats, and reduced contamination of the underground water supply and/or of rivers. Wastewater reuse as irrigation water for wind-break forests follows the principals of Integrated Ecosystem Management (IEM) which is the primary approach currently being planned and implemented by PRC under its GEF funded program for combating land degradation.

242. The improved solid waste collection and disposal systems will clean up urban areas and close down existing unsanitary landfills. They will also reduce the amount of wind-blown plastic bags and other debris that not only affects the urban areas, but is damaging to the grasslands and their productivity and poses a danger livestock ingestion.

243. Improved road networks will reduce traffic congestion; improve road safety conditions for both vehicles and pedestrians; facilitate the movement of residents, and, in some county seats, open up new areas for urban expansion. They will also reduce air emissions and provide fuel savings (with consequent significant savings in net CO_2 emissions). Improved and expanded heating systems will result in energy savings; reduced air pollution, and reduced heating costs for those currently dependent on coal fires.

244. Long term positive impacts will include: (i) Improved urban infrastructure that will facilitate the development of tourism in the county; (ii) Improved physical well-being arising from improved environmental sanitation; (iii) More environmentally-friendly behavior; (iv) Empowerment of community members; and (v) Creation of both temporary jobs during construction, and for permanent jobs to manage expanded systems and through a multiplier effect.

245. Across all counties, it is estimated that the Project will create 1,465 temporary construction jobs, and 353 permanent post-construction jobs. Indirect employment created by construction activities of the Project is estimated to be some 3,809 jobs throughout the life of the Project. Employment of people in new O&M positions arising from expansion of the infrastructure is estimated to generate 565 additional jobs on a permanent basis. To maximize the potential benefits of job creation for poverty reduction, the PMO has targeted a proportion of jobs for poor and vulnerable households, for women and for ethnic minority people who would like to be involved in construction activities.

2. Beneficiaries

246. **Water supply.** The improved water supply will improve the quality of life of affected residents by providing them with a safe and secure supply of good quality water, and eliminating the inconvenience of storing water and, for some, of having to draw it from an outside well. Potentially, this subcomponent will benefit around 90% to 100% of residents in the towns in which it is implemented – over 11,500 households in all, if anticipated growth in the number of households in the town is taken into account. It will be particularly beneficial to those living in brick house areas, who often tend to be the more vulnerable members of the community. It will also be particularly beneficial to women.

Table E.1: Anticipated Number of Beneficiaries of Improved Water Supply, County Seats

Urban Facility	Total number of households, 2010	Total number of households currently serviced	Total Number of Predicted Household connections, 2015 (% of predicted number of households)	Total number of Existing House-holds to Have New Access to Connection	Total number of New House-holds to Have New Access to Connection
Buerjin	6,241	4,060 (65%)	5,980 (89%)	2,181	
Habahe	6,311	3,400 (54%)	6,870 (100%)	2,911	559
Qinghe	4,331	2,900 (67%)	6,310 (100%)	1,431	1,979
Jimunai	5,779	3,763 (65%)	4,879	2016	

Source: Figures provided by the PMO

247. **Wastewater disposal.** The improvement to the urban environment that will come from implementation of the wastewater disposal sub-component will result in improved quality of life for all households in the Project area. Again, however, the households which will potentially benefit most will be those in the old brick house areas, which currently are often without proper drainage. 19,000 beneficiaries will benefit from access to the wastewater collection system for the first time. This sub-component again will initially be potentially most beneficial to the more vulnerable households.

Table E.2: Anticipated Number of Beneficiaries of Improved Wastewater Disposal

Urban Facility	Total number of households, 2010	Total number of households currently serviced	Total Number of Predicted Household connections, 2015 (as % of predicted number of households)	Total number of Existing Households to Have New Access to Connection	Total number of New Households to Have New Access to Connection
Buerjin	6,241	3,764 (60%)	5,980 (89%)	2,216	
Fuhai	7,330	2,800 (38%)	9,260 (100%)	4,530	1,930
Habahe	6,311	3,417 (54%)	6,870 (100%)	2,994	559
Qinghe	4,331	2,040 (47%)	6,310 (100%)	2,291	1,979
Jimunai	5,779	2,248 (39%)	4,827	1,579	

Source: Figures provided by the PMO

248. **District heating.** Table E.3 shows the anticipated number of direct beneficiaries of the heating subcomponents – over 6,000. All residents are likely to benefit indirectly to some extent from reduced air pollution from inefficient boiler houses. However, the main quality of life benefits of improvements in the heating system will be financial and comfort. It is also possible that a reduction in the use of coal fires for heating may reduce the incidence of respiratory complaints in these towns, although this remains unproven. In those towns in which it will be primarily the apartments which will be newly serviced as result of the sub-component, those to benefit will tend to be the least vulnerable members of the community.

Table E.3: Anticipated Number of Beneficiaries of Improved Heating

Urban Facility	Total number of households, 2010	Total number of households currently serviced	Total Number of Predicted Household connections, 2015 (% of predicted number of households)	Predicted Total Number of New Connections
Habahe	6,311	4,460 (71%)	5,900 (86%)	440
Fuhai	7,330	3,942 (54%)	4,780 (52%)	838
Qinghe	4,331	2,444 (56%)	6,100 (95%)	3,656
Jimunai	5,779*	1,600 (44%)	2,980*	1,380

Source: Figures provided by the PMO

249. **Solid waste management and road components.** The extent to which households' quality of life will benefit from the Project's solid waste disposal sub-component will depend to some extent on the location of bins provided by the Project. However everyone in the towns can be expected to benefit from the overall improvement to the urban environment that this component will bring about. Most residents will be the beneficiaries of road improvements that incorporate pedestrian safety design features. Other direct impacts of

improved road systems on residents' well-being are likely to be realized when the traffic gets heavier, and the improved roads can still cope with the increased traffic flow, without increased risk of traffic jams or accidents.

B. Impacts Associated with Project Location, Planning, and Design

1. Direct Losses from the Project's Footprint

250. **Loss of Land.** The loss of land, both temporarily and permanently, under planned infrastructure subcomponents is estimated at about 180 ha. The breakdown of these losses by subcomponent and land category is shown in Table E.4. These areas are estimates drawn from the subcomponent EIAs and FSRs.

251. An estimated 23 ha of farm land will be alienated in the siting and construction of subcomponents. The district/county IAs must obtain approval from the local land administration departments to alienate farmland. Under the relevant legislation and principles that apply in the PRC in such cases, farmers who lose land permanently will be compensated by replacement with land of equivalent quality and quantity, or through a lump sum payment. This process is detailed in the Involuntary Resettlement Assessment and Measures (DFR, Linked Document 12).

Table E.4: Land Use Categories Lost under the Project's Footprint

County	Sub-component	Loss Level	Agricultural Land (ha)	Wasteland, Conversion Land, and Shrubland (ha)	Forestland (ha)	Meadow or grassland (ha)
Buerjin	Road	Permanent		0.72		6.77
		Temporary				
	Water Supply	Permanent				1.56
		Temporary		2.29	9.47	11.41
	Wastewater	Permanent				4.81
		Temporary		4.95		0.97
	Solid Waste	Permanent				6.02
		Temporary				
Fuhai	Road	Permanent	8.62	2.27		
		Temporary				
	Wastewater	Permanent		4.70		
		Temporary		0.12		
	Solid Waste	Permanent		18.50		
		Temporary				
	Heating	Permanent				
		Temporary		1.46		
Habahe	Road	Permanent	13.03	0.36		
		Temporary				
	Water Supply	Permanent				
		Temporary		1.69		
	Wastewater	Permanent		6.02		
		Temporary	1.30	2.83		
	Solid Waste	Permanent		11.60		
		Temporary				
	Heating	Permanent		0.06		
		Temporary		0.74		
	White Birch Forest	Permanent		4.05		
		Temporary		7.37		
Jimunai	Road	Permanent		0.25	2.08	3.33
		Temporary				
	Water Supply	Permanent				
		Temporary		3.52		

County	Sub-component	Loss Level	Agricultural Land (ha)	Wasteland, Conversion Land, and Shrubland (ha)	Forestland (ha)	Meadow or grassland (ha)
	Wastewater	Permanent		5.22		
		Temporary		2.70		
	Solid Waste	Permanent				7.65
		Temporary				
	Heating	Permanent		0.54		
		Temporary		1.06		
Qinghe County Seat	Water Supply	Permanent				0.23
		Temporary				
	Wastewater	Permanent		4.88		
		Temporary		1.10		
	Solid Waste	Permanent				4.85
		Temporary				
	Heating	Permanent		0.21		
		Temporary		0.95		
Takeshiken Landport	Water Supply	Permanent				0.36
		Temporary				
	Wastewater	Permanent		0.00		3.49
		Temporary		2.60		

Sources: Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

252. **Land acquisition and resettlement.** The Project will acquire about 51.47 hectares (ha) of collective land, of which 40.77 ha (79%) is classified as grassland, and 68.70 ha of state-owned land will be acquired. A total of 16,143.76 square meters (m^2) of residential houses and 2,772.89 m2 shops and enterprises will be demolished. In total, permanent land acquisition and house demolition will affect 205 households and 687 persons in five counties. Among these, 353 ethnic minority people will be affected, accounting for 51%. The impacts of the Project are summarized in Table E.5.

Table E.5: Summary of Land Acquisition and Resettlement Impacts

County	Permanent Land Acquisition (ha)				House demolition (m^2)		AHs	APs	Ethnic Minorities (EM)
	Collective	Of which		State owned	Residential	Shops & enterprises			
		Grassland	Cultivated land						
Buerjin	19.15	19.15		0.89	3,608.07	1,630	59	204	151
Fuhai	8.62	0.00	8.62	25.47	6380.22	398.9	40	189	37
Habahe	0.00	0.00		31.01	1741.81	0	55	79	7
Jimunai	13.06	10.98		5.97	3611.66	743.99	35	122	78
Qinghe	10.63	10.63		5.36	802		16	93	80
Total	51.47	40.77	8.62	68.70	16,143.76	2,772.89	205	687	353

Source: PPTA DFR, August 2010
Note: ha = hectare, m^2 = square meter

253. Land take for the wind-break forest irrigated by the reused effluent will be, on current plans, 1,067 ha of which 122 ha already support some form of stabilizing vegetation. The total area will change when more detailed irrigation plans are finalized. Consistent with their role as stabilization and anti-desertification plantings these areas are on "wasteland" where there is no cultivation and no organized grazing.

254. The draft Resettlement Plans ((RP) - one for each county) address the relocation needs of the affected households and have identified resettlement site options. Detailed information will be collected for each site and the county governments will revise the draft RPs based on the physical indices survey and include details of the resettlement sites, location, number of affected households, and number of affected persons, land areas, and

infrastructure plans. The RPs will be implemented in accordance with all applicable PRC laws and regulations, and ADB's Safeguard Policy Statement 2009.

255. **Economic Displacement.** The only potential economic displacement recorded during the course of the social impact assessment and resettlement planning was the effect of new solid waste disposal subcomponents on the informal scavenging industry. There are two categories of informal scavenging: (i) the collection of waste metal material, such as iron, steel and copper; and (ii) the collection of the waste paper, glass and plastic wastes (bottles in particular).

256. The collectors of the Altay Prefecture are professional collectors, deriving most of their income from the activities. These collectors tour the streets on bicycles with attached carts collecting scrap door-to-door or from urban garbage bins. There is a selling network through which the scavengers sell what they collect. Some is sold to local factories and others middle-men who use them as raw materials. Scrap metal in particular is sold to intermediates that are linked to the Xinjiang Steel Company. Most of the collectors are so called "new immigrants" who came to the counties in recent years. No scavengers identified in the field work were from ethnic minorities in the counties. The improved solid waste disposal arrangements will not interfere with their activities.

257. Latest investigations by PMO report no scavenger activity at current landfills, due to their significant distance from population centres. The county PMO advised that salaried landfill workers often separate "useful" waste for reselling and these activities will not be curtailed by the operational management of new landfills.

258. There is potential economic displacement of small scale coal sellers when small domestic heating stoves are replaced by central heating connections under the Project. However, county PMOs have advised that local coal selling businesses will continue since households will retain their cooking stoves and that the additional coal will be directed to the expanded central heating facilities.

259. **Loss of Physical Cultural Resources.** There is no record of important heritage or archaeological sites on the land that will be temporarily or permanently lost. Should archaeological artefacts be discovered during site works, government requirements for excavating and preserving those items will be strictly followed. Chance find procedures will be established for undiscovered underground cultural or historic sites that might be identified during project implementation. This requirement is included in the EMP.

2. Impacts on Biodiversity

260. Although XUAR has considerable biodiversity values as a region, the development sites for Project subcomponents in Fuhai, Jimunai and Qinghe county seats are all located in development zones or adjacent unvegetated "wasteland" and gobi where there are no native wildlife populations nor valuable habitats. The exceptions are at Buerjin, Habahe and the Takeshiken Land Port.

261. At the Buerjin county seat, the drinking water extraction point and WTP are located 32km upstream of the town to ensure water security and gravity flow to the maximum number of users. In this area some riparian forest (of common willow and poplar species) will be lost to plant and pipeline (see Table E.4), but no wildlife species which are on the national protection lists of the PRC Wild Animal Protection Law (1989) nor the IUCN Red List have been recorded in the vicinity of this habitat.

262. At the Habahe county seat, the WWTP and landfill sites are located in a sparse shrubland (of *Haloxylon* and *Reaumuria soongorica*, common desert conversion shrubs. No nationally protection wildlife species of the PRC Wild Animal Protection Law (1989) have been recorded in the vicinity of this habitat, which is close to the urban area.

263. At the Takeshiken Land Port is the Xinjiang Buergen River Beaver Natural Reserve which is the protected habitat of the Asiatic or Mongolian beaver (*Castor fiber birulai*) This species is endemic to the Wulungu/Buergen River system, but is largely restricted now to the Buergen. It is a class 1 protected species under the PRC Wild Animal Protection Law (1989). The reserve is located on 50 km of the downstream reaches of the Buergen River, virtually from the Mongolian border to its confluence with the Wulungu River and the buffer zone of the reserve borders the southern edge of Takeshiken town. The Buergen River is the only available water supply for the town and the current extraction point is from the river as it passes through the town. The project's new extraction point (replacing the current one) will be 7km upstream to maximise water security. It is sited to avoid damage to any riparian forest habitat (see Table E.4) and locates the WTP clear of the buffer zone. The negligible extraction rate (0.22% of average annual flow of the river) has been confirmed by the water balances as sustainable and without significant effects on the aquatic habitat downstream - although the water balance has flagged the irrigation demands for water from the Buergen as potentially unsustainable in critically dry years (see Section B, subsection 3 below).

3. Indirect and Induced Impacts – Water Supply Subcomponents

264. **Impacts Downstream of Extraction Points.** Impacts on the downstream reaches of the source water body caused by the reduction in water flow have been examined via the determination of water balances for each water supply subcomponent. The water balance considers project related water extractions and current water extractions for water supply and irrigation purposes. The summary water balances are in Tables E.6 below.

Table E.6: Summary Water Balance Analyses for Annual Average Data (Unit: 10,000 m^3)

County	Inflow Conditions	Water Extraction			Balance for Annual Average Data			
		Water to Existing WTP	Water to Irrigation	Water to WTP	Inflow	Base Flow Allocation	Water Deficiency	Water Surplus
Buerjin	Normal Year	-	1,170	278	427,300	85,500	0	340,352
	Dry Year (P=95%)	-	3,510*	278	281,500	56,300	0	221,412
Habahe	Normal Year	237.25	1,300	2.78	251,900	50,380	0	250,309
	Dry Year (P=95%)	237.25	3,900*	2.78	110,300	22,060	0	84,100
Qinghe	Normal Year	-	1,052	185.31	34,630	6,926	0	26,467
	Dry Year (P=95%)	-	3,156*	185.31	28,600	5,720	0	19,539
Takeshiken	Normal Year	-	2,850	55.59	25,720	5,144	0	17,670
	Dry Year (P=95%)	-	8,550*	55.59	16,900	3,380	0	4,914

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

* Irrigation demand is elevated by the reduction in inflow (and hence rainfall) in dry years by a factor of 3.

265. A sensitivity analysis has been performed on this data to determine whether inflow is viable if snow melt and rainfall is critically reduced in the future. The results for a reduction in flow to only 25% of that of an average year are shown at Table E.7 below.

Table E.7: Sensitivity Analysis Water Balance Analyses for Critically Dry Years (Unit: 10,000 m^3)

County	Inflow Conditions	Water Extraction			Balance			
		Water to Existing WTP	Water to Irrigation	Water to WTP	Inflow	Base Flow Allocation	Water Deficiency	Water Surplus
Buerjin	25% of yearly flow	-	3,510*	278	105,825	21,165	0	80,872
Habahe	25% of yearly flow	237.25	3,900*	2.78	62,975	12,595	0	46,240
Qinghe	25% of yearly flow	-	3,156*	185.31	8,658	1732	0	3,585
Takeshiken	25% of yearly flow	-	8,550*	55.59	6,430	1,286	-3,462	-

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

* Irrigation demand is elevated by the reduction in inflow (and hence rainfall) in dry years by a factor of 3.

266. In the above tables, the "Base Flow Allocation" is calculated as 20% of inflow. It is made up of 10% of flow, after Tennant (1976), for minimum in-stream water (cited in World Bank, 2003[18]) plus an estimate of 2% flow to cover evaporation and 8% flow to cover losses through capture structure leakage.

267. The water balances show that in both an average year and a dry year (P=95%) the sum of "Surplus Water" and "Base Flow Allocation" results in sufficient water remaining in-stream for downstream users, both livelihood and ecological uses. For all water supply subcomponent this combination exceeds 98% of total inflow on annual average data. The sensitivity analysis for future significantly drier conditions shows that there will be surplus water in the source water bodies after servicing the water extraction needs in all subcomponents except the Takeshiken Land Port water supply project. In this case, with a dry year with 25% of normal runoff, the estimated demand for irrigation of 8,550 x 10,000 m^3 is clearly untenable, since it exceeds inflow and is therefore unsustainable. In critically dry years, local authorities will need to investigate the appropriate level of extraction for irrigation to ensure that essential domestic and ecological needs are met. It is noted that the Project IA in this county has no regulatory control of irrigation demands and the regulation of sustainable irrigation cannot be imposed as a loan assurance. At Takeshiken, the base flow (which includes 10% of inflow as an environmental flow) should provide adequate flow for the downstream portion of the protected beaver habitat reserve area in a dry year. "Adequate flow" will need to be defined through monitoring of the hydrological determinants of the beaver habitat and this is included in the Environmental Monitoring program and as a loan assurance.

268. A further sensitivity analysis, looking at monthly flow, is shown at Table E.8. Here, the driest month of a dry year is examined. In the absence of monthly data for inflow, the assumption for the driest month of a dry year is as follows. One twelfth (1/12) of the inflow for a dry year to establish average monthly flow, then the average monthly flow is reduced according to the ratio of the driest month's precipitation to the average month's precipitation (calculated for each county from monthly precipitation data in Chapter D) to estimate the driest month. The lowest rainfall month (with antecedent low rainfall) for the counties are: Buerjin - January; Habahe – March; Qinghe – January; and Takeshiken – January. The irrigation period in this region is April to September. The monthly water balance for the driest month therefore includes no irrigation demand. This analysis confirms that the extractions are sustainable even in the driest month of a dry year. It also indicates that the highest irrigation demand falls during the high flow period of the year.

[18] Davis, R and R Hirji 2003, *Environmental Flows: Concepts and Methods*, Water Resources and Environment Technical Note C.1, World Bank, Washington.

Table E.8: Driest Month Sensitivity Analysis Water Balance Analyses for Future Critically Dry Years (Unit: 10,000 m^3)

County	Inflow Conditions	Water Extraction			Balance			
		Water to Existing WTP	Water to Irrigation	Water to WTP	Inflow	Base Flow Allocation	Water Deficiency	Water Surplus
Buerjin	Driest month of dry year*	-	0	23.2	6,779.5	1,355.9	0	5,400.4
Habahe	Driest month of dry year*	19.8	0	0.2	4007.6	801.5	0	3,186.1
Qinghe	Driest month of dry year*	-	0	15.4	1229.8	246.0	0	968.4
Takeshiken	Driest month of dry year*	-	0	4.6	726.7	145.3	0	576.8

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

n/a= data not available

* Dry year yearly flow/12 x (ratio of driest month precipitation to average month precipitation for each county)

269. **Impacts on Downstream Users.** There are a number of categories of downstream users. These users, downstream of the water capture point on source water bodies, include domestic users, agricultural use (irrigation), and in-stream ecological use. These needs are all provided for in the water balances as a separate allocation, not included in the water supply extraction or the allocation for ecological flow, or water loss.

270. The maintenance of a minimum adequate downstream flow for aquatic resources (even when unidentified) is required – based on the precautionary principle. The hydrological analysis from the water balances (Table E.7) shows that in a dry year (P=95%) the surplus water after extraction and the base flow allocation will maintain a significant yearly downstream flow for environmental purposes of greater than 98% of natural flow.

271. **Impacts on Downstream Hydrology.** A river basin analysis has been undertaken for the subproject tracing the changes in flow, as a result of extraction, downstream to the confluence with the main regional drainage water body. Baseline river basin analyses can be used to show the relative impact of water extraction throughout the river basin. The relative magnitude of water extracted from the systems is shown at Table E.10.

Table E.10: River Basin Analysis of Water Supply Subcomponents

Subcomponent Source	Reduction of Annual Flow in source river from Subcomponent water extraction	Reduction of Annual Flow in Major River
Buerjin River (Buerjin County)	0.0651%	0.037% (of Erqis flow)
Habahe River (Habahe County)	0.0011%	0.0003% (of Erqis flow)
Daqing River (Qinghe County)	0.5351%	0.0186% (of Wulungu River)
Buergen River (Takeshiken LP)	0.2161%	0.0056% (of Wulungu River)

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

272. The wastewater treatment subcomponents do not have return treated effluent to the rivers, and, although there may be some limited return through runoff and groundwater, these extractions should be regarded as “open systems” and that the extracted water is lost to the river system. The river basin analysis at Table E.10 show that the relative reduction of flow due to extraction for the water supply components diminishes rapidly downstream through successive tributaries. The highest impact is that of the Buerjin WTP project on the flow of the Erqisi (since the Buerjin River is a major contributor to Erqisi flows and the Buerjin water extraction is the highest of the project water supply subcomponents) and this is minimal at 0.037% of flow.

4. Indirect and Induced Impacts – Road Subcomponents

273. The construction of a new road where none previously existed, or the upgrading of an existing road to a different class of usage has the potential to influence traffic volumes and consequent developments on adjacent roads. In the case of new roads the new connectivity provided is limited in scope and will alleviate traffic on the existing, less direct roads.

274. During the design phase, the issue of seasonal urban flooding and frost heave of soil have been taken into account. Urban flooding from rising temperatures causing early snow melt is a major factor and roads have been aligned, designed and provided with sufficient, appropriately sized culverts to ensure that (i) they are not impacted by flooding, and (ii) that they don't exacerbate flooding elsewhere by damming or redirecting overland flows. Design specifications also include high-capacity drainage ditches for rainfall event intensities of 1 in 100 years. Access roads for water treatment plants, wastewater treatment plants and landfill will be less travelled by the general public but their resilience to extreme weather events will be important for the continued operation of essential infrastructure. They have been designed to withstand 1 in 50 year or 1 in 100year floods as appropriate to the terrain. They will also be constructed with benches for snow drift disposal to ensure that these services are not cut off in harsh winters.

275. Roads which are associated with the development of project subcomponent, such as access roads to new water supply extraction points and the new WWTPs, have the potential to also facilitate unintended developments or the exploitation of natural resources that were previously inaccessible. Because water source locations are chosen for their undeveloped character (to facilitate water source protection) the potential impacts arising from improved access are more significant in these cases. Additionally, the riparian environment of the water source is often a narrow forested area within a predominantly desert/grassland environment, and thus the small riparian forest stands may become vulnerable to unmanaged exploitation. Mitigation of these potential impacts will be based upon strict control of the use of dedicated access roads. Where roads pass through or into source protection areas, riparian forests or native habitat areas signposts will be erected to inform people of access constraints.

5. Indirect and Induced Impacts – Solid Waste/Landfill Subcomponents

276. Solid waste/landfill sites are associated with a number of potential impacts which can occur at locations remote from the site. Water and wind-borne pollution are the most significant. Water-borne pollution can occur in two forms: (i) the carriage of refuse down-slope by flood waters or sudden snow-melt flows into downstream water bodies (in the case of Buerjin and Habahe Rivers, the Erqis River); and (ii) leachate from the base of the landfill leaking into groundwater and contaminating the water table and any groundwater-fed water bodies. Wind-borne pollution comprises plastic bags and paper litter, dust and odor.

277. Water-borne pollution is addressed by a number of measures: (i) location of new landfills in valleys which do not drain directly to the nearest water body; (ii) interception drains to divert runoff water from entering the site; (iii) design of impermeable linings for the base and sides and an adequately sized leachate diffusion cell to contain leachate.

278. For wind-borne pollution, to a degree, the location of the facility (remote from any settlements) is a mitigation feature. Additionally, site management prescriptions covering the opening of a single active tip face at any one time, daily soil covering and fencing to catch litter will act to minimize wind-borne pollution.

279. **Closure of Current Landfills.** A number of solid waste sub-components are planned either adjacent to or conjoined with existing unmanaged landfill areas or dump sites with no environmental safeguards. While the exigencies of operating in extended freezing

conditions can explain some management shortcomings, overall the current sites provide graphic evidence of low design and operating capacities. Each county will prepare a time-bound action plan for closure of the existing landfill in accordance with national standard linked to the implementation of the proposed landfill, as well as an environmental monitoring plan (in particular on the quality of the underground water) of both the existing and the proposed landfills. The closure and rehabilitation of current landfill sites in compliance with national standards will be timed to start when the new landfill is commissioned.

280. Before site closure, the following measures will be implemented to improve the environmental performance of the current landfill and to facilitate final closure: (i) Improved day-to-day site management; (ii) Monitoring of existing pollution levels (by the Altai Regional Environment Monitoring Station); and (iii) Design and construction of leachate interception and holding tanks and gas collection measures.

281. The Site Closure Plans should detail the final site sealing measures and final site contours, flood protection works, and landscaping. Time-bound closure plans for existing landfills, incorporating all the features described above, are included in the project EMP as a prerequisite of new landfill developments. Additionally, the commitment to follow through on these plans is included as a loan assurance.

6. Indirect and Induced Impacts – Waste Water Treatment Subcomponents

282. Induced impacts from the siting and design of wastewater treatment facilities focus primarily on the arrangements for the disposal of treated effluent and the closure of existing wastewater treatment facilities.

283. **Effluent reuse.** The treated effluent will be used for irrigating wind break and sand stabilizing forests and ecological shelterbelts to combat desertification. The planned plantations will cover a total area of 950 ha in five counties and utilize a total of 1,140,000 m3 of treated effluent per year. This has been determined by the outputs of the WWTPs and using a standard irrigation rate for the chosen native species (*Populus simonii, Ziziphus jujube*, and *Ulnus pumila*) of 10,500m3/ha/yr. These are non-invasive species, naturally occurring in northern China and are appropriate for land stabilization applications. However, the planned irrigation application rate does not take account of local conditions. In particular, there are different percolation rates and soil salinity of the soils in the planned plantation locations. Additionally, the period when irrigation is possible (after the winter thaw) and desirable (during the growing season) concentrates the year's effluent output into a short irrigation period. Accordingly, a number of additional measures are required before finalization of adequate irrigation plans – and these are examined below in Section D "Impacts and Mitigation Measures during the Operational Phase". The development and implementation of sound irrigation plans (including financial and institutional requirements) will be required as a loan assurance.

284. **Closure of Current Aeration Ponds.** All county WWTP developments will replace existing aeration and settlement ponds. Size and configuration of these facilities differ among the counties and their closure and rehabilitation plans will need to be finalized on the basis of individual site investigations. The general principles of closure and rehabilitation will include the natural evaporation and land infiltration of the effluent in the ponds (over a period of about 6 months), followed by sun-drying for a period of about one year. Final stages will involve the removal of contaminated soil and sludge at the bottom of the ponds and using the material as cover spoil in the county landfill sites. Additional treatment of accumulated bottom sludge may be required to ensure the necessary compressive strength, erosion resistance and hydraulic conductivity. Sludge/sediment solidification may be required, using lime (CaO). Levels of contamination with heavy metals in the sludge will need to be monitored to ensure that it complies with the PRC standard for hazardous chemicals in landfill (HJ/T300).

285. Closure and rehabilitation plans of existing aeration ponds in all counties will be developed and implemented at the time of commissioning of the new plants. The plans will be based upon site investigations and volumes of all materials. The rate of disposal of the polluted pond bottom spoil will be based on the daily operating capacity of the landfill sites. Time-bound closure and rehabilitation plans will be a project assurance through loan covenants.

7. Indirect and Induced Impacts – Heating Subcomponents

286. The heating components include the construction of new centralized heating plants, distribution pipes and heat exchange stations to either replace or upgrade existing aging facilities in Jimunai and Qinghe counties. Elsewhere, the installation of heating pipelines and new heat exchange stations (in Habahe and Fuhai) will service new areas, which are currently using local and domestic heating. In all cases, the pollution control equipment has relatively low ratings for efficiency – 65% for desulfurization and 90% for particulate scrubbers. Point source emissions from new (ADB funded) boilers comply with Atmospheric Pollutant Discharge Standards for Boilers (GB13271-2001) and this is further discussed in Section D "Impacts and Mitigation Measures during the Operational Phase". However, the induced environmental impact of the heating subcomponents is the more significant effect.

287. The new boilers will replace old, inefficient and polluting boilers resulting in net reductions in all emission levels. The expansion of areas covered by centralized heating (both though additional boilers and new pipelines and heat exchange stations) will phase out the domestic use of multiple small coal stoves for heating, again with net savings in emissions. The raw calculations for these emission savings (including CO_2 savings discussed in Chapter C, Section A "Rationale and Justification for the Project") are set out in Appendix 2. A summary of emission reductions is as follows:

288. **Habahe County.** Construction of heating exchange stations, and heating pipeline. Currently, there are two heating plants in Habahe County. One is located in the south of the county seat and the other is located in the north of the county seat. For this project, one new 1×46MW (65t) boiler, which will be funded and constructed by the IA in the existing north heating plant, will be the primary heating source. The subcomponent will provide heating pipes and heating exchange stations. Thus, the heating source for this project will be an associated development, and its timely approval and construction will determine the effectiveness and sustainability of the Project's subcomponent in this county. The new boiler, to be financed and implemented by the IA, is planned to be constructed in late 2010. An EIA under PRC regulations will be conducted for the boiler, and will require approval by the EPB. The plant will have adequate capacity to supply the additional area of households to be serviced by the Project's heat exchange stations and piping. The plant will use coal with 0.41% sulfur content and 13.13% ash content, and will be equipped with dust removal and flue gas cleanup equipment. Currently, the central heating service area supplied by the north heating plant is 141,900m^2, and after the implementation of the project, by 2015, the heating area supplied by the north heating plant will be 752,000m^2.

The Coal saved after the implementation of the project	11854.5t/a
The Dust/Smoke emission (PM) reduced after the implementation of the project	451.6t/a
The SO2 emission reduced after the implementation of the project	156.4t/a
The CO2 emission reduced after the implementation of the project	15033t/a

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

289. **Jimunai County.** Construction of new boiler house, heating exchange stations, and heating pipeline network. Currently, the central heating service area for the whole county is 270,000m^2, and after the implementation of the project, by 2015, the heating area supplied by the north heating plant will be 611,000m^2.

The Coal saved after the implementation of the project	27928.2t/a
The Dust/Smoke emission (PM) reduced after the implementation of the project	594.9t/a
The SO2 emission reduced after the implementation of the project	249.3t/a
The CO2 emission reduced after the implementation of the project	35409.2t/a

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

290. **Qinghe County.** Upgrading of boiler house, new heating exchange stations, and new heating pipeline network. Currently, the central heating service area for the whole county is 421,300m^2, and after the implementation of the project, by 2015, the heating area supplied by the north heating plant will be 1,080,000m^2.

The Coal saved after the implementation of the project	20340t/a
The Dust/Smoke emission (PM) reduced after the implementation of the project	651t/a
The SO2 emission reduced after the implementation of the project	329.37t/a
The CO2 emission reduced after the implementation of the project	31244t/a

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

291. **Fuhai County.** The sub-component is the rehabilitation of the heating supply pipe network of the county seat for improvement of energy saving and security. It includes new construction of 2,905 m of primary pipe network. Coal and emission savings will accrue from the replacement of 1,289 small household heating stoves.

The Coal saved after the implementation of the project	15141.76t/a
The Dust/Smoke emission (PM) reduced after the implementation of the project	252.9t/a
The SO2 emission reduced after the implementation of the project	79.64t/a
The CO2 emission reduced after the implementation of the project	13826.4t/a

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

292. The overall net savings in PM emissions are 1,950.4 tons/year, and the total net savings in SO_2 are 811.7 tons/year. This represents a significant environmental improvement in the counties of Altay Prefecture, as well as providing heating to more beneficiaries.

C. Impacts and Mitigation Measures during the Construction Phase

293. The following impacts and mitigation measures refer to construction impacts which are common to all subcomponents. All built infrastructure, - heating plants, roads, pipelines, treatment plants and landfill cells - will require earthworks, soil stabilization, dust and noise control as well as management of the impacts from machinery operation, transport and haulage of building materials and the domestic needs of the work force. Occupational and community health and safety issues are discussed separately in Section E below. Where a construction impact is particular to a specific sector, it is noted.

294. **Spoil Disposal – All subcomponents.** Project subcomponents have been designed to make maximum use of spoil from construction earthworks through balancing cut and fill along roads, backfilling pipeline trenches for water supply, wastewater treatment and heating subcomponents, the construction of berms for noise and wind protection of plants and facilities and earthworks for landscaping. The total earthworks and surplus spoil from the subcomponents are summarized in table E.11 below.

Table E.11: Borrowing, Excavation, Backfill and Surplus Spoil (unit: 10,000m^3)

	Borrow/Quarry	Excavation	Backfill	Surplus Spoil
Buerjin County				
Road	1.1	22.1	23.2	
Water Supply		45.5	35.8	9.7
Wastewater		8.95	7.05	1.9
Solid Waste		5.095		
Fuhai				
Road		19.9	3.4	16.5
Wastewater		5.6	4.5	1.1
Solid Waste		3.2		
Heating		1.5	1.3	0.15
Habahe				
Road	13.90	9.57	0.87	8.70
Water Supply		1.09	1.01	0. 08
Wastewater		11.36	3.80	7.56
Solid Waste		8.66	6.75	1.91
Heating		0.59	0.57	0.02
White Birch Forest		5.2	4.6	0.6
Jimunai				
Road		18.9	6.1	12.8
Water Supply		14.9	14.7	0.23
Wastewater		9.1	8.5	0.61
Solid Waste		1.4	0.1	1.3
Heating		1.27	1.25	0.03
Qinghe				
Water Supply		4.1	3.7	0.4
Wastewater		5.2	1.3	3.9
Solid Waste		2.48	2.42	0.06
Heating		1.7	1.7	
Takeshiken Landport				
Water Supply		6.7	6.3	0.4
Wastewater		2.20	0.05	2.15

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

295. All subcomponents except landfill will generate surplus spoil after maximizing reuse of spoil on-site. Surplus spoil can be used off-site by coordinating construction. Pipeline laying can be coordinated with the WTP construction. Spoil produced from the pipeline laying can be used for WTP foundation soil and earthworks. Pipeline laying can be coordinated with the WWTP construction. Spoil produced from the pipeline laying can be used for WWTP foundation soil and earthworks. The excavation soil from landfill sites will be used as the solid waste covering soil.

296. The remaining surplus spoil should be transported to suitable spoil disposal sites approved by the local EPB. All spoil disposal sites must be identified, designed and operated to minimize impacts and maximize land stability. Approved spoil disposal sites will be identified during detail project design, and defined in the construction tender documents. The spoil disposal site will be shaped and re-vegetated at the conclusion of disposal activity. The final height and shape of each disposal area will be determined by survey during the detailed design phase and will be based upon the resting stability of local spoil material and the surrounding topography.

297. During the period of active spoil disposal at a site, interception drainage channels will be established to protect the site from surface runoff. The spoil itself will be planted with grasses on completion. Spoil materials will be a mixture of soil and stone. In order to facilitate rehabilitation of these sites, topsoil will be stripped, stored safely, and used to cover

the surface of the dump on completion of activities at that site. Local grass and shrub species will be planted. These measures have been incorporated into the EMP.

298. **Erosion of disturbed surfaces – All subcomponents.** Northern Xinjiang has low rainfall, often falling as snow, and sandy soils with low erosion potential. Soil and sediment mobilisation is mostly a feature of overland flow from snow melt. Limited soil erosion can therefore be expected during the construction phase when surface vegetation and soil are damaged. Soil erosion can also occur after completion of construction in areas where site restoration has been inadequate. The areas most vulnerable to erosion include earth borrow pits, spoil sites, temporary construction sites, and other areas where surface soil will be disturbed. The most effective erosion control will be interception drainage to protect disturbed surfaces from surface flows, especially from snow melt. Construction plans will also include erosion control prescriptions for borrow pits and construction work areas. Prescriptions will include: (i) preservation of existing vegetation where no construction activity is planned or temporarily to preserve vegetation where activity is planned for a later date; (ii) check dams to control erosion in concentrated flow paths; and (iv) apply permanent soil stabilization measures, such as vegetation, re-vegetation, and concrete pavement, upon completing construction, or when closing borrow sites, disposal sites, and temporary access roads. These prescriptions have also been incorporated into the EMP.

299. **Construction Wastewater – All subcomponents.** Construction wastewater is produced from the maintenance and cleaning of mechanical equipment and vehicles, maintenance water for mixing and curing concrete, cooling water, and lost water and soil during the construction period which is discharged as pollutants. The effluent, comprised mainly of inorganic wastewater, commonly contains no poisonous and harmful substance, except suspended solid, but, if discharged in an improper manner, still has the potential to impact existing water bodies. Some oil-containing wastewater can arise from machinery repairs.

300. Construction wastewater will not be discharged unto the surrounding soil or into surface water systems. Sedimentation tanks will be built, and after settling out of solids the upper clear liquid will be recycled for spraying the construction site (dust control), and the waste residue in the tank will be cleared and transported to designated landfills. Oil-containing wastewater will require the installation of oil-water separators before the sedimentation tank. The prescriptions have also been incorporated into the EMP.

301. **Gaseous Air Pollution – All subcomponents.** Construction machinery on all sites will consume petrol and diesel, releasing gaseous SO_2, CO, and NOx. Equipment will be maintained to a high standard to ensure efficient running and fuel-burning. High-horsepower equipment will be provided with tail gas purifiers. Atmospheric monitoring will be carried out during the construction period. All vehicle emissions will be in compliance with relevant PRC emission standards. These prescriptions have been incorporated into the EMP.

302. **Gaseous Air Pollution – Road subcomponents.** A particular emission from road construction works is asphalt flue gas. During the asphalt heating and mixing process, the fuel burning will produce smoke, and the asphalt will produce flue gases emissions. Currently, modern asphalt mixing equipment used in PRC releases typical emission concentrations of asphalt flue gases of 22.7mg/m^3. This figure complies with asphalt flue gas discharge requirements of 80-150mg/m^3 of Atmospheric Pollutant Emission Standard (GB16297-1996). It also complies with the Ambient Air Quality Standard (GB3095-1996) which limits the concentration of benzopyrene at 0.01μg/m^3 100 meters downwind from the asphalt mixing station. The use of this equipment will be stipulated by the EMP. Additionally, asphalt mixing stations will be sited at least 500 meters away from residential areas.

303. **Dust – Landfill Sites.** Many areas in Altay Prefecture are particularly susceptible to dust storms. The main determinants of wind erosion are: wind speed and exposed ground (with loose soil or sparsely-covered vegetation). Intensity of wind speed has a close relation to diameter of sand is shown in Table E.12.

Table E.12: Relation between Diameter of Sand Grain and Wind Generated Dust

Diameter of grain (mm)		0.10-0.25	0.26-0.50	0.51-1.00	>1.00
Wind speed (m/s)	2m	4.0 m/s	5.6 m/s	6.7 m/s	>7.1 m/s
	10m	5.5 m/s	7.7 m/s	9.2 m/s	>9.8 m/s

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

304. An analysis of statistical data of local weather and environmental conditions reveals that mean annual wind speed in this area is 4.0m/s, with maximum wind speed as high as 34m/s. Under the influence of this wind speed, sand dust is often moved in the subcomponent areas which are desert grasslands with sparse vegetation. From on-site investigation, wind erosion will occur in the project's area of influence.

305. **Dust – All subcomponents.** All construction sites will potentially produce fugitive dust from material storage areas, waste dump sites, concrete mixing, excavation and general site usage – especially under prevailing wind conditions. Material stockpiles and concrete mixing equipment will be equipped with dust shrouds. The operators will regularly maintain the shrouds to ensure their effective operation. For both construction sites and construction roads, water spraying for the suppression of dust and maintenance of driving surfaces will be standard site management practice. Vehicles carrying soil, sand, or other fine materials to and from the construction sites will be covered.

306. **Noise - All subcomponents.** Noise can be expected during construction due to construction machinery operation and transport activities. Construction activities will involve bulldozers, graders, excavators, concrete-mixing plants, rollers, and other heavy machinery. Noise intensity from these large machines operating is typically in the range of 76–98 decibels at the site (1m from operating machinery). The transport of material, aggregate, concrete and waste material to and from sites will also cause noise impacts along the haulage routes. Activities with intensive noise levels will not only have an impact on the residents, but may cause injury to construction workers operating the equipment.

307. Work will be scheduled according to the noise rating of the machinery used and the distance to sensitive receptors to achieve Category 1 (GB12523-90) compliance. Operation of machinery generating high levels of noise and the movement of heavy vehicles along urban roads will be restricted to between 6:00 am and 10:00 pm in accordance with PRC regulations. The sites for concrete-mixing plants and similar activities will be located at least 1 km away from sensitive areas such as residences, schools, and hospitals. The erection of temporary noise barriers will reduce noise impacts from transport vehicles near sensitive receptors.

308. Landfill sites and wastewater treatment facilities will be located at sites distant from sensitive receptors and construction noise as a result will not have significant impact on surroundings. The same will be true for the water treatment plants in Buerjin and Takeshiken Land Port.

309. Road and pipeline construction are linear activities. When a section is finished, construction activities move on and away from that locality. Therefore, noise impact on a specific location from the construction activities will be temporary, lasting from several weeks to months. On the other hand, the construction of centralized heating plants will take place in close proximity to their client areas – residential precincts. If schools are nearby, the construction unit will reach an agreement with the schools regarding heavy machinery work to avoid any unnecessary disturbances. If there are construction activities that must be continued during the day and night, the construction unit will reach an agreement with residents nearby and may give compensation to the most severely affected residents. Construction noise in these areas will need to be closely managed and monitored. The prescriptions have been incorporated into the EMP.

310. **Traffic Management – Roads subcomponents.** The project construction traffic might cause temporary traffic congestion, and inconvenience and safety issues to city residents. Interim roads will be sited and managed to avoid traffic problems, and will be reinstated to their original condition on completion of construction. Transport and haulage routes will be selected to reduce disturbance to regular traffic, and construction traffic will be diverted during peak periods.

311. **Construction Camps Solid Waste – All subcomponents.** The construction workforce will generate garbage (food wastes, kitchen wastes, paper, and other solid waste including food-laden wash water). Proper disposal of this waste will be essential. It will be the responsibility of the construction contractors to provide sufficient garbage bins at strategic locations and ensure that they are (i) protected from birds and vermin, (ii) emptied regularly (using the county seat solid waste system and landfill), and (iii) do not overflow. This contractor responsibility is included in the EMP.

312. **Hazardous and Polluting Materials – All subcomponents.** A construction material handling and disposal protocol that includes spill responses will be prepared and implemented as part of each site's environmental supervision manual. The following measures will be taken to prevent pollution of soil and surface water/groundwater: (i) storage facilities for fuels, oil, asphalt material, and chemicals will be within secured areas on impermeable surfaces, provided with bunds and cleanup installations; (ii) vehicles and equipment will be properly staged in designated areas to prevent contamination of soil and surface water; (iii) vehicle, machinery, and equipment maintenance and refueling will be carried out in such a way that spilled materials do not seep into the soil; (iv) oil traps will be provided for service areas and parking areas; (v) fuel storage and refilling areas will be located at least 300 m from drainage structures and important water bodies. The prescriptions have also been incorporated into the EMP.

313. The contractors' fuel suppliers will be properly licensed, follow proper protocol for transferring fuel, and be in compliance with Transportation, Loading and Unloading of Dangerous or Harmful Goods (JT 3145-88).

314. **Construction Waste – All subcomponents.** The handling and disposal of construction wastes could have adverse impacts on the surroundings. Solid waste that cannot be used will be collected on site and not be discarded in a way that will damage farmland or the immediate environment. Solid waste will be regularly transported off-site by the contractor for disposal at designated landfill sites in compliance with the Law on the Prevention and Control of Environmental Pollution by Solid Waste of PRC (2004) and scrap material and demolition waste disposal standards promulgated by the Ministry of Housing and Urban-Rural Development.

315. **Demolition – Heating subcomponents.** Associated developments for this subcomponent will be the demolition of old boiler houses and removal of multiple domestic stoves. Recycling of small domestic heating stoves will be achieved through their scrap metal value. However, the demolition of boiler houses will have potential for short term impacts of noise and dust as well as the handling and disposal of demolition waste. This will need to be undertaken in compliance with the Law on the Prevention and Control of Environmental Pollution by Solid Waste of PRC (2004) and scrap material and demolition waste disposal standards promulgated by the Ministry of Housing and Urban-Rural Development. There is also a likelihood that the boiler houses being demolished will contain hazardous substances such as asbestos. Work will therefore need to be undertaken under the supervision of the local bureau for Work Safety and in compliance with the provisions of the PRC Occupational Disease Control Act (2002) and Work Safety Act (2002). The FSRs did not cover this issue and demolition plans with environmental safeguards will be required as loan assurances.

316. **Contractor Performance – All subcomponents.** To ensure that construction contractors are able to implement the mitigation measures, the IAs will put in place the following arrangements: (i) environmental specifications will be included in the bidding documents to contractors; (ii) an appropriate environment section describing standards and responsibilities will be included in the terms of reference for bidders; (iii) approved spoil disposal sites, material haulage routes, borrow pit locations and waste disposal arrangements will be defined in the construction tender documents as appropriate; and (iv) clauses referencing the EMP mitigation provisions and monitoring plans will be written into the construction contracts. Following the award of construction contracts, the successful head contractor will prepare a Site Environmental Management and Supervision Manual, including an emergency preparedness and response plan, for approval by the IAs.

317. **Construction Site Management and Supervision – All subcomponents.** Before implementation of a new subcomponent, a detailed plan including measures for site environmental protection will be formulated. The plan, once approved by the EPB, must be executed strictly. During construction, the assigned environmental protection team should be strengthened to enhance site supervision, management and appraisal, so as to identify problems and solve the problems in time. Environmental training, especially related to environmental management, is included in the EMP. The contractor will take reasonable measures to minimize the impact of construction on the environment.

D. Impacts and Mitigation Measures during the Operational Phase

1. Operation of Road Subcomponents

318. **Soil erosion.** During project road operation, no significant soil erosion is expected if all slope protection measures and drainage, properly installed during construction, are adequately maintained. For proper maintenance, regular inspection will be important to detect signs of slope instability and ensure re-vegetation. Drainage systems will be regularly monitored.

319. **Traffic Management.** Traffic flows on Project road components and adjoining road networks will be monitored to confirm or adjust traffic forecast predictions. The HIWAY-2 mode (linear source mode) will be applied. This methodology is authorized and recommended by the PRC State Department of Traffic. Adjustments to intersections and road networks in the future, as well as road maintenance schedules, will be based upon the traffic monitoring.

320. **Air Pollution.** Using traffic volume projections provided in the subcomponent FSRs and model computations, vehicle exhaust pollutant volumes at average traffic volumes during the operation period for sensitive zones for Buerjin and Fuhai were quantified. Typical results are shown in Table E.13. This shows predicted result of ground level concentration of pollutants along both sides of road in sensitive zones.

Table E.13: Maximum density of impact caused by vehicle exhaust in sensitive zones during operation period (mg/m^3)

Title	Road section	Vehicle exhaust at peak hour of traffic volume	
		CO	NO_2
Buerjin			
Kindergarten	East Wolongwan Road	0.524	0.028
Education bureau	East Wolongwan Road	0.524	0.028
County hotel	West Wolongwan Road	0.469	0.023
TV station	North Youyifeng Road	0.561	0.026
Public security bureau	North Youyifeng Road	0.561	0.026
Tianzhu Tourist Hotel	Meilifeng Road	0.417	0.019
Fuhai			
Residential area	Xingfudong Road	0.021	0.004
TV station	Xingfudong Road	0.021	0.004
No. 2 middle school	Huanchengdong Road	0.016	0.002
Park	Tuanjie Road	0.023	0.004

Sources: Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

321. The predicted air emissions from operational road subcomponents in Jimunai and Habahe were calculated differently in the FSRs (by a different Institute – see sources). Habahe roads were assessed for predicted emission levels at specific future times, rather than for the average of the operational period. These predictions are at Table E.14. No predictive analysis was undertaken for the Jimunai roads subcomponent.

Table E.14: Traffic Emissions Prediction for Habahe Road Subcomponent (mg/m^3)

Prediction Year	CO	NO_2	Distance from the road shoulder (m)
2014	0.173	0.041	60
2020	.229	0.065	60
2029	0.335	0.107	60

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

322. The results show that CO and NO_2 density at all sensitive spots comply with the levels for Class II of the PRC ambient air quality standard. There is no recommended level for CO in the World Bank Group EHS Guidelines[19], however there is a set level of 0.04 mg/m^3 in the guidelines. The predicted levels for project roads in Buerjin and Fuhai therefore comply with the EHS guidelines, however the longer term predictions for Habahe roads (after 2014) do not. Accordingly, to reduce exhaust gas for the new and upgraded roads, speed-limiting signs will be set up. Air pollution compliance monitoring will also be undertaken (see EMP).

323. **Noise Pollution.** Traffic noise within set distances from the centre of the roads has been predicted and is shown in Tables E.15 and E.16.

[19] IFC/World Bank 2007, *Environmental, Health and Safety Guidelines General EHS Guidelines*, World Bank, Washington.

Table E.15: Predicted Traffic Noise Levels – Fuhai and Buerjin (dB(A))

Time period	Traffic Noise and Distances from Road dB(A)													
	10	20	30	40	50	60	70	80	100	120	140	160	180	200
Fuhai														
Day		63.7		59.5		57.0		55.3	54.0	53.0	52.0	51.3	50.7	50.0
Night		56.7		52.2		49.4		47.3	45.8	44.6	43.5	42.6	41.7	41.0
Buerjin														
Day	56.50		54.72		53.34		52.21		51.25					
Night	52.26		51.07		50.15		49.40		48.76					

Sources: Altay Prefecture Government via Zhongsheng EIA Institute

Table E.16: Predicted Traffic Noise Levels – Jimunai and Habahe (dB(A))

Year of prediction	Time period	Traffic Noise and Distances from Road dB(A)									
		20m	40m	60m	80m	100m	120m	140m	160m	180m	200m
Jimunai											
2014	Day	45.5	43.8	42.6	41.7	40.9	40.31	39.7	39.3	38.8	38.4
	Night	41.2	39.5	38.4	37.4	36.7	36.1	35.5	35.0	34.6	34.2
2020	Day	46.7	45.0	43.8	42.9	42.2	41.5	40.9	40.5	40.0	39.6
	Night	43.4	41.7	40.5	39.6	38.9	38.2	37.7	37.2	36.8	36.4
2029	Day	47.6	45.9	44.7	43.8	43.1	42.4	41.9	41.2	40.9	40.6
	Night	44.5	42.8	41.6	40.7	39.9	39.3	38.8	38.3	37.8	37.4
Habahe											
2014	Day	58.76	56.3	54.75	53.61	52.71	51.96	51.32	50.77	50.28	49.84
	Night	49.99	47.52	44.47	44.03	43.93	43.18	42.55	41.99	41.5	41.06
2020	Day	61.52	57.82	55.49	53.78	52.43	51.31	50.36	49.53	48.79	48.13
	Night	54.02	51.2	49.45	47.78	47.2	46.38	45.69	45.09	44.56	44.09
2029	Day	65.1	61.8	59.6	57.9	56.7	55.8	54.9	54.3	53.8	53.3
	Night	56.94	53.24	50.91	48.17	47.85	46.73	45.78	45.95	46.21	45.55

Sources: Altay Prefecture Government via Zhonglanlianhai EIA Institute

324. From the tables, traffic on project roads in Fuhai and Habahe will both exceed day and night noise levels set for Class II standard of Noise Environment Quality Standards (GB3096-2008) in the medium term. Buerjin and Jimunai will comply. Buerjin, Habahe and Jimunai roads noise predictions all exceed the recommended levels for noise in the World Bank Group EHS Guidelines (55 dBA day; 45 dBA night). However, pre-project ambient noise levels in Habahe, Jimunai and Buerjin already either exceed or match the World Bank Group EHS recommended levels (see Chapter D - Baseline Environment).

325. In order to mitigate these trends, a number of noise abatement and protective measures will be implemented in the operation phase including: (i) Increase control of vehicle noise, including the installation of effective mufflers for reducing noise from engine and exhaust; (ii) Traffic management to avoid noise produced by stop-and-start driving, and avoid noise caused by vehicles held up due to double parking or illegal parking; (iii) Limits on driving speed, especially over speed limit. Large and heavily loaded vehicles forbidden during night time (iv) Signs and education to reduce use of horn; (v) Road maintenance and timely repair of damaged road pavements; (vi) Undertake noise monitoring at regular intervals to check on compliance.

326. **Noise Sensitive Areas.** In order to protect sensitive receptors, their location within the over-standard noise distances from the road will be identified by the IAs and provided with built noise barriers as part of road construction and noise-proofing of individual buildings (such as hospitals and schools)..

327. Additional mitigation of traffic noise will be gained by sound planning decisions by local authorities. This should include good land use planning along new roads. Schools, hospitals, apartments for the elderly, and hotels should not be built within 50 m of the centre

lines of new roads. Set-backs from the roadside should be enforced and used as greening belts and pavements.

328. Ambient noise monitoring will be mandated to determine whether mitigation measures will be required for sites where noise levels are predicated to exceed less than 3 decibels in audible scale or where noise levels are expected to be exceeded by more than 3 decibels in audible scale in the medium and long term. Monitoring will be conducted twice annually, for 2 days on each occasion. Mitigation measures will be implemented if infringement of PRC standards is observed.

329. **Hazardous Goods Haulage.** The haulage of hazardous goods on the new and upgraded roads raises the possibility of destructive pollution to water, villages and towns surroundings caused by traffic accidents, especially when hazardous goods are transported across rivers or environmental sensitive spots during the operation period. Hazardous goods for road transport in the project's areas of influence include petrol, chemical fertilizer and farm chemicals. By combining estimated risk occurrence frequencies at predicted traffic volume at sensitive road sections, the probability of destructive pollution produced in these areas was predicted.

330. The risk for hazardous goods pollution from accident for all road subcomponents is in the order of 0.0012 times per year at average traffic volumes within the designed operational period of the road (to 2029). The risk for hazardous goods spillage into water channels is even lower at 0.000008 times per year. This indicates a very low probability for the occurrence of this kind of accident. In order to further reduce the risk of pollution by spillage of dangerous goods, an emergency preparedness and response mechanism has been defined and will be implemented by all counties with road subcomponents.

331. **The Emergency Preparedness and Response Plan** consists of (i) Establishment of a road accident emergency command organization, consisting of the road management department, the fire control department and the environment protection department. This organization will be responsible for commanding, leading and organizing the emergency team, inspections and accident prevention planning; (ii) Establishment of an emergency response plan; (iii) Preparation of emergency equipment and allocation of facilities, including small-scale equipment and facilities for dealing with various emergent accidents, which include emergency communication equipment, on-site supervision equipment, and first aid.

2. Operation of Water Supply Subcomponents

332. A number of operational impacts of water supply subcomponents have been incorporated in the design and location of the facilities. Issues of water availability have been examined and confirmed through water balances with sensitivity analyses for dry years. Water quality has been addressed by locating extraction points in remote locations to minimize any domestic or industrial runoff reducing water quality. Water security at the water source is partially provided by the remoteness of the extraction point, and also by active measures to protect the watershed (see below).

333. **Water Source Protection Planning.** Protection measures will be formally delineated for water source protection zones (if they have not already been established according to national standards). These comprise: (i) a Prohibited Zone (Grade I Zone), closest to the water source; (ii) a Protection Zone (Grade II Zone), adjoining the Prohibited Zone; and (iii) a Buffer Zone. The detailed provisions and restrictions for each of the for watershed protection areas are as follows:

334. Prohibited Zone restrictions and measures: unauthorized personnel will be forbidden from entering within 100m surrounding the water intakes.

335. Protection Zone restrictions and measures: No new buildings or construction projects which may drain pollutants to the water body are allowed within the zone. Existing developments must reduce and manage their pollutants discharge.

336. Buffer Zone restrictions and measures: No new building or extension of construction projects which may drain pollutants to the water body are allowed. Existing developments must reduce their pollutants discharge; Existing drainage and sewerage must be upgraded to ensure the water quality meets the relevant standards. No disposal of garbage, feces, oil, or hazardous substances is permitted in the zone.

337. There are also a set of general land use controls. These include: (i) Fences should surround the water intake on the source water body, humans and livestock are forbidden to enter the river bed to avoid the influences to the water quality of the source; (ii) Intensive poultry plants will be forbidden in the protection zones, and any existent poultry plants will be forced to moved or close within a definite time; (iii) Signage notifying the public of water source protection zones and prohibitions.

338. To facilitate immediate protection, the IAs plan to first adopt Buffer Zone measures (before the scope of the Protection Zone and Prohibited Zone are finally determined) and the relevant management methods for the Protection Zone be initially applied. This will allow time for planning and undertaking the stringent provisions of the Prohibited Zone.

339. **Hazardous Materials Handling and Disposal.** The water purification plants in all counties will use chlorine dioxide for water disinfection. Chlorine dioxide will not produce harmful organic halogenic compounds and trihoIomethanes (carcinogenic substances). The main constituents of chlorine dioxide, sodium chlorite solution and hydrochloric acid will be transported to and mixed in a reaction tank (batch reactor), in the WTPs' preparation area. The product, a gas-liquid mixture which consists of chlorine dioxide and chlorine, is added to the intake water to achieve chlorine disinfection and oxidation.

340. Hazards exist in preparing, transporting, storing and handling hydrochloric acid and sodium chlorite used for chlorine dioxide generation. In the chlorination room of water purification plants, there is an environmental risk of hydrogen chloride and chlorine dioxide leakage. Chemicals will be transported and managed in compliance with relevant state regulations on hazardous chemical substance management. Transport vehicles and personnel should be qualified and trained with hazardous chemical substance transportation. Storage will be arranged with certificates procured from the police department and fire authorities. Additional on site mitigation measures fall under the heading of occupational health and safety and are discussed below.

341. The chlorination room and chemical storage area will be equipped with automatic alarms, which will be triggered by chlorine dioxide leakage. To protect personnel on duty from hazard caused by hydrogen chloride and chlorine dioxide leakage, the duty room will be equipped with gas masks, oxygen breathing apparatus and other rescue materials. An emergency response plan will be developed and implemented. The plan will inform staff and visitors about the characteristics of chlorine dioxide and hydrochloric acid, describe potential health hazards, and define accident prevention measures and an evacuation plan.

342. **Water quality monitoring, emergency response.** Monitoring data of the quality of the water sources in Chapter D "Description of the Environment" show that the raw water quality can meet Water Quality Standards for Domestic Drinking Water Sources (CJ3020-93). Water sources and extraction points have been selected to maximize water security, and routine monitoring program for water quality will be undertaken by the WTP operators. This is described in the EMP.

343. **Water leaks.** There is a risk that water pipes may leak and burst, leading to localized flooding, with environmental and economic impacts. Adequately designed pipes, properly selected piping materials, proper supervision during construction, and proper O&M will mitigate such a risk.

3. Operation of Wastewater Collection and Treatment Subcomponents

344. **Effluent Discharge.** The treated sewage will be used for irrigating wind break and sand stabilizing forests and ecological shelterbelts to combat desertification. When the sewage treatment plants go on stream after completion, the quality of discharged treated water will comply with the Water Quality Standard for Irrigation (GB5084-2005). Parameters of this standard are listed below. At and below these levels the irrigation water will not significantly impact ground water quality.

Table E.17: Design Effluent Standard for Irrigation Discharge

BOD_5, mg/l	COD, mg/l	SS, mg/l	pH	Dissolved Solid, mg/l	Chloride, mg/l	Sulfide, mg/l	Coliform Bacteria, number/100ml	Roundworm Eggs, number/l
100	200	100	5.5-8.5	1000	250	1	4000	2

Source: PPTA DFR, August 2010

345. The planned plantations will cover a total area of 950 ha in five counties and utilize a total of 1,140,000 m^3 of treated effluent per year. This has been determined in the FSRs by the outputs of the WWTPs and using a standard irrigation rate for the chosen species (Populus simonii, Ziziphus jujube, and Ulnus pumila) of 10,500m^3/ha/yr. The specifications of the planned water use and establishment of these plantings are in Appendix 4.

346. The planned irrigation application rate does not take account of the different percolation rates and soil salinity of the planned plantation locations which are the major determinants of irrigation planning (see Table E.18 below). Nor does it take account of the short irrigation period (within the frost-free period) during which the year's effluent volume, including over-winter stored effluent, will be applied.

Table E.18: Percolation Rates and Salinity of Soils at Irrigation Sites

Irrigation Site	Soil Type	Salinity	Percolation
Buerjin	Sandy brown desert soil	0.13%	86.4-8.6m/d (1×10^{-1}—1×10^{-2}cm/s)
Habahe	Brown calcic soil	0.084%-0.109%	0.009m/d (1×10^{-7}cm/s)
Jimunai	Brown calcic soil	0.084%-0.109%	15-20m/d (1.7×10^{-2}cm/s—2.3×10^{-2}cm/s)
Fuhai	Sandy brown desert soil	0.67%	0.036-0.086m/d (4.15×10^{-5}—1.024×10^{-4}cm/s)
Qinghe	Brown calcic soil	0.084%-0.109%	0.043m/d (5×10^{-6}cm/s)
Takeshiken LP	Brown calcic soil	0.084%-0.109%	3.8m/d (4.39×10^{-3}cm/s)

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

347. The soils of Buerjin, Jimunai and, to a lesser extent, Takeshiken have high percolation rates and are able to absorb significant volumes of irrigation water over the irrigation period. A constraining factor will be the elevated salinity of the Buerjin soil. The soils of Habahe, Fuhai and Qinghe have low to very low percolation rates and will consequently require substantially larger areas of plantation than planned to fully utilize the available irrigation volumes.

348. It is therefore essential that individual irrigation and plantation plans be developed by the IAs on a case-by-case basis, taking into account the local soil conditions, percolation rates and the local growing periods. The irrigation rate to fully consume all available stored final effluents, plus that added on a daily basis, such that the use of storage is at a minimum by the start of ground freezing will determine the minimum area of plantation required. The

specific method for irrigation will also need to be determined. A detailed operational plan must be prepared to ensure that effluent flows are only released in accordance with horticultural needs and the available percolation rate at the time. The project will require assurances, through loan covenants and other avenues, that the wind break and sand stabilizing forests appropriate to the location will be individually planned to suit local conditions, constructed in time, and operated, maintained and monitored to ensure their long-term performance.

349. **Air emissions.** Malodorous gases generated during sewage collection and treatment (including sewage grating room, sedimentation tank, oxidation pond, secondary sedimentation tank) will impact upon the environment within and around the plant area. The concentration of malodorous gas is related to wastewater quality, and its dispersal is related to meteorological conditions and terrain.

350. The subcomponents will comply with Class II standard of the Emission Standard for Odor Pollutants (GB14554-93). Boundary standards of odor pollutants plant are defined in Table E.19.

Table E.19: Boundary Standard of Odor Pollutants

Controlled Items	Unit	Class I	Class II	
			New Sites	Existing Sites
Ammonia	mg/m3	1.0	1.5	2.0
Hydrogen sulfide	mg/m3	0.03	0.06	0.10

Sources: Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

351. The capacity of the proposed sewage treatment plants vary between 1,200 and 8,000 m^3/d. The average hydrogen sulfide content of the inflow typically amounts to 0.3mg/L. If completely volatilized, source emissions have been estimated at 2.1 mg/s for a WWTP of 6000m^3/d. The annual average wind speed at the project WWTPs is around 4.0m/s, which will allow rapid atmospheric diffusion. Additionally, an 8-10m wide green belt will be established around the plant boundary to enhance odor absorption.

352. Locations and processes where odor is generated, including water pumping station, grit chamber, secondary settling tank and oxidation ditch, will be equipped with exhaust devices. The grit chamber and secondary settling tank will be equipped with covers, and the sludge in grit chamber, oxidation ditch, secondary sedimentation tank and sludge dewatering room will be removed in time so as to prevent the accumulation of a large volume of malodorous gases for a long time. The dewatered sludge will be transported to a designated landfill where regular covering (as part of landfill management) will prevent the creation of an odor source in a new location.

353. **Heating.** The treatment plant boilers for plant and staff heating will be environmental-friendly energy-saving vertical boilers. During operation particulate matter concentration will be less than 120 mg/m^3. Using low-sulfur coal (< 0.5% sulfur content), SO_2 emission concentration will be kept below 900 mg/m^3, which will meet Class II standard in Atmospheric Pollutant Discharge Standards for Boilers (GB13271-2001). These emission levels will also comply with World Bank Group EHS guidelines for boilers[20], which recommend 50-150 mg/m^3 for particulate matter and 2,000 mg/m^3 for SO_2 emissions.

354. **Solid Waste.** Primary filtration residue mainly consist of floating solids, discarded plastic, sticks and leaves, and generally contains no toxic and harmful substances. Sludge mainly comes from the grit chamber, oxidation ditch and secondary settling tank. Calculation

[20] IFC/World Bank 2007, *Environmental, Health and Safety Guidelines General EHS Guidelines*, World Bank, Washington. p.7

by common sewage treatment plant design parameters shows that total grille residue and sludge from sewage treatment plant will be about 672t/a (dry weight). Primary filtration residue will be dried, baled, and transported to designated landfills for burying by semi-closed dump truck.

355. **Sewage Sludge.** Sludge from sewage treatment plants is a concentrate consisting of solid matter and sediment in the sewage along with residues of biological and chemical compounds. Harmful substances in sludge consist of (i) organics such as oil, sodium M-nitrobenzene, sulfonates and phenol, most of which can be removed through digestive treatment; and (ii) inorganics - mainly heavy metals, some of which are water soluble and can be absorbed by crops, and others which are non-water-soluble and difficult to deal with. The sludge will be first mechanically dewatered to water content below 80%. The sludge drying facility will have anti-seepage measures to avoid polluting groundwater in the area. Afterwards lime will be added to further decrease water content and for sludge stabilization. It will then be transported to the landfill for disposal.

356. As recommended by ADB's recent TA-7450(REG) Project Preparation Support for Livable Cities study to promote "3R" approaches[21], the application of the stabilized sludge to windbreak forests should be trialed for Buerjin County, as a pilot project. If successful, this method may become the standard for future disposal and take the burden off the landfill sites.

357. **WWTP operation.** The achievement of the required operating standards and effluent quality will need a high level of plant management. Training and technical competence of staff will need to be matched by adequate, automated monitoring systems for treatment processes. A commitment from Altay Prefecture government and the respective subcomponent county governments to acquire and install appropriate monitoring and analytical equipment and to adequately resource, train and support management and operational staff of facilities in environmental awareness and environmental management skills will be required as a loan covenant.

358. The design and operational adjustments for operations over winter have been discussed in Chapter C "Description of Project". In winter, due to the curtailment of many commercial and industrial activities, the quantity of the influent entering WWTP is appreciably reduced and the quality of the influent is slightly improved. In these conditions the plants can continue operation by raising the concentration of the mixing liquid in the aeration pond, reducing the sludge load, and increasing the sedimentation time, the efficiency of pollutant removal in the aeration pond can reach 40%.

359. **Control of industrial discharge to sewers.** As required by the PRC, industrial wastewater discharged to the municipal sewers will be pretreated to meet the standards of the Ministry of Construction for municipal wastewater discharge (CJ3082-1999). Illegal discharge of industrial wastewater could have major toxic effects on microorganisms and wastewater treatment processes. To forestall these effects, the following mitigation measures will be implemented: (a) water quality in the municipal sewer systems in the WWTP subproject areas will be monitored at least four times a year by the local environmental protection bureau (EPB); and (b) in case of noncompliance, the WWTP will terminate the illicit discharge either by requesting the violator to stop voluntarily or by disconnecting the discharger's effluent pipe until compliance is confirmed.

[21] TA-7450(REG) Project Preparation Support for Livable Cities Study to Promote "3R" Approaches.

360. **Overflow at WWTPs.** The WWTPs will have standby equipment to reduce the risk of accidental overflow. Pumping stations will adopt dual-power supply lines, as well as proper operation and maintenance and process controls that include emergency plans. Water drainage and storm-water systems will be cleaned regularly.

361. **Noise.** Operational noise comes from mechanical equipment such as waste water lift pumping, return sludge pump and grid screen rotation. Cumulative noise from these sources is predicted at 88~95 dB(A). The waste water treatment plant is located in all cases in areas remote from sensitive receptors. Noise impact will be experienced by employees (see Section E "Occupational Health and Safety"). The level of external noise is lower than the class III Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008).

362. **River Crossings.** Major sewer lines will cross the Erqisi River bed in the Buerjin subcomponent and the Wulungu River bed in the Fuhai subcomponent. There are existing pipelines in place in both locations. In both situations they are double DN500 concrete reinforced pipes, and currently, one line is in use and the other one is not. The pipes have been put in use since 2003 (Buerjin) and 2005 (Fuhai). No wastewater leakage has occurred to date. There are many factors that can cause wastewater leakage, including low material quality, accident, earthquake and other human and natural factors. Leakage can lead to water body, soil and groundwater pollution.

363. The local PMOs have confirmed that the crossing points are visible on both banks; and that emergency response arrangements have already been established. To augment these safeguards, the following measures will be implemented: (i) clear caution signals will be erected at the crossing points; (ii) the pipelines will be checked periodically and regularly maintained.

4. Operation of Solid Waste/Landfill

364. The environmental sanitation department in each city or county administers the SWM system of the city or county. The department is responsible for municipal solid waste collection, transfer, transport, and disposal. Industrial solid waste, including hazardous waste, is controlled strictly and prevented from entering the municipal solid waste stream.

365. **Noise.** Operational machinery includes front-end loaders, bulldozers (with roller compaction), excavators, dump trucks, pumping tankers, and transportation vehicles for garbage loading and unloading. Their typical average cumulative noise level is 88-96dB(A). While this level of noise will be of concern for occupational health and safety of landfill workers (see below), the isolated locations of all landfill sites will ensure that there will be minimal effects on the nearest residences.

366. Noise mitigation measures will include: (i) Scheduling working hours and transportation routes for garbage collection and disposal, avoid urban traffic peak period and sensitive location; (ii) Selecting low noise equipment and vehicles in the acquisition of machines and vehicles; (iii) Installing sound isolating and mufflers for blower and pumps in leachate treatment station, water pump in water supply pump rooms; and (iv) Site landscaping to reduce noise impacts on the environment by mass plantings.

367. **Gaseous Emissions.** Gas will be generated from the biochemical degradation within the landfill. The main components are CO_2 and CH_4, accounting for 40% and 50% of the waste gas contents respectively. CH_4 can be recycled and used as energy, but due to unstable yield and impurities, its recycling on this small scale is not considered feasible. If the concentration of CH_4 builds up to surface concentrations in the range 5-15%, there is a danger of ignition.

368. One kilogram of organic carbon can be completely broken down into 1.868m3 of gaseous product, the main components of which are CH_4 and CO_2. This is an upper limit since in practice only part of the carbon matrix can be gasified under general conditions. Potential upper level of gas output in the Project's landfill site are listed in Table E.20. Landfill subcomponents in Buerjin, Fuhai, Habahe, Jimunai and Qinghe will give an upper limit of CH_4 of 159.8, 252.3, 252.3, 210.2 and 125.2 m3/a respectively.

Table E.20: Emission Parameters of Exhaust Gas Pollutants

Names of Gases	Total Volume of emissions (m3/a)	Volume Percentage (%)	Density (kg/m^3)	Gas Emission Volume (t/a)
Buerjin				
CH_4	443840	50	0.72	159.78
CO_2		40	1.977	350.99
NH_3		0.3	0.77	1.03
H_2S		0.2	1.539	1.37
Fuhai				
CH_4	700800	50	0.72	252.29
CO_2		40	1.977	554.19
NH_3		0.3	0.77	1.62
H_2S		0.2	1.539	2.16
Habahe				
CH_4	700800	50	0.72	252.29
CO_2		40	1.977	554.19
NH_3		0.3	0.77	1.62
H_2S		0.2	1.539	2.16
Jimunai				
CH_4	584000	50	0.72	210.24
CO_2		40	1.977	461.83
NH_3		0.3	0.77	1.35
H_2S		0.2	1.539	1.80
Qinghe				
CH_4	350400	50	0.72	126.15
CO_2		40	1.977	277.10
NH_3		0.3	0.77	0.81
H_2S		0.2	1.539	1.08

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

369. Landfill generated CH_4 concentration in the air within the landfill's area of influence should not exceed 5% - the limit set by Sanitary Landfill Technical Specification of Municipal Solid Wastes (CJJ17-2004). Specifically, below 2m height above landfill work surface, the concentration of methane should not exceed 0.1%, and where landfill gas is directly discharged through constructed airways, the concentration of methane in the outlet airway should not exceed 5%. The monitoring results in the EIA for the Urumqi Xishan Taepo Ditch Sanitary Landfill Project[22], which shares similar climatic conditions with the project's landfills, showed a maximum instantaneous concentration of 224.01mg/m^3, occupying 0.03 % of total air content. Repeat sampling of the airway detected a maximum CH4 concentration of 1.4%. The daily garbage treatment capacities of the project's landfills are far lower than the daily processing capacity of the Urumqi Xishan Taepo Ditch Landfill, and the waste composition is relatively simple compared with the latter. It is assumed that the generated CH_4 volumes and corresponding concentrations in the Project's landfills will be lower than the CH_4 output in Urumqi Xishan Taepo Ditch Landfill.

370. Mitigation measures will include: (i) Methane levels in and around the landfill will be monitored daily; (ii) The local EPBs will monitor methane densities of the landfills' area of

[22] From EIA for Solid Waste Landfill Buerjin County by Zhongsheng EIA Institute, July 2010.

influence as well as landfill gas drain outlet once every three months; (iii) The daily methane density monitoring can be implemented by a portable methane detector consistent with the requirements of GB13486; (iv) The implementation of fire control measures. In the landfills' area of influence, open fires will be prohibited and lightning protection will be installed; (v) Regular inspections of the gas outlet pipes will be undertaken to check for blockages or damage; (vi) No new residential houses or community buildings will be allowed within the health-protective range around the site (600m); (vii) The identification of downslope and downwind areas where CH_4 might pool under certain conditions. In these locations residential and community facilities will be prohibited, and methane alarms to warn of any increase in CH_4 above ambient levels will be established. These requirements have been defined in the EMP.

371. **Odours, pest control.** To reduce the breeding of flies, mosquitoes, rats and other vermin, and to prevent odour and wind-borne dispersal of garbage, compaction and earth covering of the active tip face or landfill cell will be undertaken daily. Additionally, periodic spraying with approved pesticide will further control the breeding of flies and mosquitoes and regular rat trapping programs will be undertaken.

372. **Leachate.** The maximum predicted leachate yields in the landfills under extreme weather conditions have been calculated. Leachate quality predictions have been made based on the nature of the county towns' domestic garbage and from data of landfill leachate of other cities. The leachate will have very high concentrations of BOD, COD, and NH_3-N. If not collected and treated, the leachate will seep into groundwater and contaminate it. Typical results are summarized in Table E.21 below.

Table E.21: Predicted Leachate Quality

pH	BOD_5	CODcr	NH_3-N	TP
≥7	1200 mg/L	2000 mg/L	700 mg/L	5.0 mg/L

Sources: Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

373. Leachate collection pipes at the bottom of the landfills will guide leachate to a leachate diffusion cell. The capacities of these cells have been calculated (plus an additional 150m^3 for on-site snow melt infiltration). The collected leachate will be back-sprayed onto the landfill to obtain leachate volume reduction and to increase the concentration of leachate (to aid solidification and "fixing"). In this process toxic organic compounds are broken down by microbial biotransformation over time. In parallel, a macro-molecular humus is generated from the refuse during degradation, which fixes the heavy metal ions and other leachate residues in a stable chelate.

374. To avoid leachate penetration into the groundwater a monitoring program will be implemented (see details in the EMP). Background ground water quality will be monitored before the domestic garbage landfills become operational. Continuous groundwater monitoring will be carried out during operation and following closure. The ground water monitoring indices will be pH, total turbidity, total soluble solid, permanganate index, ammonia nitrogen, nitrate, nitrite, sulfate, chloride, volatile phenols, cyanide, arsenic, mercury, hexavalent chromium, lead, fluorine, cadmium, ferrous, manganese, copper, zinc, fecal coliforms. The quality standards for the ground water of different quality types should be in consistency with the GB/T14848.

375. **Runoff.** Flood waters entering the site can pick up garbage, spoil and leachate contaminants – carrying them downstream into water bodies. Flood control channels and concrete flood control dams will be constructed around the landfill sites. These will be constructed to withstand a 1 in 50 year flood event.

376. **Hazardous Waste in Landfill.** Hazardous wastes produced in the project counties are not likely to make up a large volume of mixed dumping at the proposed landfills. Potentially hazardous waste will only be accepted at landfill if it complies with the provisions of HJ/T228 (chemical disinfection treatment); HJ/T229 (microwave disinfection treatment); and HJ/T2769 (hyperthermia vapour treatment) – all applicable to medical waste. General industrial solid wastes can enter the landfill when their levels of potentially hazardous chemicals after treatment are within the limit values stipulated in HJ/T300. These constraints have been included in the EMP. A targeted awareness program will be carried out for collection workers and households to increase awareness and ensure waste segregation by households and at the collection points.

377. **Waste Leakage from Waste Collection, Transportation and Disposal.** During operation, wind can blow solid waste into the air and carry it to unwanted places; this is a potential problem for landfills. In addition, improper transportation could cause waste leakage or loss during transportation, resulting in odor and secondary solid waste pollution. To reduce these impacts to a minimum, the transportation vehicles will be enclosed. The necessary retaining walls, chain-link fences, and covers will be installed at the landfill sites to prevent the waste from spreading during windy or rainy season.

378. **Site Closure.** Site closure is an integral part of the sanitation landfill process. The quality of site closure works and the daily management and maintenance after site closure is the determinant factor to the continuing safety of the sanitation landfill. According to the Standard for Pollution Control of Landfill for Domestic Waste (GB16889-2008) implemented on July 1, 2008, standards and mandatory prescriptions for site closure and later maintenance and management cover: (i) Waste gas guidance and discharge layer; (ii) Impermeable lining layer; (iii) Rain and sewage guidance and discharge layer; (iv) Final earth covering layer and re-vegetation.

379. For the later maintenance and management phase after site closure, continued treatment of the leachate and landfill gas generated in the site and periodical inspection should be implemented until the liquid pollutants density of the leachate generated from the site to be lower than the limit value stipulated in the Standard for Pollution Control on The Landfill for Domestic Waste (GB16889-2008). Post-closure monitoring should be implemented for at least three years to manage the environment of the landfill and to ensure no pollutants escape to impact public health and the surrounding environment.

5. Operation of Heating Plants

380. **Emissions.** The ADB funded boilers in Jimunai and Qinghe counties have been examined for point source (stack) emissions during the operation period. These are shown in Tables E.22 and E.23. The large discrepancies between the predictions for PM, SO_2 and NOx between the two plants may be explained by the significantly different quality of coal sourced by each county (see Appendix 4). Additionally, the combination of 3x14MW boilers in Jimunai results in a much higher flue gas volume, and thus lower concentrations of contaminants, that the 2x29MW arrangement of the Qinghe boiler. Although different orders of magnitude, both sets of predicted emissions comply with Category II -Time Period II standard of PRC Atmospheric Pollutant Discharge Standards for Boilers (GB13271-2001). However, while the Jimunai subcomponent complies with the World Bank Group EHS recommended limits for Small Combustion Facilities Emissions[23] (of 50-150 mg/m3 for PM; 2000 mg/m3 for SO_2; and 650 mg/m^3 for NOx), the Qinghe subcomponent exceeds it for PM and NOx. To achieve the predicted levels, the wet scrubber and desulfurization/dentrification equipment are operating at 95% and 70% efficiency

[23] IFC/World Bank 2007, *Environmental, Health and Safety Guidelines General EHS Guidelines*, World Bank, Washington. p.7

respectively. To comply with World Bank Group EHS guidelines these efficiencies would need to increase to 96% and 86% respectively. These improvements will be negotiated with the IA and county PMO during the Fact Finding Mission.

Table E.22: Point Source Emissions Prediction - Jimunai

Size	Pollutant Parameters	Emission rate (kg/h)	Fume quantity (Nm^3/h)	Concentration (mg/m^3)		Category-II Standard of GB13271-2001	World Bank EHS
3x14MW	SO_2	3.1	125000	24.8 mg/m^3		900	2000
	NO_2	30.23		241.84 mg/m^3		-	650
	Particulate Matter	1.4		11.2 mg/m^3		200	5--150

Sources: Zhonglanlianhai EIA Institute

Table E.23: Point Source Emissions Prediction – Qinghe

Size	Pollutant Parameters	Emission rate (t/a)	Emission capacity ($10^4m^3/a$)	Concentration (mg/m^3)		Category-II Standard of GB13271-2001	World Bank EHS
2×29MW	SO_2	119	23707.63	501.95 mg/m^3		900	2000
	NO_2	341		1438.36 mg/m^3		-	650
	Particulate Matter	44.8		188.98 mg/m^3		200	5--150

Sources: Zhonglanlianhai EIA Institute

381. The new boiler house in Habahe, to be funded locally, is an associated facility for the Project's extended piping and heat exchange infrastructure. Due diligence was therefore conducted for the boiler in Habahe. The new boiler is planned to be constructed in late 2010. An EIA under PRC regulations will be conducted for the boiler, and will require approval by the EPB. The plant will use coal with 0.41% sulfur content and 13.13% ash content, and will be equipped with dust removal and flue gas cleanup equipment. Its predicted emissions, 45.3 t/a of SO_2 and 61.1 t/a of PM, will comply with the class II Air Pollutant Discharge Standards for Boilers and the World Bank Group EHS recommended limits for Small Combustion Facilities Emissions (of 50-150 mg/m3 for PM; 2000 mg/m3 for SO_2).

Table E.24: Point Source Emissions Prediction – Habahe

	Pollutant concentration mg/m^3	Category-II Standard of GB13271-2001	World Bank EHS
SO_2	166.58	900	2000
Particulate Matter	78.72	200	5--150

Note: No prediction of NO_x emissions were undertaken in the PRC EIA for Habahe Heating

Sources: Zhonglanlianhai EIA Institute

382. There is no new or upgraded boiler house associated with the Project's contribution to the central heating sector in Fuhai county seat – which centers on the replacement of pipes.

383. **Noise.** The ADB funded boilers in Jimunai and Qinghe counties have been assessed for noise levels at the plant boundaries during the operational phases. The noise during day at four sides of the plants (east, south, west and north sides) meets 60dB(A) of Category-II Standard stated in Ambient Noise Emission Standard at Plant Side of Industrial Enterprises (GB12348-2008); however the noise levels during the night fail to meet the night 50dB(A) of Category-II Standard. There are residential areas surrounding both plants. The PRC EIAs

recommend that the relevant construction unit should mount double glazing glass windows for the affected households and this is endorsed by the CEIA and will be included in the EMP.

384. **Heat exchange stations.** The 15 heat exchange stations in three counties (Habahe, Jimunai and Qinghe) are expected to generate backwash effluent, which has relatively low pH. Equalization tanks will be built in each substation for pH adjustment before the backwash effluent is discharged into the municipal sewer. The substations will have a buffer distance of at least 15 m from the nearest household and will use low-noise water pumps with noise levels controlled to within 55 dB(A) at a distance of 1m from the pump house. There will be no operational noise impact from the heat exchange stations.

385. Households which are adjacent to existing heat-exchange stations experience indoor noise levels in the range 52dB(A)~55dB(A). These levels meet the PRC standard and the World Bank Group EHS standard. In public consultations residents reported that the heat-exchange station noise does not have great negative impact on their domestic life.

E. Health and Safety (Construction and Operational Phases)

386. The objective of environmental health and safety is to provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. It also covers the establishment of preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. It is therefore a combination of occupational health and safety of staff/workers at the subcomponent facilities and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities.

387. Safety risks are mainly related to the construction phase. Residents, particularly children, are at risk during project construction. In linear construction activities such as road construction and pipe network construction which typically occur in areas frequented by the public, physical and educational measures to protect residents from risks are needed. Safety measures for construction staff and public will include the following responsibilities of the contractor: (i) providing safe and convenient passages for the public; (ii) Providing construction workers sufficient personal protection equipment such as hard hats, earpiece, safety shoes, and others; (iii) Providing seminars on safety issues to local public, particularly school students; (iv) Installing warning signs where potential dangers are present; (v) Ensuring construction staff are on duty on or near heavy movement of construction vehicles, or heavy construction vehicle traffic through the villages to ensure safety; and (vi) Setting up traffic signs at and near construction sites.

388. Health risks are primarily related to increased transit population during construction (construction workers) and operation (visitors) in the regions. The increased mobile population could potentially bring and spread infectious diseases in the Project area. Workers could spread diseases such as hepatitis and HIV-AIDS to local residents as well as among themselves. Measures for protecting community health include: (i) Providing disease prevention and control training to construction workers, particular epidemic diseases such as HIV, H1N1 and hepatitis B prior to the start of construction. Leaflets, education seminars will be organized, in association with the local government and communities, to increase the awareness and knowledge of HIV/AIDS; (ii) Providing posters in and around the construction sites for disease control, for not only construction workers but also villagers and others in the areas; (iii) Providing adequate protective gear such as condoms to workers at the construction camps; (iv) Providing periodical health checks to construction workers to ensure their health and well being.

389. An improved road system can reduce the number of vehicular accidents. However, in that it allows traffic to travel more smoothly, it can also increase the risk of serious pedestrian accidents, especially to children, if behavior does not change in response to changed traffic conditions. It will be important to promote road safety for adults and children alike. This will be conducted as a separate IEC campaign both in schools and in communities. In each of the counties, the issue of road design features that could enhance the safety of roads improved was also raised in consultative meetings involving local residents. Standard features such as bilingual signs (Kazakh and Chinese), pedestrian crossings and speed humps were raised as desirable.

390. The considerations of environmental health and safety discussed elsewhere in this chapter include (i) an assessment of traffic accident hazards, including spillages of transported substances into waterways and emergency response planning; (ii) the formulation (on site), storage and handling of disinfection chemicals at WTPs, including staff emergency procedures; (iii) siting of WWTPs; (iv) siting of landfills; (v) CH4 monitoring of landfill surface atmosphere and downwind areas; and (vi) personal noise protection gear for heating plant, WTP and WWTP staff.

391. Regular monitoring will be undertaken throughout the construction in order to ensure the implementation of safety measures and to identify areas of concerns for improvement.

F. Cumulative Impacts

392. Cumulative effects are defined as the impacts on the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency (central or non-central) or person undertaking such other actions.

393. The active construction of a number of sub-projects close to each other in the county seats will cause a magnification of environmental and social impact in the project areas in terms of traffic on the existing road network, civil works, air-borne dust, waste generation, community disturbance and safety etc. These construction impacts might be increased as a result of other infrastructure projects which might be implemented in a near future (although no evidence could be found on planned projects in the project county seats). These construction related cumulative impacts could be effectively minimized by adopting proper mitigation measures, including: (i) coordination between all project sub-components and other projects in the area of influence in terms of construction schedule, possible access road and borrow/disposal sites sharing; (ii) contractors will develop material transport plan with consultation of local road management authority and local community; (iii) enforcement of good construction management to minimize dust, noise and waste generation; (iv) education of construction workers to minimize social disturbance and cultural conflict; (vi) provision of temporary access to local traffic; (vii) proper maintenance of the access roads and timely restoration/strengthening upon completion. With effective implementation of good construction management measures, these common construction-related cumulative impacts can be adequately mitigated to acceptable level.

394. During operation, cumulative impacts on the project affected rivers have been assessed based on water balances and river basin analyses. Water availability for extraction without compromising beneficial downstream uses in normal and dry years has been confirmed through water balances for each water supply subcomponent. The impacts of water supply components of the major river systems have been checked by river basin analyses and shown to be negligible.

395. During operation, the Project's cumulative benefits will extend to the majority of the population of the county seats. Most beneficiaries will receive multiple benefits from the

combination of the new and upgraded roads, water supply, sewerage and wastewater treatment, heating and landfill facilities developed in their area.

396. The Project might promote development of industries within the project's areas of influence. EIAs will be carried out based on the PRC's regulations and consultations with relevant management. PRC total emission amount regulation will be strictly implemented for these industries project to reduce cumulative impacts.

397. In summary, the cumulative impacts are identified to be not significant with proper project design and effective implementation of necessary mitigation measures which will minimize those impacts to acceptable level.

G. Unanticipated environmental impacts

398. Where unanticipated environmental impacts become apparent during project implementation, the executing agency, with the support of the provincial government, will update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, outline mitigation measures and resources to address those impacts; and obtain approvals by the XPMO and ADB.

CHAPTER F. CONSIDERATION OF ALTERNATIVES

A. Scope of Alternatives for Sectors

399. During Project preparation, various alternatives for the components were proposed, screened, and studied against technical, economic, social, energy efficiency and environmental criteria. The primary objective with respect to environmental criteria was to identify and adopt options with the least adverse environmental impacts and maximum environmental benefits. The following key environmental factors were used in comparing the alternatives: (i) potential impacts on surface and groundwater; (ii) land occupation; (iii) emission reduction; (iv) minimization of community disturbance; (v) resettlement and economic displacement; and (vi) adaptation to local context (climatic constraints, required skills, etc.). The range of alternatives considered depended on the infrastructure sector and its characteristics.

400. **No-Project Alternative.** All analyses considered the 'do-nothing' alternative, the consequences of which are a continuation of the current situation for roads, water supply, wastewater treatment, solid waste disposal and heating.

401. Currently, many urban roads in the county seat networks lack connectivity, cross sections are often inadequate, and the mix of pedestrians, non-motorized traffic and motorized traffic is uncontrolled and dangerous. The standards of some road structures and roadbase treatments are low and many road surfaces have seriously deteriorated. The networks often cannot adequately function in terms of traffic distribution and separation of arterial and secondary roads.

402. Present water supply facilities are weak and cannot service predicted future growth. In summer when water usage is high, areas in each of the country seats receive low or no water supply, with potential health hazards. The pipe networks in many cases are several decades old and some have reached the end of the design life with consequent maintenance problems. At present many residents in outlying areas have no piped water supply. In the poorer areas, drinking water is from pressure water wells and the water quality is often poor. In many places, leachate generated from pit toilets contaminates the same water table used for domestic water.

403. Many current sewerage pipelines and pipeline-connected septic tanks in the county seats have leakages, causing frequent surface discharge of sewage in flood periods in summer. Existing pump stations are old, and frequently break down. There are also breakdowns at plants and sewage from urban areas is sometimes discharged without adequate treatment. This has resulted in pollution of surface water and drinking water sources.

404. Current landfill sites in the counties are being operated without environmental safeguards. The existing landfills lack anti-seepage measures, fencing or garbage compaction and covering equipment, causing a number of environmental problems including odour and air pollution, wind-blown garbage, and contamination of soil and underground water. This can result in the spread of diseases, degradation of the surrounding grassland, and threats to the quality of drinking water downstream and consequently the health of people using the water.

405. The central heating facilities of the county seats vary in quality, efficiency and environmental performance. A number of existing boilers are nearing the end of their operational life, are highly polluting and have low energy efficiency. Additionally there are large settlements in the low income areas with no service from central heating facilities and use small domestic stoves for household heating (in addition to cooking stoves). Taken

together, the county seat heating sources currently produce significant air pollution (including greenhouse gases).

406. **Alternatives considered.** The range of alternatives considered depended on the infrastructure sector and its characteristics. Many of the FSRs' alternatives analyses were concerned with technical and engineering specifications. These include: surface materials, base course materials and cross section designs for roads and pipe laying techniques, pipe materials and pipe sizes for Water supply, waste water treatment and heating plants. The discussion below will focus on those parts of the analysis of alternatives with potential for differential environmental effects. These categories of alternatives are summarized in Table F.1 below. The main emphases in the consideration of alternatives used relevant parts of the scoping of the project's main environmental risks (see Chapter B, Section F) and mainly focused on the following areas:

i. Waste water treatment –effluent management
ii. Solid waste management –leachate management
iii. Heating – gaseous emissions

Table F.1: Major Alternatives with Differential Environmental Effects

Alternative Considered	Selection
Water Supply Subcomponents	
Do-nothing	Not selected (disadvantages listed)
Alternative (usually upstream) extraction point and WTP location	Alternative location selected
Treatment process (Chlorination; Ozone; UV)	Chlorination treatment selected
Water pipe materials (steel-reinforced polyethylene (SRPE); ductile iron pipe (DIP); high-density polyethylene (HDPE)	Ductile iron selected
Waste Water Treatment Subcomponents	
Do-nothing	Not selected (disadvantages listed)
Alternative plant location	Alternative location selected
Treatment process (Oxygenation ponds; SBR; Pre-treatment and aerated oxygenation pond)	Pre-treatment and aerated oxygenation pond selected
Treated discharge options (To water body; to irrigation)	Discharge to irrigation selected
Roads Subcomponents	
Do-nothing	Not selected (disadvantages listed)
Alternative road cross-sections	Cross-sections with pedestrian features and other facilities selected
Road surface (asphalt; concrete)	Asphalt selected
Solid Waste/Landfill Subcomponents	
Do-nothing	Not selected (disadvantages listed)
Alternative Site location	Alternative location selected
Garbage disposal treatments (Landfill; Incineration; Composting)	Landfill selected
Landfill anti-seepage engineering options (natural base with vertical anti-seepage; Horizontal anti-seepage layer)	Horizontal anti-seepage layer selected
Landfill anti-seepage material (natural material (clays); impermeable membrane)	Impermeable membrane selected
Landfill leachate management (Transfer by tanker to WWTP; percolation backspraying)	Percolation back-spraying selected
Heating Subcomponents	

Pipe-laying techniques (above ground or buried)	Direct burying selected
Dust removal (Electrostatic precipitator; Bag precipitator; Ceramic precipitator)	Ceramic precipitator selected
Alternatives (location, operations) are limited due to the need to integrate new work with existing networks. Pollution control equipment is standard in all plants and is integrated with new boiler installations.	

407. The alternatives with particular relevance to environmental impacts will be discussed at more length below under two categories. First, those alternatives which pertain to the selection of preferred design, location and implementation of subcomponents which are common to all counties where their construction is planned. Second, alternatives which are location-specific will be considered.

B. Environmental Alternatives Common to all Counties

1. Roads

408. Of the alternatives with potential environmental effects, the do-nothing alternative, road pavement and cross-section alternatives have been considered in the FSRs. The do-nothing alternative has already been discussed in the Project Justification and Rationale (Chapter C) where the current situation is described. The poor environmental performance of existing infrastructure and the lack of connectivity are the main justifications for change.

409. **Road pavement.** Two types of pavement materials for carriageways were considered: bituminous pavement and concrete pavement. Bituminous pavement was selected because it is cheaper and will make the maintenance of underground utilities easier than concrete pavement would. Although bituminous pavement tends to soften under high temperatures and crack under low temperatures, it is commonly used in XUAR and in most other cold-climate areas. Specifying the correct grade of bituminous pavement during detailed design to take into account the low temperatures in XUAR in winter, and constructing the carriageways properly, should deal with the concerns.

410. **Road alignment.** The alignments of urban roads are based on rehabilitating or connecting existing roads and conform to the cities' master plans and 11th FYPs. No alternative alignments were considered.

2. Water Supply

411. **Treatment process.** Three treatment processes have been considered, and the conventional pre-sedimentation, coagulation, sedimentation and disinfection process has been selected. For disinfection, agents such as chlorine, chlorine dioxide, ozone, and ultraviolet light were considered. As the treated water needs to remain continuously disinfected, chlorine and chlorine dioxide are more appropriate. Chlorine is the most common disinfectant, and its operating expenses are lower than those of chlorine dioxide. However, it is not produced or sold in Altay, and has to be purchased in Urumqi, about 700 km away. Thus chlorine disinfection is not realistic, economical or secure. From technical and economic comparisons, chlorine dioxide is selected as disinfectant.

412. The climate of Altay is cold. In winter the raw water may have both low temperature and low turbidity (water temperature lower than 4oC and turbidity lower than 15 NTU). The processes now selected will operate effectively in these conditions.

3. Waste Water Treatment

413. **Treatment process.** The FSRs have compared three treatment processes: (i) oxidation ditch; (ii) SBR; (iii) aerated lagoon. From technical and economic comparisons, the aerated lagoon is selected for all facilities. The full comparison is shown in Table F.2 below.

Table F.2: Comparison of Sewage Treatment Alternatives

Analysis Criteria	Implication/ Impact	Oxidation pond/ continuous activated sludge process	SBR process (intermittent activated sludge process)	Pre-treated and aerated oxidation pond process
Section 1: Technical feasibility				
Technical suitability	Extensive application, water quality, volume and scale adaptation degree	It is widely used both at home and abroad, adaptive to various large, medium and small scaled processes, adaptable to a wide range of water quality and volume.	It is gradually extended in the country, adaptive to various medium and small scaled processes, adaptable to a wide range of water quality and volume, highly efficient in phosphorous and nitrogen removal.	It is gradually extended in the country, adaptive to various medium and small scaled processes, highly efficient in phosphorous and nitrogen removal.
Section 2: Water quality target				
Effluent quality	The degree of meeting the discharge standard and ensured recycling for farmland	The effluent is of very good quality and recycling performance	The effluent is of good quality, available for recycling.	The effluent is of good quality, effluent quality in winter can be guaranteed.
Suitability to the environmental conditions	Impact of temperature, water temperature, nutrient and water volume change on effluent quality	The effluent is of stable quality, the effluent quality in winter may still be guaranteed, it is very adaptable to the change of environmental conditions.	The effluent is of stable quality, the effluent quality in winter is good, it is generally adaptable to the change of environmental conditions.	The effluent is of stable quality, the effluent quality in winter is acceptable, it is generally adaptable to the change of environmental conditions.
Section 3: Cost				
Total investment in infrastructures	Refers to the sewage technique system, including one-time investment in sewage and sludge treatment.	high	Moderate-high	Moderate
Operating cost	Power cost, chemicals cost, etc. (annually)	high	Moderate-high	Moderate (chemicals cost excluded, mainly referring to power cost)
Section 4: Project implementation				
Difficulty level for construction	Difficulty level for construction and construction speed	It is of common difficulty.	It is highly difficult, while covering the least area.	It is of common difficulty, while covering less area.
Section 5: Energy consumption				
Power consumption	Refers to power consumption	Low	High	Medium

Analysis Criteria	Implication/ Impact	Oxidation pond/ continuous activated sludge process	SBR process (intermittent activated sludge process)	Pre-treated and aerated oxidation pond process
Section 6: Operation and management conditions				
Running and operating	Operation and control – technical capacities	Common in region	High	Common in region
Maintenance and management	Work volume and level of difficulty for maintenance	Wide range of equipment, which need large maintenance capacity.	Wide range of equipment, which need large maintenance capacity.	Less equipment, which needs small maintenance capacity.

414. The best sewage treatment performance (highest quality effluent) is achieved by adopting the oxidation pond with continuous activated sludge process. However, it needs high investment and running costs. The sewage treatment performance of the SBR process is good, but the running and engineering costs are still comparatively high. The aerated oxidation pond process with pre-treatment achieves comparatively good sewage treatment performance with significantly lower running and engineering costs, and is the selected option as a result.

415. In winter in Altay Prefecture the average outdoor temperature is about -18^{o}C. This greatly affects the selection of the aeration method. Two aeration methods were compared and analyzed, the floating aerator and the suspended aeration chain. The low temperature was the primary factor in preferring the floating aerator. Low temperature is also a major determinant of microbial activity and the efficiency of the removal of organics. When water temperature falls below 13^{o}C, the biological treatment efficiency rapidly drops. When water temperature falls below 4^{o}C, the treatment efficiency is almost zero. However, by raising the concentration of the mixing liquid in the aeration pond, reducing the sludge load, and increasing the sedimentation time, the efficiency of pollutant removal in the aeration ponds can still reach 40%.

416. The quantity of the influent to the WWTPs will be significantly lower in winter, and the quality of the influent higher. Therefore, the sewage loading of the aeration ponds can be appreciably reduced, and the sedimentation time correspondingly increased. In this way the effluent from the plants will satisfy the water quality requirements for irrigation in all seasons.

417. **Disinfection.** Liquid chlorine is the commonly used disinfection method. However chlorine is not produced or sold in Altay and has to be purchased from Urumqi. This is not economical or secure. To overcome this, the disinfection method originally selected in the FSRs was ultraviolet light, but as the wastewater would have high content of suspended solids and turbidity, this method is not appropriate. Based on the TA Consultant's recommendation, this has been changed to chlorine dioxide.

418. **Sludge treatment and disposal.** The sludge production rate for all plants is relatively low and the evaporation rate in this area is high. It was therefore originally planned that sludge drying beds be constructed for natural drying and the dried residue used for windbreak forest or Gobi soil improvement. This method would achieve beneficial use of sludge and reduce the amount of waste sent to landfills. However, the IAs and FSR institutes have advised that there is no land available that can be used for natural drying, and that in winter a drying bed is not feasible. Therefore, it is now planned that the sludge will be first mechanically dewatered to water content of below 80% and subsequently dosed with lime to further decrease water content and for sludge stabilization. The stabilized, dried sludge will then be transported for landfill disposal.

419. The ADB's recent TA-7450(REG) Project Preparation Support for Livable Cities study to promote "3R" approaches[24] has recommended that the application of the stabilized sludge to windbreak forests should be trialed for Buerjin County, as a pilot project. If successful, this method may become the standard for future disposal and take the burden off the landfill sites.

4. Landfill

420. A number of alternatives with significant environmental implications were analysed in the FSRs for landfill facilities.

421. **Site Location.** Decisions on the location of landfills was based upon site characteristics, local environment and land use pattern. Selection was thus particular to individual county seats and is discussed under Section C below. Site soil characteristics were not a selection criterion as all soils in the candidate areas were sandy and required the installation of impermeable membranes. Similarly, all sites considered had groundwater depth 2 metres or more below the floor of the proposed landfill as required by PRC standards[25].

422. **Treatment process.** Three processes were compared for an overall garbage treatment process: (i) sanitary landfill; (ii) incineration; and (iii) composting. Only landfill was considered both affordable and capable of operating well into the winter period. The full comparison is shown in Table F.3 below.

Table F.3: Comparison of Solid Waste Treatment Methods

Analysis Criteria	Sanitary landfill	Incineration	Compost at high temperature
Technical reliability	Reliable, It is a disposal method in common use	Relatively reliable, It is a mature technique in foreign countries	Relatively reliable, There is practical experience in PRC
Land requirements	Large,500~900m^2/t	Relatively small,60~100m^2/t	Moderate,110~150m^2/t
Construction period	9~12 months	30~36 months	12~18 months
Pre-conditions	Moisture content of the garbage to be disposed should be less than 30%, while the inorganic content should be more than 60%	Calorific value of the garbage to be burnt should be higher than 4180Kj/kg, while the moisture content should be less than 50% and the dust content should be less than 30%	Biodegradable organic content in the garbage should be more than 40-50%
Operation security	Good. Needs sound biogas management.	Good. Should be operated through strict procedure control	Good
Management effort	Medium	High	Relatively high
Resource utilization	After final cover and stabilization of disposal site, a range of land uses are available.	Part of sorted garbage may be recycled, ash may be reused	Compost product may be used for agricultural planting and gardens. Some material may be recycled.
Stabilizing	10~15 years	2 hours +	20~30 days

[24] TA-7450(REG) Project Preparation Support for Livable Cities Study to Promote "3R" Approaches.
[25] Technical Code for Municipal Solid Waste Sanitary Landfill (CJJ17-2004)

Analysis Criteria	Sanitary landfill	Incineration	Compost at high temperature
time			
Waste reduction	The bulk may be reduced through compression.	The bulk may be reduced to 80~90%.	The bulk may be reduced to 65~75%.
Final disposal	Landfill itself is a final disposal.	Ash needs disposal, which amounts to 10%~15% of the total garbage to be disposed.	Substances unsuitable for composting need extra disposal, which covers 30%~40% of the total garbage to be disposed.
Pollution of surface water	Leachate containment is necessary.	Minimal.	Effluent produced and needs management. May be discharged into sewerage network.
Pollution of groundwater	Impermeable measures are necessary for the bottom of the site.	Impermeable measures are necessary for stockpiles.	Impermeable measures are necessary for the bottom of the site.
Pollution of atmosphere	It may pollute the air slightly, which may be controlled with air scoop, covering or isolating method.	Control and treatment of acid gas, heavy metal and Dioxin should be strengthened.	Odor produced. Needs deodorization device and buffer zone.
Pollution of soil	Limited to within the disposal zone.	Ash should be reused or buried.	Heavy metal content and PH value in the compost should be controlled.
Investment per ton	180~280 thousand Yuan/t	500~700 thousand Yuan/t	250~360 thousand Yuan/t
Technical policy	Sanitary landfill is a necessary final method for garbage disposal and the most common way of disposing garbage in cities in PRC nowadays.	Burning is an effective method of garbage disposal in cities. It may be applied in places where there are high levels of combustible material in garbage but limited place for garbage disposal.	Compost is an effective method of disposal and reuse of biodegraded organics in urban garbage. It can be promoted and applied in places with active markets for compost products.

423. Landfills are relatively low capital cost infrastructure, with low running costs. This is balanced by the need for stringent site and environmental management. It is the preferred option for all project counties.

424. **Waste collection.** Two schemes were compared for the collection and transfer of garbage: (i) transfer by garbage transfer station; and (ii) compaction and transfer by garbage compaction vehicles. The latter was chosen to increase mobility and to rapidly move garbage away from urban areas.

425. **Leachate treatment.** Two processes were considered for the treatment of leachate: (i) transport by truck to WWTP for treatment; and (ii) recirculation and reduction/fixing by back-spraying. It was determined that the treatment of high COD and contaminated leachate would put too much pressure on the management of WWTPs which are finely tuned to cope with the treatment of urban wastewater to irrigation standards over varying climatic conditions.

426. **Seepage prevention.** Three processes were compared for seepage prevention process for the landfill: (i) natural seepage prevention using on-site materials such as clay; (ii) artificial seepage prevention; and (iii) composite seepage prevention. In the sandy desert

soils, only complete seepage prevention through artificial barriers is environmentally acceptable.

5. Heating Plants

427. The heating network in a county seat is a complex and functional infrastructure. The challenge for local authorities is to integrate new and replacement facilities within the currently operating frameworks or to expand the network to new areas in a way which will (i) fit into the existing network, (ii) continue and improve the service, and (iii) achieve net emission reductions. There is therefore little scope for the analysis of alternatives beyond the choices of boilers, the installation of heat exchange stations and heat compensation units and the method of pipe-laying. These are all discussed in the technical/engineering sections of the FSRs.

428. Dust removal. Three dust removal alternatives were considered in the FSR for the boiler stations in Qinghe, including (i) dry electrostatic precipitator; (ii) wet electrostatic precipitator (ceramic); and bag filter. Dry electrostatic precipitators can achieve low pollutant concentrations with low power requirements but are limited by the temperature of flue gases within which they operate (temperatures above 200°C can form dioxin derivatives (PCDD/PCDFs) in the precipitate). The wet precipitator can achieve the same levels of pollution control and generate process waste water. The bag filter can achieve higher levels of particulate stripping but has high energy consumption (compared to electrostatic precipitator). Most modern heating boilers in the prefecture use the wet precipitator and its operation and maintenance requirements are well known. The wet precipitator has been chosen for the new installations.

C. Environmental Alternatives Particular to Individual Counties

1. Buerjin County

429. **Water supply.** The location of water supply extraction point was considered. Alternative 1 is a location in the mid-stream of Buerjin River, 10 km away from the county seat, at an elevation of 494 m ASL. Alternative 2 is located in the upstream of Buerjin River, about 35 km from the county seat, at an elevation of 555 m ASL. Alternative 2 has higher water source security. No pumping is needed for water supply to the county seat, and it will also be able to supply water to the townships along the water transmission pipelines. Alternative 2 is selected as the water source ground for the proposed WTP.

430. **Sewage sludge treatment.** For the wastewater treatment subcomponent, the analysis of alternatives has adopted a scheme for sludge handling and disposal where the sludge will be first mechanically dewatered and subsequently dosed with lime to further decrease water content and for sludge stabilization. Following a recommendation by ADB's recent TA-7450(REG) Project Preparation Support for Livable Cities study to promote "3R" approaches, the stabilized sludge will be applied as mulch to the windbreak forest in Buerjin County, as a pilot project.

431. **Landfill site.** Two Landfill sites were considered: (i) expansion of the existing landfill site, 2 km south of the county seat, and (ii) an area 1 km further upstream of the existing landfill, 3 km south of National Road 217 and 2 km south of the county seat. Alternative (ii) was selected since it was further away from existing and planned development and the terrain (and thus surface drainage) naturally sloped away from the Erqisi River.

2. Fuhai County

432. **Roads.** The road subcomponents in Fuhai have taken account of the frost-heave of soils which is characteristic of local soils. Before final decisions are made on the road base composition, tests of road foundation alternatives will be undertaken to determine the best approach in these conditions.

433. **WWTP site.** In determining the site of the planned waste water treatment plant, two alternative locations were considered. Site one is located northeast of the existing WWTP, adjacent to the Wulungu River and 0.2 km away from the county seat boundary. No further influent pumping will be needed under this option and the original oxidation pond can be easily utilized to store a certain amount of effluent of the proposed WWTP in winter. However, this site is very close to the river, and will therefore have a potential impact on the downstream water source; moreover, there is no adequate land available for future WWTP expansion. In addition, pumping will be required to transport the treated effluent for windbreak forest irrigation. Site two, located 300 m northwest of the existing WWTP, is 6 km away from the county seat and 5.5 km from the Wulungu River. The collected wastewater will be pumped into the proposed WWTP under this option while the WWTP effluent can be piped to irrigate the windbreak forest by gravity. This site is relatively far from the river and the groundwater level is deeper, which will reduce potential impacts to any water body. This is the preferred alternative.

434. **Landfill site.** Two sites were compared: (i) 12 km south of the county seat, being a natural gully south of the existing landfill site; and (ii) existing landfill site, 10 km south of the county seat, also a natural gully. Alternative (ii) was selected for its greater distance from existing settlement. This will also enable an impermeable, managed sanitary landfill to be established and the existing one shut down.

3. Habahe County

435. **WWTP site.** Two WWTP locations were compared. Alternative 1 is located in the natural wasteland southeast of the county, about 3.0 km away from the county seat. This site is downwind and a substantial distance from the Habahe urban area. Downstream of the proposed WWTP site is large area of waste ground and semi-desert where treated effluent can be used to irrigate the vegetation cover and windbreak forest. Alternative 2 is located near the existing WWTP, within the planned area of the county seat and only 100 m away from a residential area. This site is located upwind of the prevailing wind direction, and is also close to agricultural land. Alternative 1 is preferred for the WWTP site.

436. **Landfill sites.** Two sites were considered for landfill: (i) a natural sandy area west of the existing landfill, 10.5 km southeast of the county seat and 2.5 km south of Provincial Road 227; and (ii) a natural sandy depression about 8 km south of the county seat, 600 m south of Provincial Road 227, and south of the existing landfill. Alternative (ii) was selected for its greater distance from any settlement.

4. Habahe White Birch Forest

437. **Water supply.** For the water source of the water supply, three alternatives were considered. Alternative 1 is to lay a water supply pipeline of about 5 km from the water supply pipe network of the county seat to the scenic area. Alternative 2 is to lay a pipeline from the WTP in a village 2 km away from the scenic area. Alternative 3 is to construct large wells in the scenic area. The pipeline for Alternative 1 will pass parts of a large swamp. Apart from ecological concerns, construction will be difficult, and uneven ground settlement will likely cause damage to the pipeline. For Alternative 2, the capacity of the existing WTP in the village is inadequate to supply both the village and the scenic area. Considering these constraints, Alternative 3 is preferred, but has also undergone some revision. The first draft FSR, in considering Alternative 3, focused on the use of underground water as the water source for the proposed WTP and the use of surface water as a backup water supply. This has been revised in light of site studies. The water source of the proposed water abstraction facility is now filtered surface water drawn from the river bank of Habahe River.

438. **Wastewater.** Three wastewater treatment alternatives were considered: (i) Construction of a new WWTP with a treatment capacity of 70 m^3/day; (ii) Construction of a single infiltration well at each water flush toilet and the reception station, for land filtration

treatment of the wastewater; and (iii) New construction of a 150 m septic tank from which wastewater is regularly pumped by a tanker and taken to the wastewater pipe network in the county seat for centralized treatment.

439. Due to the constraints posed by the other alternatives, alternative 3 is the preferred method of treatment of the domestic wastewater in the scenic area. The analysis of alternatives in the FSR also considered a dry eco-toilet, to reduce wastewater discharge and the need for pipelines. However, this type of toilet has complex maintenance requirements and is not suitable for a scenic area where tourists stay for only a short period. Therefore, all toilets in the scenic area have been changed to water flushing toilets.

5. Jimunai County

440. **WWTP site.** The first site considered for the WWTP was in the natural wasteland about 6 km north of the county seat. However, this site conflicts with the planned economic development zone of the country seat which is set to expand in this same direction. After further consideration and discussion with Altay Prefecture, a second site has been identified further north by about 3 km, in a natural semi-desert at a distance of about 9.3 km from the county seat. The new site is situated appropriately to service any urban growth in the north and to help protect the settlement areas from the elements by providing irrigation water to wind-break forests.

441. **Landfill site.** Two sites were considered for landfill: (i) expansion of the existing landfill site, east of the southern entrance to the county seat, and (ii) a site 3.5 km south of the county seat, a deserted low depression in wasteland. The option of a new landfill facility at site (ii) was selected , since this will enable an impermeable, managed sanitary landfill to be established and the existing one shut down.

442. **Heating boiler site.** Two locations were considered for the installation of a new boiler. (i) North site. In this alternative, the existing north site is expanded, and the equipment in the existing south site is reinstalled in the north site. New boilers of 3×14MW will be built. The north site is far from the county seat town area, which is in the downwind direction. There is enough space for site expansion in the future. (ii): South site. In this alternative, the existing south site is expanded, and the equipment in the existing north site is reinstalled in the south site. New boilers of 3×14 MW will be built. The south site is near the county seat town area and consequently the likelihood of noise impact to town residents. There is less space at site (ii) for future expansion. The north site alternative (i) is the preferred option for its ability to absorb expansion without impacting residents.

443. **Boiler type.** Jimunai considered two types of boilers: (i) sequential batch boilers, and (ii) recirculating fluidized bed boilers. Although more commonly used than sequential batch boilers, recirculating fluidized bed boilers are less reliable and cost more to operated. The station will use dynamically washed coal as fuel, which has high calorific content and is more suitable for the sequential batch boilers. With the installation of dust removal and flue gas cleanup equipment, the sequential batch boilers can match those re-circulating fluidized bed boilers in air emissions. The sequential batch boiler was selected because of its lower cost, better reliability, greater suitability for the calorific content of the fuel, and comparable amount of air emissions.

444. Jimunai considered both aboveground and underground heat supply pipeline networks. The underground option was selected because it has no visual impact and does not result in permanent land loss.

6. Qinghe County

445. **Water supply.** Baixing Reservoir on the upstream of Daqing River is the present water abstraction point. Other alternatives were compared to it on the basis of water source security, raw water quality, water supply capability and pumping criteria. Baixing Reservoir

was the preferred source on all these factors. Baixing Reservoir is relatively far away from the urban area and the water security can be guaranteed. The raw water can flow to the WTP by gravity, without the need for a pumping station or a secondary lifting pumping station. Additionally, the reservoir has some sedimentation functions, and can significantly reduce the effects of the sediments in the flooding season. Therefore, Baixing Reservoir remains the preferred water source for the new WTP and distribution infrastructure. The new WTP will be located near the water source.

446. **WWTP site.** Two alternative wastewater treatment plant sites have been compared. Alternative 1 is located north-east of the existing WWTP and southeast of the county seat, about 1 km from the urban area. Alternative 2 is located 600 m south of the existing WWTP. Alternative 1 is further away from the Xiaoqing River, and the effluent can be used for irrigation with minimal risk of surface drainage to the river. This is the primary selection factor between the two sites. Alternative 1 is the preferred site.

447. **Landfill sites.** Two potential landfill sites were considered: (i) a wasteland surrounded by hills on three sides, 3.5 km northwest of the county seat and 2 km away from the Provincial Road 228; (ii) a natural sandy depression about 8 km west of the county seat and 270 m south of Halaqiaola Road. Site (ii) was selected for its remoteness from settlement and its suitable terrain.

448. **Heating.** The major issue for the heating scheme in Qinghe County is the selection of the boiler type and manufacturer. This assessment has not yet taken place. The decision will use Category II -Time Period II standard of PRC Atmospheric Pollutant Discharge Standards for Boilers (GB13271-2001) as a guide for minimum environmental performance requirements. The alternative analysis will compare different types of boilers, including sequential batch boilers and recirculating batch boilers. The comparison will consider calorific value of the fuel (coal), emissions, costs, reliability, and required capacities and skills.

7. Takeshiken Land Port

449. At the Takeshiken Land Port, the planned location of infrastructure related to two proposed subcomponents (water supply and waste water treatment plant) had the potential to impact upon the Xinjiang Beurgen River Beaver Natural Reserve. The reserve is delineated with Buergen River as its middle line. The core area of the reserve extends 300m either side of the river, and the area between 300 and 500m either side forms its buffer zone. The beaver in the beaver protection zone migrate as a result of change in ecological environment, usually following the riparian woodland.

450. **WWTP site.** The originally proposed location of Takeshiken WWTP was in the core zone of the Beaver Natural Reserve. Based on the PRC Law on Natural Reserve Management, no construction work is allowed within the core zone or buffer zone of any natural reserve. Accordingly, the Qinghe County PMO sought and found a new plant site. It is remote from the reserve and will have no physical or ecological impacts on the beaver habitat. This site is located southwest of the town, near Buergen River. Alternative 2 is located northeast of the town. It is located on higher ground and the collected wastewater will need to be lifted to reach the proposed WWTP. However the treated effluent can flow by gravity to be used to irrigate the surrounding desert vegetation cover and windbreak forest. Alternative 2 is the preferred site.

451. **Water supply.** The current water supply extraction point in Takeshiken is about 200m upstream of the Beaver Natural Reserve on the Buergen River. One alternative considered was upgrading of the present water abstraction facility and plant. This would involve a new large open well adjacent to the existing well to deliver 1,800 m^3/day. To avoid hydrological impact on the beaver habitat a new extraction point and WTP was proposed, sited 7 km upstream from this point. Although this alternative requires additional 550m water distribution pipelines, the water abstraction point is far away from residential area, and the

water source will be better protected. The water balances in Chapter E (Environmental Impacts and Mitigation Measures) confirms the adequacy of downstream flows for ecological function.

452. **Sludge disposal.** Sludge disposal options from the WWTP have been considered. There is no landfill in Takeshiken Land Port and transportation to Qinghe County landfill for disposal is not economically feasible. For sludge utilization, no local well-proven experience is available and there are no means for analyzing and monitoring sludge utilization, with the risk of causing soil contamination. The presently recommended scheme is this: The sludge will be mechanically dewatered (to a moisture content below 80%) and then a pilot project will be undertaken to explore potential application of the dewatered sludge to windbreak forest. If application is proved feasible, detailed testing will be conducted to determine the application method and application rate to minimize adverse impacts to soil and vegetation. Takeshiken WWTP is the smallest in the Project with a relatively low sludge output, and is therefore the most appropriate subcomponent for this trial. The implementation and proper evaluation of this pilot will be included as a loan assurance.

CHAPTER G. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Legislative Framework for Public Consultation

453. Public participation and consultation in the evaluation of project design, planning and implementation is an important part of environmental impact assessment; it can directly reflect the public's perceptions on environmental quality in the project's area of influence. Relevant provisions in the Environmental Protection Law of PRC and the Regulations on the Administration of Construction Project Environmental Protection (Order of the State Council, No. 253) require that "Environmental Impact Report formulated by construction unit shall be in accordance with relevant laws to solicit the opinions of units concerned and inhabitants of project construction site". ADB's environmental guidelines also have detailed and strict requirements on public participation and consultation. The public consultation processes for this Project therefore follow both the PRC requirements and the ADB requirements (most recently amended in the ADB Safeguards Policy Statement of 2009).

454. The PRC EIA requirements and attendant public consultation requirements differ among the subcomponent sectors. Road and landfill developments require a full EIA under PRC regulations. An integral part of the EIA procedure is two rounds of public consultation, involving information dissemination, a questionnaire exercise and an analysis and incorporation of comments. The first round of public consultation following these procedures was undertaken by the IAs and EIA Institutes in April, 2010.

B. The First Round of Public Consultation Activities

1. Information Dissemination

455. In accordance with the requirements of PRC Interim Guidelines on Public Participation in Environmental Impact Assessment (2006), public notices were issued. The public notices were posted in prominent government offices related to the IA. For example, the notices in Buerjin County seat were posted at the main entrance of the Construction Bureau. The notices included a detailed description of the planned developments and invited the views of residents (through e-mail, letters, telephone and other forms to the construction unit and EIA unit).

2. Questionnaire and Responses

456. During the exhibition period of the Public Notices, the IAs and Institutes randomly distributed questionnaires among the residents and the public within the subcomponents' area of influence. The standard distribution rate was 100 questionnaires per subcomponent, with high return rates of between 90 and 96%. The breakdown of comments and responses to the questionnaires is described in considerable detail in the subcomponent EIAs. In general, the respondents in the first round of public consultation supported the construction of the new projects. They believed that the projects would improve the existing environmental quality and living amenity, and they would support their implementation on condition that their reasonable requirements and recommendations were satisfied.

457. These requests and recommendations focused on noise, odor and resettlement issues. Noise issues related mainly to road construction and heating stations during operation. Odour concerns were for the operation of waste water treatment plants and landfills. These concerns have all been addressed in the final drafts of the domestic EIAs with appropriate mitigation measures and have been incorporated into the EMP of this CEIA.

458. Resettlement issues were referred to and covered by the parallel public consultation and participation program for social action planning and resettlement. All of the affected households and villages/communities, village leaders and town/township and county governments have been involved in the social impact and social-economic survey. On

various occasions during meetings, interviews, focus group discussions, public consultation workshops, and community consultation meetings, local representatives have participated in the planning and their concerns have been integrated into the five Resettlement Plans for the project.

C. The Second Round of Public Consultation Activities

459. The second round of consultations was undertaken to communicate preliminary findings from the draft EIAs and the additional findings of the TA Consultants, and to receive additional public feedback. Consultation meetings were held in all five subproject counties (Buerjin, Fuhai, Habahe, Jimunai and Qinghe) throughout May 2010. Following the ADB environmental assessment guidelines, the TA team ensured that people from different social strata, with different literacy levels and belonging to different ethnic groups (Han people, Kazak ethnic minority, Hui ethnic minority, Uygurs ethnic minority) were consulted. Different annual income levels, age groups and education level were also represented.

460. Official stakeholders attending the consultation process included EIA Institute representatives, government officials from county EPBs, construction bureaus, financial bureaus, development and reform committees, poverty relief offices, women's federations, grassland management bureaus, municipal facilities maintenance teams, land and resources bureaus, ethnic and religion commissions, and water resource bureaus.

461. The main opinions and concerns collected during the second consultation round were as follows: (i) most of the people surveyed knew about the proposed subcomponents through the media, public meetings and posters, and were aware of the environmental assessment work and resettlement planning undertaken; (ii) most people knew the importance of the Project, and support the Project; (iii) most of the people surveyed were satisfied with the mitigation measures proposed to address the anticipated adverse environmental impacts; (iv) some people expressed their concerns about the quality of existing water from either tap water or self-provided wells, some people said they would appreciate if noisy construction work could be suspended during night time, some people expressed their concern about the possibility of water body pollution caused by discharging of the WWTP effluent, and supported the concept to reuse effluent for irrigation, (v) most of the people surveyed who will benefit from the water supply, wastewater and solid waste subcomponents were concerned about the drinking water rate, wastewater tariff, solid waste collection and treatment rate, the water quality and the water quantity supplied, and the WWTP effluent quality; and (vi) most of the residents who will be affected by the road subcomponents expressed their concern regarding resettlement and hoped that their future living standards would be improved or at least will not decline. These concerns have been considered in the resettlement plans.

462. During the public consultations, the attending EIA institute engineers, IA representatives and governmental officials addressed and acknowledged all the initial concerns and suggestions raised by the participants. The majority of participants indicated that if the measures and policies recommended in the FSRs, EIAs and EMPs were carried out during the construction phase and operation phase, they would be satisfied.

463. After the public consultations, all the concerns and suggestions were summarized and provided to the design and EIA institutes. In turn, these concerns and suggestions, as well as corresponding mitigation measures, have been fully taken into account and incorporated in the latest project design, EIAs and EMPs.

464. A summary of the main issues raised, and the subsequent responses is listed in Table G.1 below.

Table G.1: Issues and Responses

Subcomponent Sector	Issue	EIA/EMP Response
All subcomponents – construction and operations	The potential for high level noise during the project implementation phase in some areas, which has concerned some participants the most.	Has been addressed in the design, EIAs and EMPs through the installation of noise reduction equipment, limitation of working hours, and restriction of locations where machineries with high noise level can operate (away from residential areas).
All subcomponents – construction phase	Management of domestic solid waste generated from the construction site	Measures, such as the setting up of domestic solid waste bins, timely transfer of the solid waste to the town/township waste transfer stations, and strengthened day-to-day management have been incorporated in the design, EIAs and EMPs.
WWTP subcomponents	Whether the WWTP effluent quality will meet the relevant national irrigation standard	Measures have been incorporated in the design, EIAs and EMPs and will be implemented during the operation phase. These include regular monitoring at wastewater treatment plant to guarantee that the WWTP effluent quality will meet relevant national irrigation standard.
Water Supply subcomponents	Whether the quality of the water supplied will meet the drinking water standard	Measures have been incorporated in the design, EIAs and EMPs and will be implemented during the operation phase. These include regular water quality monitoring at the water supply plant to guarantee that the water supplied will meet the national potable water quality standard.
Landfill subcomponents	Leakage of landfill leachate into neighboring areas and water bodies	The requirements in the EIA and EMP to safely store the leachate, timely and properly transfer and back-spray to the landfill working area, and general strengthening of operation management, have been incorporated in design and operation management prescriptions.
Heating subcomponents	Operational noise affecting neighboring residents	Since these facilities need to be located within or adjacent to urban areas, the IAs have undertaken to noise-proof neighboring houses.
All subcomponents – construction phase	The disposal of construction spoil	Requirements to plan and locate acceptable disposal sites, timely and careful transfer of spoil to the designated disposal sites, and general strengthening of construction site management, have been incorporated in design and construction management prescriptions.

465. The important issues of water supply and waste water and solid waste disposal tariffs were canvassed during the public consultation and participation program for social action planning and resettlement. During the household survey and meetings with key informants the TA Team social specialists undertook a number of consultative meetings (focus group discussions). The issue of affordability and willingness to pay has been examined in the Financial and Economic Analysis of the DFR. An issue of particular concern was the affordability of connection to piped water. An attempt was made in all the consultative meetings to consult participants on methods of paying for connections which could make it easier for poor households to connect.

D. The Third Round of Public Consultation Activities

466. This public consultation was conducted in the form of information disclosure and focused primarily on the setting up, refining and dissemination of the **Grievance Redress Mechanism** (GRM) developed for the Project. It is an important tenet of the ADB's Safeguards Policy that the GRM should be readily accessible to affected persons. This

round of public consultation has ensured that the people in each subcomponent's area of influence are aware of the GRM and how to use it.

467. The third round of public consultation was therefore not undertaken on a subcomponent-by-subcomponent basis (as occurred in the previous two rounds). Instead, since the GRM applies equally to all subcomponents, the third round was conducted in each county.

468. The TA team trained PMO staff to conduct the consultation. The PMO delivered the third round public consultation in Buerjin county seat at the County Construction Bureau on 21 August, 2010. Fifty one participants, including ethnic minorities, were instructed in the Project Grievance Redress Mechanism which has been designed to facilitate the handling and resolution of complaints from affected persons during construction and operation of Project subcomponents. Over the following four days public consultation events on the GRM were conducted in Habahe county seat (County Government Building, 51 people); Jimunai county seat (County Government Building, 61 people); Fuhai county seat (County party School, 52 people); and Qinghe county seat (County Government Building, 80 people including 24 from Takeshiken Land Port). Ethnic language translators were arranged for better understanding and communication in the communities.

469. The Grievance Redress Mechanism described in Chapter H of this Consolidated EIA was the basis for the information dissemination and discussions. The information dissemination covered the following:

- Current knowledge about the existing domestic letters and visits system;
- Current options for complaints or petition approaches when environmental grievances or issues occur;
- The processing of environmental grievances or issues;
- Explanation of the grievance redress mechanism of this project;
- The expected impacts of the grievance redress mechanism on this project (especially on the environmental protection).

E. Future public consultation

470. Comments and responses from the public have been used in finalizing the EIA documents. Future public consultation will include involvement in monitoring impacts and mitigation measures during the construction and operation stages; evaluating environmental and economic benefits and social impacts; and interviewing the public after the Project is completed. In particular, households living near heating subcomponents and along new road alignments will be targeted. The county EPBs have all nominated contact persons for environmental complaints (see Chapter H "Grievance Redress Mechanism") which will also be made available for continued public inputs for the Project. The Project's Grievance Redress Mechanism will also provide a conduit for public participation in subcomponent construction and operation.

471. The future public involvement in monitoring impacts and mitigation measures during the construction and operation stages is detailed in the Environmental Management Plan (Chapter I) and includes a Public Consultation Plan.

CHAPTER H. GRIEVANCE REDRESS MECHANISM

472. Public participation, consultation and information disclosure undertaken as part of the local EIA process, assessment and development of resettlement plans, and consultations undertaken by the project consultants have discussed and addressed major community environmental concerns. Continued public participation and consultation has been emphasised as a key component of successful project implementation. As a result of this public participation and safeguard assessment during the initial stages of the project, major issues of grievance are not expected. However, unforeseen issues may occur. In order to settle such issues effectively, an effective and transparent channel for lodging complaints and grievances has been established, in parallel with the mechanism developed under the resettlement planning process (refer to subproject resettlement plans).

473. The ADB Safeguards Policy requires that the IAs will establish and describe a mechanism to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the Project's environmental performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all sections of the community at no cost and without retribution.

A. The Current System

474. The 2005 PRC Decree No. 431 entitled Regulations on Letters and Visits codifies a complaints receival mechanism at all levels of government, and safeguards the complainants from any retaliation. In 2007, the national regulation was adapted to environmental matters in Decree No. 34 of SEPA on Environmental Letters and Visits System.

475. Provinces and autonomous regions were empowered by this decree to develop local systems for grievance redress. The "Letters and Visits System" was issued by the EPB of Xinjiang Uygur Autonomous Region in August 2007. This grievance redress system nominates the region's environmental protection administration (made up of EPB at different levels of government) and sets out the three principles of: (i) the level of environmental administration with the power to deal with an issue is responsible for that issue; (ii) issues not resolved to the satisfaction of the complainant can be referred to higher levels of the administration; and (iii) that the responsible authority will make "full use of the existing network resources for governmental affairs information, establish or designate the information system within its administrative areas and connect its information system with those of higher and lower government levels, and their relevant departments".

476. In the current system, when people are adversely affected by a project, they can appeal to contractors, local government, local EPB or court. Among the agencies involved, local EPB takes the leading coordination role in dealing with environmental complaints.

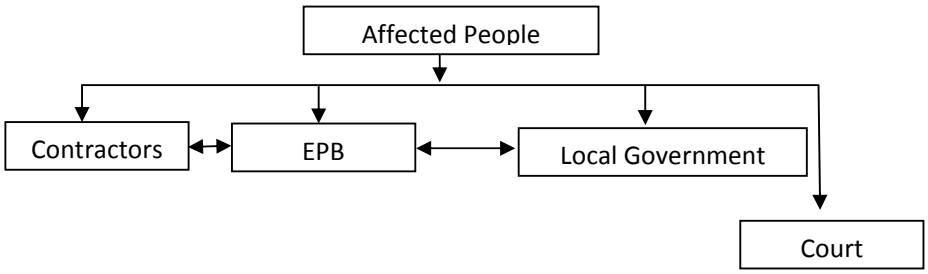


Figure H.1: Current Complaints Pathways

477. In case of problems during the construction, affected persons usually complain to the contractors first if they believe the construction is the source of issues. If the contractors' responses are unsatisfactory, they then go to local government. If they refer their complaint to the local EPB, the EPB will need to consult with the IA or environmental supervision engineer to develop project understanding. Therefore, it is usual for the IA, who is familiar with the project, to take the lead role in complaint investigation.

B. Proposed Mechanism

478. The following proposed mechanism for grievance redress of environmental matters in construction and operation of the project's infrastructure subcomponents uses existing village administrative structures (affected persons/ village committees/ village groups), any of which can be complainants. It may use diverse complaint media that are culturally appropriate, including self-identified, confidential, or anonymous procedures such as professional letter writers, suggestion boxes, mail-in forms, hotlines, and electronic submission through a website.

479. This system also mirrors the approach of the grievance redress mechanism for the Project's resettlement and asset compensation. The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple points of entry, including face-to-face meetings, written complaints, telephone conversations, or e-mail, should be available. Opportunities for confidentiality and privacy for complainants should be honored where this is seen as important.

480. In consultation with the project IAs, the county PMOs will establish a complaints center for each county. Contact details for the complaints center will be publicly disseminated on information boards at construction sites and at the main entrance of county Construction Bureaus.

481. The complaint pathways in this process, simplified, are as follows: (i) The affected persons submit an oral or written petition/complaint to either the county PMO or county EPB; (ii) EPB and PMO find a solution and implement corrective actions through their own resources and authority; (iii) PMO/EPB refer more difficult matters to higher levels of government authority and the XPMO/APMO; and in extreme cases, (iv) AP complains directly to the ADB.

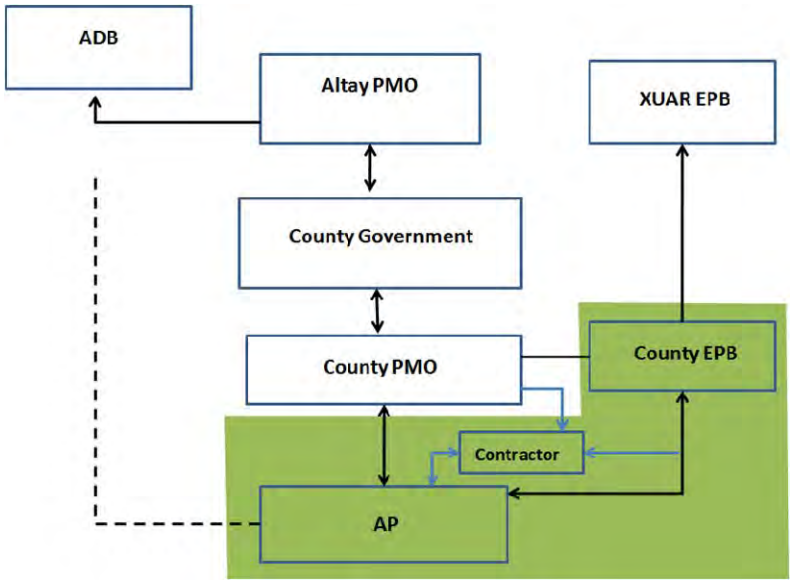


Figure H.2: Proposed Environmental Grievance Redress Mechanism

AP: Affected Persons. PMO: Project Management Office. EPB: Environment Protection Bureau. ADB: Asian Development Bank

Note: The shaded part of the diagram indicates the current system (described above).

482. In the event of a grievance issue, the basic stages established for redress are as follows:

Stage 1: If a concern arises during construction, the affected person tries to resolve the issue of concern directly with the contractor and the project manager. If successful, no further follow-up is required.

Stage 2: The affected person should submit a verbal or written petition and/or complaint to the County EPB or the County PMO. The receiving entity must inform the other one (EPB informs PMO or vice-versa). For a verbal complaint the PMO must make written records properly and record them in a complaint register. The County PMO and EPB must give a clear reply within 2 weeks. If the complaint is successfully solved, the County PMO informs the Altay PMO which records the grievance redress process in its central register.

Stage 3: If the complainant is not satisfied with the reply in Stage 2, he or she can appeal to the Altay Prefecture PMO after receiving the reply in Stage 2 and Altay PMO will deal with the complaint within 2 weeks.

Stage 4: If the affected person is still not satisfied with the reply of APMO, he or she can appeal to the XPMO after receiving the reply of Stage 3. The XPMO must report to ADB as soon as the complaint is recorded by submitting relevant documents; and prepare a clear reply in consultation with ADB, Altay Prefecture EPB, the EMC, and APMO. The XPMO must give the reply to the affected person within 30 days. The ADB project team will assess the situation, contact the affected people and government.

483. In all cases, the county EPB is in a line agency relationship with the Altay Prefecture EPB and above them the XUAR EPB and can pass the complaint up that line if resolution requires the higher level agencies. The county EPBs have also nominated contact persons to receive complaints and to have primary carriage of their resolution (see Table H.1).

Table H.1: EPB Contact Points

City/County	Responsible Person				Responsible Agency	
	Contact Person		Responsible Officer		Name	Address
	Name	Contact Information	Name	Contact Information		
Altay City	He feiqiu	0906-2128509	Adelehan	0906-2128509	EMIT, Altay Prefecture EPB	EMIT of Altay Prefecture EPB, Jiefang South Road, Altay City
Buerjin County	Liu delin	0906-6527740	Xu yuzhu	0906-6527740	EMIT, Buerjin County EPB	EMIT of Buerjin County EPB, Youyifen Road, Buerjin County
Habahe County	Xu yonghong	0906-6626746	Jin gesi	0906-6626746	EMIT, Habahe County EPB	EMIT of Habahe County EPB, Renmin Road, Habahe County
Jimunai County	Dumanguli	0906-3690300	Gao aiguo	0906-6184355	EMIT, Jimunai County EPB	EMIT of Jimunai County EPB, Guanghui Road, Jimunai County
Fuhai	Sun ke	0906-	Wang	0906-	EMIT, Fuhai County	EMIT of Fuhai County

City/County	Responsible Person				Responsible Agency	
	Contact Person		Responsible Officer		Name	Address
	Name	Contact Information	Name	Contact Information		
County		3690300	yujiang	3690300	EPB	EPB, Tuanjie South Road, Fuhai County
Qinghe County	Bian jiang	0906-8825188	Huo qingjiang	0906-8825188	EMIT, Qinghe County EPB	EMIT of Qinghe County EPB, Tuanjie Road, Qinghe County

EMIT: Environmental Monitoring and Inspection Team

Source: XPMO

484. In the construction period and the initial operational period covered by loan covenants the PMO will be reporting progress to the ADB, and this will include reporting complaints and their resolution.

485. The tracking and documenting of grievance resolutions within the county PMOs will include the following elements: (i) tracking forms and procedures for gathering information from project personnel and complainant(s); (ii) dedicated staff to update the database routinely; (iii) systems with the capacity to analyze information so as to recognize grievance patterns, identify any systemic causes of grievances, promote transparency, publicize how complaints are being handled, and periodically evaluate the overall functioning of the mechanism; (iv) processes for informing stakeholders about the status of a case; and (v) procedures to retrieve data for reporting purposes, including the periodic reports to the XPMO and the XPMO's report to the ADB.

486. The third round public consultation focused on explaining the Project Grievance Redress Mechanism to people in all county seats, including ethnic minorities (see Chapter G, Section D). This public consultation in was undertaken by the Altay and county PMOs between 21 and 24 August 2010, and included a total of 295 people, representing potentially affected communities and neighborhoods.

CHAPTER I. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

487. The environmental management plan (EMP) covers all phases of sub-component implementation from preparation through commissioning and operation of all subprojects, and it aims to ensure the monitoring of environmental impacts and activation of environmental mitigation measures. Relevant parts of the EMP will be incorporated into the construction, operation, and management of each sub-component.

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

489. Environmental monitoring programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures or compliance with related rules and regulations.

B. Summary of Potential Impacts

490. Table I.3 summarizes the potential impacts of the sub-components during construction and operation as identified by the environmental impact assessment (EIA), as well as corresponding mitigation measures designated to minimize those impacts. Each county has prepared individual EMPs covering the subcomponents within their jurisdiction. These have been integrated into consolidated EMP and environmental monitoring plans in this chapter covering all counties and subcomponent sectors (see Tables I.3 and I.4 below).

C. Mitigation Measures

491. The mitigation measures will be incorporated into tender documents, construction contracts, and operational management plans. Contractors and the project implementing agencies (IAs) will implement these measures. The effectiveness of these measures will be carefully watched via the environmental monitoring to determine whether to continue them or to make improvements.

492. Resettlement plans have been prepared to ensure proper resettlement of any affected persons and avoid deteriorating their quality of life. Details of required actions are in the resettlement plans.

493. A complementary program to the mitigation of impacts described in this EMP will be the management of the natural resources and human activity in the catchment of the water supply sub-component sources. Subproject counties will apply water source and water quality protection through the proper delineation of water sources and protection zones, and the effective management of these zones. The water protection zones will be delineated according to the requirements of the PCR and Xinjiang Uygur Autonomous Region laws and regulations before the processing of construction tenders.

494. An additional requirement, included in this EMP is for the preparation and implementation, by the county governments, of time-bound action plans for the closure of existing landfills and existing aeration and settlement ponds in accordance with national standards as a prerequisite of the commissioning of the new landfills and WWTPs respectively. This will include proper remediation and monitoring of environmental conditions of the rehabilitated sites.

D. Performance Indicators

495. Before the construction, performance indicators, targets, or acceptance criteria should be specified for the EMP to describe the desired outcomes as measurable events. These indicators will be responsive to changes in Project design, such as a major change in Project location or route, or in technology, unforeseen events, and monitoring results – but primarily they should flag the successful (or unsuccessful) pre-construction positioning of the IAs which show that environmental commitments are being carried through and environmental systems and pre-requisites are in place before construction commences. The following performance indicators listed in the Table I.1 will show how well the EMP is being implemented.

Table I.1: Performance Indicators of Environmental Management prior to Construction

Indicator	Measurement Methods	Measurement
Public involvement effectiveness	• The completion and agreements to Resettlement plans before the construction.	Yes NO
	• Three rounds of public consultation completed.	
	• Grievance Redress Mechanism established with contact points.	Yes NO
		Yes NO
Water security committed	• Protection zones delineated.	Yes NO
	• Land use controls publicized	Yes NO
Facility closure plans	• Closure and restoration plans for existing landfills completed and approved by local authorities	Yes NO
	• Closure and restoration plans for existing aeration and sedimentation ponds completed and approved by local authorities	Yes NO
	• Boiler house demolition EIAs completed and approved by county EPBs	Yes NO
Irrigation plans	• Irrigation plans for windbreak forests completed and submitted	Yes NO
EMP financial support	• The fund from ADB has been used to support the EMP measurement according to the financial plan.	Yes NO
	• The fund from Altay Prefecture government has been used to support the EMP measurement according to the financial plan	Yes NO
Contract documents	• Environmental requirements of EMP included in contract documents for construction contractors.	Yes NO

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute
Note: ADB = Asian Development Bank, EMP = environmental management plan

496. During the construction and operation of the Project, negative impacts might occur to the environment; appropriate mitigation measures were defined to avoid or minimize these potential impacts. Performance indicators were defined to measure the effectiveness of mitigation measures, including quality of wastewater discharged; groundwater, surface water, soil and air quality; noise; and relevant public health indicators. Table I.2 below is a list of indicators that measure the environmental performance of the Project.

Table I.2: Monitoring Indicators of Mitigation Measures and Their Relevant Standard

Period	Subcomponent	Indicators	Standard
Construction	All	Soil loss (erosion)	Class II Control Standards for Soil and Water Loss on Development and Construction Projects (GB50434-2008)
	All	SO_2, CO, and NO_x	Grade II, Ambient Air Quality Standard (GB3095-1996)
	Roads	Asphalt flue gas	Class II Atmospheric Pollutant Emission Standard (GB16297-1996).
	All	noise	Category 1 Construction Noise (GB12523-90)
Operation	Roads	CO and NO_2	Grade II, Ambient Air Quality Standard (GB3095-1996)
	Roads	Noise	Class II standard of Noise Environment Quality Standards (GB3096-2008)
	Water supply	Temperature, DO, SS, NH_3N, TN, TP, BOD_5, COD_{Cr}, fluoride, sulfate, nitrate, As, Hg, Gd, Cu, Mn, Se, Cu, Zn, Pb, Cr, Fe, chloride, oils	Class II Water Quality Standards for Domestic Drinking Water Sources (CJ3020-93)
	Waste water Treatment	BOD_5, COD, and SS	Water Quality Standard for Irrigation (GB5084-2005)
	Waste water Treatment	NH_3, H_2S	Class II standard of the Emission Standard for Odor Pollutants (GB14554-93)
	Waste water Treatment	Noise	class III Emission Standard for Industrial Enterprises Noise at Boundary (GB12348-2008)
	Solid Waste (landfill)	CH_4	Sanitary Landfill Technical Specification of Municipal Solid Wastes (CJJ17-2004)
	Solid Waste (landfill)	pH, NH3N, permanganate index, Cr(+6), As, Pb, Cd, Hg, volatile phenol, cyanide, fecal coliform, total hardness, chloride	Grade III of Standards for the Quality of Groundwater (GB/T14848-93)
	Heating Plants	PM, SO_2 and NO_x	Category II -Time Period II standard of PRC Atmospheric Pollutant Discharge Standards for Boilers (GB13271-2001)
	Heating Plants	Noise	Category-II Standard stated in Ambient Noise Emission Standard at Plant Side of Industrial Enterprises (GB12348-2008)

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

Table I.3: Summary of Potential Impacts and Mitigation Measures

	For all Components
	For Road Sub-Components only
	For Water Supply Sub-Components only
	For Wastewater Sub-Components only
	For Solid Waste Sub-Components only
	For Heating Sub-Components only

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
1. Pre-construction										
1.1 FS stage	Site/alignment selections	The recommended sites for the individual sub-components were selected from various alternatives to minimize adverse impacts on the environment.	IA, LDI and PPTA team	IA, County EPB						Included in the FS Stage
	EIA report	As required by law, ensure EIA has been prepared for each subcomponent.	LDI and PPTA team on behalf of IA	IA, County EPB	400	360	400	240	250/80	1730
	Public consultations	Three rounds of public consultations conducted in each county on environmental issues, poverty, resettlement and the Grievance Redress Mechanism during the project design and EIA preparation.	IA, PPTA team	IA,						Included in the FS Stage
	Resettlement Plans	As required by law, prepare RPs for the Project in each county to required ADB and PRC standards. i. Establish a resettlement office comprising local government officials to manage the	LDI, IA and PPTA team	Altay PMO						Included in the RP

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		resettlement process. ii. Conduct community consultation programs and ensure information is disseminated about entitlement based on the Land Administration Law. iii. Ensure that all relocation and resettlement activities are reasonably completed before construction starts on any subproject. iv. Include provisions for households suffering economic displacement through new landfill controls.								
1.2 Design Stage	Updating EMP	Mitigation measures defined in this EMP will be updated and incorporated into the detailed design to minimize adverse environmental impacts.	LDI, IA	IA, County EPB						Included in the Detail Design Stage
	Land-take confirmation	RP will be updated and incorporated into the detailed design.	LDI, IA	IA, County EPBs						Included in the Detail Design Stage
1.3 Water availability confirmation	Water security and water use conflicts	i. Water balances prepared ii. River basin analyses prepared	LDI, IA and PPTA team	WRB						Included in the EIA
1.4 Closure of current landfills being replaced	Current unmanaged and non-complying landfill site will reduce effectiveness of environmental controls on new, adjoining, site	Prepare and implement a time-bound action plan for the closure of the existing landfills in accordance with national standards as a prerequisite of the commissioning of the new site. This will include proper remediation and monitoring of environmental conditions.	County govts	APMO, County PMOs, County EPBs						Included in the Detail Design Stage

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
	Current WWTP aeration and settlement ponds require restoration.	Prepare and implement a time-bound action plan for the closure of the existing ponds in accordance with national standards including proper remediation, sludge disposal and monitoring of environmental conditions.	County govts	APMO, County PMOs, County EPBs						Included in the Detail Design stage
1.5 Planning for reuse of treated effluent	Release of treated effluent as irrigation for windbreak forests	i. Detailed irrigation plans to ensure that effluent flows are only released in accordance with horticultural needs and the available percolation rate at the time. ii. Treated effluent should be contained in a bunded storage area to allow controlled release for irrigation.	County govts	APMO, County PMOs, County EPBs and FB						Included in the Detail Design stage
1.6 Construction preparation	Contract documents	i. Prepare environment section in the terms of reference for bidders. ii. Prepare environmental contract clauses for contractors, namely the special conditions (e.g., reference EMP and monitoring table).	Environmental consultants or companies contracted by IA	IA, County EPB						Included in the Detail Design stage
	Environmental Protection Training	Environmental specialists and/or officials from County EPB will be invited to provide training on implementation and supervision of environmental mitigation measures to contractors.	IA	County EPB	154	324	154.5	162.5	332	1127
1.7 Ancillary sites and construction support preparation	Impacts from spoil disposal and earthworks	Spoil disposal sites and borrow pit locations will be defined in the construction tender documents, subject to approval by the County EPBs, and selected using the following criteria:	IA, LDI	County EPB						Included in the Detail Design stage

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		i. Siting to minimize transportation and the need for temporary storage; ii. Siting to avoid potential flood areas or floodways; iii. Sites to be small, and have no encroachment on cultivated land or forestland; iv. Design of sites to be concave land, gullies or gentle slopes.								
Subtotals					**554**	**684**	**554.5**	**402.5**	**662**	**EIAs** **Training**
2. Construction										
2.1 Water	Wastewater from construction camps	Latrines and seepage pits will be installed in any camps. After project completion, the sites will be vacated only after waste has been effectively treated or removed.	Contractors	IA, County EPB	49	62	93.5	113	83/11	411.5
	Wastewater from washing aggregates, pouring and curing concrete, machinery repairs	i. Settling ponds, oil-water separators. ii. Recycled water will be used to spray for dust control. iii. Sludge will be removed from site and disposed in municipal landfills.	Contractors	IA, County EPB	90	69.5	93.5	98	107/8	466
	Handling of hazardous and harmful materials	i. A construction materials handling and disposal protocol that includes spill responses will be prepared and applied to prevent soil and surface/ground water pollution. ii. Construction of storage facilities (including fuel and oil storage),	Contractors	IA, County EPB	145	59.5	67	62	46/8	387.5

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		with bunds and clean-up equipment. iii. Fuel supplier is properly licensed and follows the proper protocol for transferring of fuel and in compliance with JT 3145-88 (Transportation, Loading and Unloading of Dangerous or Harmful Goods). iv. Vehicles and equipment are properly parked in designated areas to prevent contamination of soil and surface water. v. Vehicle, machinery, and equipment maintenance and refueling will be carried out so that spilled materials do not seep into the soil. vi. Fuel storage and refilling areas will be located at least 300 m from drainage structures and important water bodies. vii. Oil traps will be provided for service areas, and parking areas.								
2.2 Air	Generation of dust by construction activities	i. Vehicles carrying soil, sand or other fine materials to and from the sites must be covered. ii. Materials storage sites must be 300 m from residential areas and covered with canvas or sprayed with water. iii. Water will be sprayed on construction sites and access roads each day. iv. All roads and tracks used by vehicles of the contractors or any subcontractors or supplier will be kept clean and clear of all dust,	Contractors	IA, County EPB	212	149	218.5	193	175/19	966.5

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		mud, or extraneous materials dropped by their construction vehicles.								
	Dust generation from landfill operations	Earthworks at landfill sites preparing cells and stockpiling spoil for covering will be protected to avoid wind-blown dust	Contractors	IA, County EPB	50	50	50	45	60/	255
	Air emission from vehicles and equipment	i. Vehicle emissions must be in compliance with PRC-GB18352-2005, GB17691-2005, GB 11340-2005, GB3847-2005, and GB18285-2005. ii. Equipment and machinery will be maintained to a high standard to ensure efficient running and fuel-burning. High-horsepower equipment will be installed with tail gas purifier to ensure emissions be in compliance with PRC-GB16297-1996. iii. A regular inspection and certification system must be initiated.	Contractors	IA, County EPB	155.5	115	146	147	75/15	653.5
	Generation of asphalt flue gas	i. Use modern equipment which complies with the asphalt flue gas standard of GB16297-1966 ii. Locate asphalt mixing stations at least 500m from residences.	Contractors	IA, County EPB	20	20	15	15		70
2.3 Noise and Vibration	Noise from Vehicles and construction machinery	The following safeguards will be implemented: i. Noise levels from equipment and machinery to conform to PRC-GB12523-90. ii. Install portable noise shields near sensitive receptors such as schools, hospitals and residential areas.	Contractors	IA, County EPB	208.5	144	192.75	163	127/19	844.25

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		iii. At construction sites within 500 m of the nearest habitation, noise-generating construction work will be stopped between 2000 and 0600 hours. iv. In cases where construction noise needs to continue into the night, the construction unit must reach an agreement with APs and provide compensation								
2.4 Solid wastes	Domestic waste from construction camps	i The contractors will provide appropriate waste storage containers. ii Trash collection bins will be regularly sprayed with pesticides to reduce flies. iii Wastes will be stored away from water bodies and will be regularly hauled to a suitable landfill or designated dumping site. iv Agreements will be signed with local authorities for waste disposal, where appropriate, through local facilities and to approved disposal sites.	Contractors	IA, County EPB	108	94.5	103.3	78	88/10	481.8
	Construction and demolition wastes could have adverse impacts on surrounding environments.	Construction wastes that cannot be reused will be regularly transported off-site for disposal, and not allowed to accumulate on site over long periods.	Contractors	IA, County EPB	39	46	44.7	76	46/5	256.7
	Demolition of existing boilers will have environmental	The demolition of replaced boilers needs to have approved EIAs and the demolition activities undertaken in compliance with standards for	Contractors, county govts	Altay EPB, County EPBs						Govt. funding

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
	and occupational health impacts	occupational health and safety and disposal of demolition wastes.								
2.5 Soil erosion and ecology	Erosion from spoil disposal sites and borrow pits	The following safeguards will be implemented for all earthworks: i. Strip and stockpile topsoil from all sites. ii. Provide temporary detention ponds or containment to control silt runoff. iii. Construct intercepting ditches and drains to prevent outside runoff entering disposal sites, and divert runoff from sites. iv. Preserve existing vegetation where no construction activity is planned.	Contractors	IA, County EPB, WRB	176.3	117.5	110.75	132	105/15	656.55
	Erosion from construction sites	The following safeguards will be implemented: i. Strip and stockpile topsoil ii. Provide temporary detention ponds or containment to control silt runoff. iii. Construct intercepting ditches and drains to prevent outside runoff entering construction sites, and divert runoff from sites to existing drainage system or ponds. iv. Rehabilitate construction sites into grassland, or farmland at completion.	Contractors	IA, County EPB	140.5	120	73.5	126	95/13	568
	Re-vegetation of disturbed areas.	i. In compliance with the PRC's forestry law, IA will undertake compensatory planting of an equivalent or larger area of affected forest trees.	Contractors, IA	IA, County EPB, FB	80	109.5	183.25	123	98/10	603.75

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		ii. The re-vegetation will comprise a selection of species that are suitable for this area and have the most appropriate attributes to survive and serve their designated functions. iii. New plantings will be maintained during the operation period.								
2.6 Social	Resettlement of affected persons	All affected persons will be resettled in a timely and adequate manner, in accordance with the Resettlement Plan.	IA	IA, XUARG, communities						Included in the RP
	Compensation of lost assets	All affected persons will be compensated in a timely and adequate manner, in accordance with the Resettlement Plan.	IA	IA, XUARG, communities						Included in the RP
	Traffic management	The following safeguards will be implemented: i. Siting and management of interim tracks to avoid traffic problems. ii. Selecting haulage routes to reduce disturbance to regular traffic (where possible). iii. Diverting or limiting construction traffic at peak traffic hours. iv. Blocking and reinstating interim tracks to original condition on completion of construction.	Contractors, IA	IA, Traffic authorities	44.2	63.5	73.5	44	55/7	287.2
	Work camp health and hygiene	i. Contractors will be required to safeguard environmental hygiene in the construction camps, including the quality of water supplies. ii. All construction sites must provide the necessary personal protective	Contractors, IA	IA, Local and/or Provincial Health Bureau	12	16	15	13	10/5	71

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		equipment and other resources to create a safe working environment. iii. Construction site operations must comply with PRC's State Administration of Worker Safety Laws and Regulations.								
	Cultural heritage protection	i. Cultural heritage values will be preserved where identified. In accordance with PRC regulations, no person shall destroy, damage, deface, conceal, or otherwise interfere with a relic. ii. In case an important site is unearthed, work should be stopped immediately and the matter promptly referred to the county, city, autonomous region, or state level agencies for evaluation and decision on appropriate actions.	Contractors	IA, Local and/or Provincial Cultural Heritage Bureau						Included in construction costs
2.7 Unexpected environmental impacts		If unexpected environmental impacts occur during project construction phase, the IAs will update the EMP, and environmental protection measures will be designed and resources will be utilized to cope with these impacts	IA, County PMO	XUAR PMO and APMO						Included in construction costs and contingency
Subtotal					**1530**	**1236**	**1480.25**	**1428**	**1305**	**6979.25**
3. Operations										
3.1 Water	Water source protection and management	i. Declaration of potable water sources for each water supply component: Prohibited zone, protected zone and buffer zone. ii. Implementation of legislative requirement for potable water	County Government	APMO, County PMOs and WRBs						Govt. program

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		source protection iii. Assignment of responsibilities and resources								
	Wastewater being discharged without meeting relevant requirements /standards	i. Procure wastewater quality monitoring devices for real-time monitoring ii. Establish real-time monitoring framework iii. Wastewater should be pre-treated by responsible industries and only after meeting relevant standards , can be discharged into wastewater collection network	IA and Operators	County EPB	100	250	200	50	60/60	720
	Potential impacts on ground water from landfill leachate	The landfill leachate will be reduced and stabilized within the landfill by back-spraying techniques. This will be accomplished by: i. Landfill site anti-leakage treatment ii. Landfill leachate containment cell iii. Pumping and spraying equipment	IA and Operators	County EPB	50	350	50	150	150/	750
3.2 Air	Exhaust emissions from predicted traffic volumes on roads	i. Speed limiting signs and enforcement ii. Air pollution monitoring iii. Vehicle inspections	IA and Operators	County EPB						Included in operational costs
	Odor from WWTP	i. Equip odor generating facilities with ventilation or odor containment. ii. Implement timely sludge cleanup. iii. Institute daily check, repair and maintenance of all wastewater treatment facilities/equipment.	IA and Operators	County EPB	200	100	200	40	50/30	620
	Dust generation during landfill processes	Follow landfill operation regulations strictly, including timely covering with soil, and water spraying to suppress dust	IA and Operators	County EPB	50	20	50	50	120/	290

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
	NH_3、H_2S and flammable CH_4 emissions from landfill	Monitor air constituents and concentration. Establish and implement risk response system/framework.	IA and Operators	County EPB	40	50	40	50	50/	230
3.3 Noise	Noise from increasing traffic volumes on Project roads	i. Increase control of vehicle noise, including the installation of effective mufflers; ii. Traffic and parking management to avoid noise produced by stop-and-start driving and traffic jams iii. Driving speed limitations iv. Large and heavily loaded vehicles forbidden during night time v. Signs and education to reduce use of horn vi. Road maintenance and timely repair of damaged road pavements vii. Noise monitoring at regular intervals to check compliance	IA and Operators	County EPB						Included in operational costs
	Noise impact from traffic on sensitive receptors	Mitigation measures, including noise barriers or noise-proofing buildings, if levels exceed PRC standard	IA and Operators	County EPB	150	200	150	150		650
	Noise produced during wastewater treatment (mechanical equipment)	i. Design and implement noise absorbing, noise reduction, noise insulation and vibration reduction measures during operation. Adopt low noise level equipments. ii. Create green buffer zone >10m.	IA and Operators	County EPB	120	200	220	30	50/50	670
	Mechanical equipment and haulage traffic noise in and out	Manage solid waste transportation and landfill at a regular time interval to alleviate the impacts on residents to the minimum	IA and Operators	County EPB	5	5	5	50	80/	145

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
	of landfill site									
	Noise from new boiler house operations (Jimunai and Qinghe)	Noise-proofing building adjoining boiler houses (including double glazing of windows and noise barriers)	IA and Operators	County EPB				150	150/	300
3.4 Solid wastes	Solid waste (sludge) from WTP operations	Develop and implement a sludge handling plan which includes: i. Collection and storage of sludge ii. Transport iii. Environmentally sound disposal of sludge iv. Health and safety safeguards	IA and Operators	County EPB						Included in operational costs
	Solid waste from primary separation of inflow sewage	Develop and implement a sewage solid waste handling plan which includes: i. Packaging, ii. Transportation, and iii. Disposal in landfill	IA and Operators	County EPB	100	90	100	40	50/20	400
	Disposal of sludge from Sewage settlement ponds	Develop and implement a sludge handling plan which includes: i. Treatment for use as composting, and ii. Disposal in landfill	IA and Operators	County EPB	14	50	40	60	50/20	234
	Ashes and slag residue from heating boilers	Establish and implement slag and coal ashes treatment/disposal plans, including: i. Slag and coal ashes collection and storage ii. Transportation iii. Treatment or disposal of the slag and coal ashes iv. Health and safety safeguards	IA and Operators	County EPB				50	120/	170

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
	Spillage or leakage of waste from garbage trucks transporting to landfill	i. Enclosed or covered transport vehicles ii. Retaining fences and covers at landfill to catch wind-blown trash iii. Timely compaction and soil covering of tip face.	IA and Operators	County EPB						Included in operational costs
3.5 Emergency preparedness and response	Spills of hazardous materials in road accidents	i. Establishment of a road accident emergency command organization; ii. Establishment of an emergency response plan; iii. Preparation of emergency equipment and training.	IA and Operators, local Security Bureau	County govt.	20	25	20	20		85
	Disinfection chemicals formulation, handling and storage	i. Chlorination room and storage equipped with alarms and breathing apparatus ii. Emergency response and evacuation plan implemented iii. Awareness program	IA and Operators	County EPB	60	60		60	60/40	280
	Methane emissions from landfill	i. Methane levels in and around the landfill monitored daily; ii. The local County EPBs monitor methane densities of the landfills' area of influence once every three months; iii. Fire control and lightning protection measures; iv. Regular inspections of the gas outlet pipes to check for blockages or damage; v. No new residential houses or community buildings within 600m; vi. Identification of down-slope and downwind areas where CH_4 might pool. In these locations residential and community facilities will be prohibited, and methane alarms to	IA and Operators	County EPB						Included in operational costs

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
		warn of any increase in CH_4 above ambient levels will be established.								
	River crossings of sewerage pipes (existing)	i. Erection of warning signs at crossing points ii. Pipelines checked and maintained iii. Establishment of an emergency response plan for leakage or accident	IA and Operators	County EPB						Included in operational costs
3.6 Pest and disease vector management	Mosquitoes, flies and rats, the main pests in solid waste collection points and landfill sites, will impact ambient sanitary environment, and provide potential vectors for disease transmission	i. Timely soil cover to minimize breeding areas for flies and mosquitoes; arrange staff timely soil cover the hollow area within the landfill site ii. Monitor mosquito, fly and rat activities during landfill operation. iii. Staffs assigned to catch and kill mosquitoes, flies and rats, according to their living habits and activities patterns iv. Periodic spraying with approved pesticide	IA and Operators	County EPB	15	100	15	80	50/	260
3.7 Ecological issues	Cumulative effect on water extraction on downstream protected habitats in dry years	Monitor hydrological conditions in the Buergen River Beaver Natural Reserve. Manage irrigation demands to ensure adequate flow.	Operators and WRB	County EPB						Included in operational costs
	Access roads to remote facilities will enable unplanned and uncontrolled exploitation of	Strict control over the use of dedicated access roads to remote facilities and the protection of any natural resources in their vicinity	IA and Operators	County EPB						Included in operational costs

Item	Environmental Impacts and issues	Mitigation Measures and/or Safeguards	Who Implements	Who Supervises	Budget (CNY1,000)					Subtotal (CNY1,000)
					County					
					Buerjin	Habahe	Fuhai	Jimunai	Qinghe / TLP	
	natural resources									
3.8 Environmental capacity	Insufficient environmental management capacity	Conduct training for environmental management and develop facility and staff setup.	IA and Operators, County EPB	County EPB, county PMOs	46	96	45.5	77.5	98	363
3.9 Unexpected environmental impacts		If unexpected environmental impacts occur during project operation phase, the IA will update the EMP, and environmental protection measures will be designed and resources will be utilized to cope with these impacts	IA and Operators, county PMO	XUAR PMO						Included in operational costs
Total					**970**	**1596**	**1135.5**	**1107.5**	**1358**	**6167**

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng E Institute and Zhonglanlianhai EIA Institute

ADB = Asian Development Bank, APMO = Altay Prefecture Project Management Office, EA = Executing Agency, EIA = Environmental Impact Assessment, EPB = Environment Protection Bureau, FB = Forestry Bureau, IA = Implementing Agency, LDI = Local Design Institute, PMO = Project Management Office, RP = Resettlement Plan, WRB = Water Resources Bureau, WWTP = Wastewater Treatment Plant, XUARG = Xinjiang Uygur Autonomous Region Government, XPMO = XUARG Project Management Office.

E. Environmental Monitoring

1. Monitoring Program

497. The Project monitoring program will focus on the environment within the project's area of influence. A detailed consolidated environmental monitoring program is summarized in Table I.4. The program considers the scope of monitoring, monitoring parameters and frequency, data processing, and quality control requirements.

498. **Internal monitoring.** The IAs will, at the outset of sub-component implementation, prepare detailed internal monitoring programs to be implemented by the contractors and Environmental Supervisors (under IAs) during construction and operation phases. These will be carried out more frequently than the (external) compliance monitoring programs. These monitoring programs and budgets will be included in the Project tendering documents and budgets, as well as in the construction and operation contracts.

499. **External (compliance) monitoring.** Licensed Environmental Monitoring Centers (EMCs) will carry out external monitoring on behalf of Altay Prefecture and the County Environmental Protection Bureaus (EPBs) during construction and operation. The external monitoring program is to ensure that the IAs and their contractors and operators are in compliance with PRC environmental standards and regulations. The Loan Implementation Environmental Consultant (LIEC) has an important role in coordinating these activities. The LIEC will also assist in interpreting and clarifying the application of mitigation measures and the monitoring of their outcomes.

500. **Environmental acceptance monitoring and audit.** Within 3 months after the construction completion or no later than 1 year, with the permission form the local environmental authority, the environmental acceptance monitoring and audit reports on the completion of the subcomponents will be (i) prepared by a qualified environmental institute in line with the People's Republic of China (PRC) regulation on project completion environmental audit (Ministry of Environmental Protection, formerly the State Environmental Protection Administration, 2001), (ii) reviewed and approved by the environmental authority that have approved the EIA reports, and (iii) finally submitted to the Asian Development Bank (ADB).

501. At the outset of each sub-component's implementation, the IAs will develop (i) a Project Design and Monitoring Framework (PDMF) to systematically generate data on inputs and outputs of the Project components, and (ii) detailed environmental and related socioeconomic indicators to measure impacts.

502. Under the PDMF, the IAs will report baseline and progress data at the requisite time intervals. The IAs will be responsible for analyzing and consolidating the data through their management information systems. The PDMF will be designed to permit adequate flexibility to adapt remedial action regarding design, schedules, activities, and development impacts.

2. Monitoring Management

503. During construction and operation phases, the IAs will make appropriate arrangements for internal monitoring according to the progress of implementation. The IAs may assign, employ or contract a team of environmental supervisors for the task. Monitoring reports will be made available to the Altay Prefecture/ County EPBs as required, on a monthly basis during construction. When complaints are received from the public (either directly or via the formal grievance redress mechanism), monitoring staff will conduct additional inspections immediately.

3. Monitoring Costs

504. Environmental monitoring costs are included in Table I.4. These are to be included in the construction contracts and counterpart budgets. Before implementing the monitoring plans, responsible parties will need to refine and confirm a detailed breakdown of the estimated budget. It should be noted that the IAs will pay for external, or compliance, monitoring although carried out on behalf of the EPBs. During implementation, the cost required can be adjusted based on actual requirements. If there are unpredictable environmental impacts found during the implementation of the environmental monitoring, EIA and EMP should be updated in timely manner and mitigation measures will be put forward to reduce the impacts to the environment.

Table I.4: Environmental Monitoring Program

	For all Components
	For Road Sub-Components only
	For Water Supply Sub-Components only
	For Wastewater Sub-Components only
	For Solid Waste Sub-Components only
	For Heating Sub-Components only

Item	Parameters	Location	Implementing Agency	Supervise Agency	Time and Frequency	Budget (CNY1,000)						
						County						Total
						Buerjin	Habahe	Fuhai	Jimunai	Qinghe	TLP	
1. Construction					**Construction monitoring costs are spread over the construction period**							
1.1 Work camp domestic wastewater quality	pH, SS, DO, NH_3-N, TP, BOD_5, COD_{Cr}, Total coliform, oil	Internal monitoring will be conducted at all construction sites and domestic wastewater discharge areas.	Internal monitoring: Contractors, IA / ES	IA	Random spot check of the domestic wastewater effluent sites (at least monthly)	30.5	41.5	31	38.5	33	8.5	183
		External monitoring will be conducted at selected camp sites.	External monitoring: Licensed EMC	County EPB	Twice per year	30.5	41.5	31	39	33	10	185
1.2 Construction wastewater and wastewater pollution mitigation measures	pH, SS, Oil	Internal monitoring will be conducted at all construction sites.	Internal monitoring: Contractors, IA / ES	IA	Random spot check of the wastewater effluent sites	14	26	16	28	21	4	109
		External monitoring will be conducted at selected sites	External monitoring: Licensed EMC	County EPB	Twice per year	14	28	18	28	21	4	113
1.3 Water quality of nearest water body	pH, SS, DO, NH_3N, TP, BOD_5, COD_{Cr}, Total coliform, oil	Internal monitoring will be conducted at all construction sites.	Internal monitoring: Contractors, IA / ES	IA	Random spot checks	35	5	4	1.5	7	3	55.5
		External monitoring will be conducted	External monitoring Licensed EMC	County EPB	Twice per year	35	5	4	1.5	7	3	55.5

		downstream of the construction sites										
1.4 Construction workers' drinking water source	Hardness, Mn, Fe, CCl_4, fecal coliform, chloride, sulfate, nitrate, residual chlorine	Drinking Water Source Areas or water supply (if imported)	Internal monitoring: Contractors, IA / ES	IA	Random spot checks	30	43.5	28	41	30	8.5	181
1.5 Air Air pollution prevention measures	Use of dust shrouds, water spraying. Maintenance and condition of vehicles and equipment. TSP, SO_x, NO_x	Internal monitoring will be conducted at all of the construction sites and sensitive receivers External monitoring will be conducted at work sites and sensitive receivers	Internal monitoring: Contractors, IA / ES	IA	Spot check the construction sites	27	43	30	35	30	8.5	173.5
			External monitoring: Licensed EMC	County EPB	twice per year during construction period, two samplings one day at each location each time	24	40.5	24	34	26	7	155.5
1.6 Noise Noise pollution control measures	Leq (dB[A])	Same locations as air quality monitoring	Internal monitoring: Contractors, IA / ES	IA	Random, but at least once monthly, one day each time and two samples each day: Once during daytime, once during night time	23	39.5	29	37.5	31	10.5	170.5
			External monitoring: Licensed EMC	County EPB	Random, but at least twice per year, a day each time and two samples each day: Once during daytime, once during night	26	39.5	31	38	32	11	177.5

					time							
1.7 Soil Erosion control measures	Topsoil stockpile, detention ponds construction, intercepting ditches, rehabilitate construction sites	All spoil disposal sites and construction sites	Internal monitoring: Contractors, IA / ES	IA	Random spot check, in rainy season and at least four times a year	9	17	10.5	18	12.5	3.5	70.5
			External monitoring: Licensed soil erosion monitoring unit	County EPB	Quarterly	9	17	10.5	18	12.5	3.5	70.5
	Compensatory plantings. Re-vegetation of spoil disposal sites and construction sites.	Disposal sites, quarry sites and, borrow pits	Internal monitoring: Contractors, IA / ES	IA	Random spot check	9	17	10.5	18	12.5	3.5	70.5
			External monitoring: Licensed soil erosion monitoring unit	County EPB	Quarterly	9	17	10.5	18	12.5	3.5	70.5
1.8 Hygiene and disease	Health status Hygiene status Availability of clean water, and medical advice HIV/AIDS awareness	Construction sites and work camps and resettlement areas	Internal monitoring: Contractors, IA	IA	Random spot check	17.5	22.5	15	18	14.5	3.5	91
			External monitoring: County Epidemic Prevention Departments	County EPB	Once a year	17.5	22.5	15	18	14.5	3.5	91
Subtotal						**360**	**466**	**318**	**430**	**350**	**99**	**2023**
2. Operation				**Operation phase costs are listed as recurring annual costs**								
2.1 Source water quality	Temperature, DO, SS, NH_3N, TN, TP, BOD_5, COD_{Cr}, fluoride, sulfate, nitrate, As, Hg, Gd, Cu, Mn, Se, Cu, Zn, Pb, Cr, Fe, chloride, oils	Source waterbody at capture point.	Internal monitoring: Operators, IA	Operator, County EPB	Four times a year	10	10		10	10	10	50
			External monitoring: Licensed EMC	County EPB	Four times a year	10	10		10	10	10	50
2.2 Downstream	Temperature, DO, SS, NH_3N, TN, TP,	Nearest river, downstream of treated	Internal monitoring: Operators, IA	Operator/ County EPB	Four times a year	10	10	10	10	10	10	60

surface water quality	BOD_5, COD_{Cr}, fluoride, sulfate, nitrate, As, Hg, Gd, Cu, Mn, Se, Cu, Zn, Pb, Cr, Fe, chloride, oils	effluent reuse for irrigation.	External monitoring: Licensed EMC	County EPB	Four times a year	10	10	10	10	10	10	60
2.3 Ground water quality	pH, NH3N, permanganate index, Cr(+6), As, Pb, Cd, Hg, volatile phenol, cyanide, fecal coliform, total hardness, chloride	One background well monitoring point (setup at 30～50m upstream of the direction of ground water under landfill site); one at the outlet of ground water main pipes of landfill site; two at a 30～50m distance of both sides of landfill site; two at a distance of 30m and 50m downstream of the direction of ground water under landfill site separately.	Internal monitoring: Operators	Operator/ County EPB	once per year	15	15	15	15	15		75
			External monitoring: Licensed EMC	County EPB	once every two years	7.5	7.5	7.5	7.5	7.5		37.5
2.4 Waste water effluent from offices	CODCr, BOD5, SS, NH_3-N, TP, TN, oil, fecal coliform	WTP management office	Internal monitoring: Operators, IA	County EPB	Spot check the disposal or treatment	1	1		1	1	1	5
			External monitoring: Licensed EMC	County EPB	Twice a year	2	2		2	2	2	10
2.5 Wastewater discharge from WWTP	pH, CODcr, SS, BOD_5, NH_3-N, TP	Effluent discharge point	Internal monitoring: Operators, IA	Operator/ County EPB	Four times a year	4	4	4	4	4	4	24
			External monitoring: Licensed EMC	County EPB	Four times a year	4	4	4	4	4	4	24
2.6 Landfill leachate quality	SS, CODcr, NH3-N, coliform bacteria, heavy metals	Landfill leachate monitoring point	Internal monitoring: Operators, IA	County EPB	once per year	10	10	10	10	10		50
			External monitoring: Licensed EMC	County EPB	once every two years	5	5	5	5	5		25
2.7 Air and	H_2S, NH_3	Upwind and downwind of the boundary of WWTP	External monitoring: Licensed EMC	County EPB	four times per year	20	20	20	20	20	20	120

noise	Odor concentration											
	CH_4, TSP, NH_3, H_2S, CO, SO_2, NO_2	Upwind and downwind of the landfill boundary	External monitoring: Licensed EMC	County EPB	four times per year	20	20	20	20	20		100
	Leq dB(A)	4 monitoring points located at 1m outside of the WWTP boundary	External monitoring: Licensed EMC	County EPB	Twice a year	4	4	4	4	4	4	24
	Leq dB(A)	8 monitoring points, within which, 2 located at management area and solid waste collection station, 4 located separately at east, west, south and north directions of landfill site, 2 located at transportation road route	External monitoring: Licensed EMC	County EPB	Four times a year	8	8	8	8	8		40
2.8 Solid waste	Implementation of sludge handling plan	At WWTP and other areas covered by the sludge handling and disposal plan	Internal monitoring: Contractors, IA	Operator	Spot check, twice a year	2	2	2	2	2	2	12
			External monitoring: Licensed EMC	County EPB	Spot check, once a year	1	1	1	1	1	1	6
	Solid waste constituents. Divide into organic, inorganic, recyclables, others	Solid waste transportation vehicles entering landfill site	Internal monitoring: Contractors, IA	County EPB	Conduct solid waste constituents monitoring and analysis once for each month. If abnormal situation occurs, strengthen monitoring and analysis, according to GB/T18772-2002	5	5	5	5	5		25
	Collection and treatment/ disposal plans of	Management offices and heating stations	Internal monitoring: Operators, IA	Operator	Random spot check, once a year				1	1		2

	the domestic solid waste produced (Heating)		External monitoring: Licensed EMC	County EPB	Random spot check, once a year				2	2		4
	Slag and coal ashes treatment/ disposal implementation plans (Heating)	Heating plant	Internal monitoring: Operators, IA	Operator	Random spot check, once a year				2	2		4
			External monitoring: Licensed EMC	County EPB	Random spot check, once a year				2	2		4
2.9 Soil and vegetation	Inspect vegetation survival and coverage rate.	Re-forestation sites (spoil disposal sites and construction sites)	Internal monitoring: Contractors, IA	County EPB	Spot check, once a year	8	14	8	2	4	2	38
			External monitoring: Licensed EMC	County EPB/FB	Spot check, every second year	4	9	4	1	2	1	21
2.10 Traffic flow	Vehicle numbers – road use (against predictions)	Subproject roads	IA, Township governments	Operator, TB	Road traffic monitoring program	1	1	1	1			4
2.11 Methane gas generation	CH_4、CO、H_2S	Methane gas collection and discharging pipes outlets	External monitoring: Licensed EMC	County EPB	Once per year	5	5	5	5	5		25
2.12 Fly density		Setup no less than 10 monitoring points within landfill site	Internal monitoring: Contractors, IA	County EPB	According to local climate characteristics, two times for each month during seasons when flies are active	6	6	6	6	6		30
Subtotal						**172.5**	**183.5**	**149.5**	**170.5**	**172.5**	**81**	**929.5 per yr**

Sources: PPTA Team; Altay Prefecture Government via Zhongsheng EIA Institute and Zhonglanlianhai EIA Institute

BOD_5 = 5-day biological oxygen demand, CCl_4 = carbon tetrachloride, COD_{Cr} = chemical oxygen demand, DO = dissolved oxygen, EMC = Environmental Monitoring Center, EPB = Environment Protection Bureau, ES =Environmental Supervisor, FB = Forestry Bureau, Fe = iron, IA = Implementing Agency, L_{eq} = noise unit, Mn = manganese, NH_3-N = free nitrogen, NO_x = nitrogen oxides, SO_x = sulfur oxides, SS = suspended solids, TP = total particles, TSP = total suspended particles, WRB = Water Resources Bureau; WWTP = Wastewater Treatment Plant.

F. Public Consultation

1. Public Consultation during Project Preparation

505. Three rounds of public consultation were conducted. These are described in Chapter G of this CEIA.

506. Direct public participation was conducted as an ongoing element in the development of the sub-components. These activities were carried out by the IAs in their preparation of the FSRs and EIAs and by the Technical Assistance (TA) Consultants following PRC National Environmental Impact Assessments Technical Guidelines and Asian Development Bank guidelines and the Safeguard Policy Statement (2009).

2. Future Public Consultation Plan

507. Future plans for public involvement during the detailed design, construction and operation phases were developed during the project preparation. These plans include public participation in (i) monitoring impacts and mitigation measures during the construction and operation stages, (ii) evaluating environmental and economic benefits and social impacts, and (iii) interviewing the public after the sub-components are completed.

508. Public participation plans are part of the project implementation and management plan. The IAs are responsible for public participation during project implementation. Costs for public participation activities during construction are included in the project funding. The unit costs are estimated as CNY 20,000 ($2,941) for each public investigation on a particular issue, CNY5,000 ($735) for each public workshop, and CNY6,000 ($882) for each press conference. The IAs will cover costs for public participation activities during operation.

Table I.5: Public Consultation Plan

Organizer	Approach	Times/Frequency	Subjects	Participants
Project preparation				
EIA preparation authors (Institutes)	Questionnaires and interviews	During field work for EIA	Project priority, effects, attitudes to the Project/components, and suggestions	Residents within subproject areas and construction area
TA Consultants, ADB	Site visits, and public consultations	Three rounds of formal consultation	Comments and recommendations of affected people and stakeholders	Representatives of affected people and stakeholder agencies
TA Consultants, APMO and county PMOs	Establish Grievance Redress Mechanism arrangements in each county	Ongoing	Pathway for complaints from and resolution of environmental problems in construction and operation	Affected persons, AP representatives and other stakeholders
Construction				
IAs, County PMOs	Public consultation and site visits	At least once a year	Adjusting mitigation measures if necessary, construction impacts, comments and suggestions	Work staff within construction area; Residents within construction area
	Expert workshop or press conference	As needed, based on public consultation	Comments and suggestions on mitigation measures, public opinions; adjusting mitigation measures accordingly	Experts from various sectors, media

Organizer	Approach	Times/Frequency	Subjects	Participants
	Public workshop	At least once a year	Adjusting mitigation measures if necessary, construction impacts, comments and suggestions	Representatives of residents and social sectors
Test Operation				
APMO, County PMOs, IAs, Operators	Site visits	Multiple, depending on results of Project completion environmental audit	Comments and suggestions on operational impacts, public suggestions on corrective actions	Local residents and social sectors, EPBs
Operation				
IAs	Public consultation and site visits	At least once	Effects of mitigation measures, impacts of operation, comments and suggestions	Residents adjacent to project sites
	Public workshop	As needed based on public consultation	Effects of mitigation measures, impacts of operation, comments and suggestions	Representatives of residents and social sectors
	Public satisfaction survey	At least once	Comments and suggestions	Project beneficiaries

EIA = Environmental Impact Assessment, IA = Implementing Agency, PMO = Project Management Office, TA = Technical Assistance.

Source: County PMOs

G. Environmental Responsibility for Implementation

509. All project components are located within the jurisdiction of Altay Administrative Offices and therefore AAOG will be the Project Executing Agency. However, the XUARG will have an overseeing and support role in the project implementation. A tiered management structure of project leading groups and project management offices have been established at the Xinjiang, Altay and county levels. The Altay PMO (APMO) will undertake detailed project coordination, engage and supervise the technical engineering design institutes, project implementation consultants, and external social and environmental monitors involved in the Project. Both the Xinjiang and Altay PMOs have previous experience in the implementation of ADB financed projects. The five county governments participating in the Project will be the implementing agencies (IAs) for the project components. Each county government has designated local agencies to be responsible for the operation and maintenance (O&M) of the facilities of each individual project sub-component. The designated agencies include existing and newly formed state-owned enterprises (SOE), public institutions (PI) and two private enterprises (PE) for the district heating components in Fuhai and Habahe. Of the SOEs only the Jimunai County Jiyun Municipal Construction Company is being specifically established for the purpose of project implementation and the others are existing SOEs already responsible for the relevant county services.

510. The IAs will each nominate dedicated, trained, and qualified environment specialists to undertake environmental management activities and ensure effective EMP implementation. Table I.6 shows the environmental responsibilities in different phases of the Project.

Table I.6: Environmental Responsibility

Phase	Responsible Agencies	Environmental Responsibility
Preparation	Design institutes on behalf of IAs	Prepare EIAs and EMPs for subprojects, conduct public consultation
	Xinjiang Autonomous Region EPB	Review and approve the sub-component EIAs and EMPs
	PPTA consultant	Provide technical assistance, review domestic EIAs, prepare consolidated EIA.
	ADB	Review and approve the consolidated EIA,including the integrated EMP
Design	Design Institutes on behalf of county IAs	Update the EMP in cooperation with EIA institutes, incorporate mitigation measures in the EMPs in engineering detail designs, and contracts
	IAs and County PMOs	Review and approve environmental measures
Tendering and contracting	County PMOs, IAs, contractors	Incorporate EMP clauses in RFPs and contracts
Construction	IAs and County EPB	Advise on implementation of mitigation measures and monitoring
	IAs and County PMOs	Conduct public consultation
	Contractors	Implement mitigation measures and internal monitoring
	Environmental Monitoring Centers, on behalf of County IAs	Undertake internal inspection and monitoring, and public consultation
	Environmental Monitoring Centers, on behalf of County EPB	Undertake external monitoring and inspect implementation of mitigation measures
Test Operation	Licensed environmental institute	Conduct Project completion environmental acceptance, including sampling, lab tests, and prepare Project completion environmental acceptance report
	AEPB	Review and approve Project completion environmental acceptance report, and promulgate corrective action orders if necessary
Operation	Operators	Ensure proper operation of component facilities according to design standards, and implementation of mitigation measures and public consultations
	IAs, ES (on behalf of IAs)	Undertake internal environmental monitoring and inspection, and public consultation
	County EPB	Undertake periodical and random environmental monitoring and inspect environmental compliance, supervise implementation of EMP, and conduct public consultations

ADB = Asian Development Bank, IA = Implementing Agency, EIA = Environmental Impact Assessment, EMC = Environmental Monitoring Center, EMP = Environmental Management Plan, EPB = Environmental Protection Bureau, ES = Environmental Supervisor (under IA), PMO = Project Management Office, XUAR EPB = Xinjiang Autonomous Region Environmental Protection Bureau.

Source: PMOs

511. The IAs will be largely responsible for environmental management and implementation of mitigation measures. They will ensure that the EMP is followed at the preparation, design, construction, and operation phases. Construction contractors will be responsible for implementing mitigation measures during construction, while the IAs and operators will be responsible for implementing such measures during operation. The IAs will be responsible for arranging environmental monitoring reviews and responding to any adverse impacts beyond those foreseen in the EIAs.

512. The Altay Prefecture EPB and county EPBs will ensure compliance with PRC and local environmental regulations through spot checks and regular environmental monitoring

and inspection during construction and operation (external monitoring). EPBs will review the effectiveness of regulations annually and modify if necessary, in accordance with applicable legal procedures. Appropriate penalties may be levied to the IAs, operators and contractors for non-compliance. The IAs will incorporate environmental management activities into construction management plans. The IAs, contractors and operators will be strengthened by environmental management training as summarized in Table I.7.

H. Institutional Strengthening and Training

513. The proposed project implementation arrangements are similar to those adopted by most ADB projects in the PRC and are therefore well proven. They are compatible with the hierarchical structure of government in the PRC and are understood to be similar to those used for earlier ADB financed urban development projects in XUAR. The main difference in the implementation arrangements from other similar projects is that responsibility for infrastructure construction has been separated from the O&M responsibility. The reason for this is that the existing O&M units (operators) currently have little or no infrastructure construction experience or capacity and are therefore not well-equipped to undertake the physical construction of the project assets.

514. In order to ensure that O&M considerations are properly taken into account in the project design, each operator is involved in the project preparations and the specification of the required infrastructure. It is proposed they will be similarly involved in detailed design review.

515. An assessment undertaken during the project preparatory technical assistance indicates that XUAR PMO and APMO have adequate technical and institutional capacities for Project implementation. However, the IAs and the operators have relatively weak capacity in environmental management and monitoring. For proper implementation of the EMP, it is necessary to strengthen the capacity of the IAs and the operators. The proposed training is shown in Table I.7.

516. It is considered that XUAR PMO, APMO, and IAs/operators—provides a reasonable framework for Project management and control. The definition of roles, responsibilities and relationships between the PMOs, IAs and operators, and other relevant agencies (e.g., XUAR EPB, Altay Prefecture EPB, County EPBs) is adequate to ensure the effective implementation of the Project.

517. Environmental specialists in the PMOs, IAs, operators, County EPBs and contractors will receive training in environmental management, environmental monitoring and supervision, mitigation planning, emergency response, environmental policymaking, and other environmental management techniques. The IAs and county EPBs will be offered EMP training that is specific to their roles on the Project. However, the main training emphasis (>50% of training budget) will be to ensure that contractors are well versed in environmentally sound practices and are able to undertake all construction with the appropriate environmental safeguards (see Table I.7 below).

518. Funding of this training will be included in the Project budget and in the operation and maintenance budgets during operation phase. The estimated costs for the institutional strengthening and training are shown for each county at Items 1.6 (Pre-construction) and 3.8 (Operation) of Table I.3 above.

Table I.7: Institutional Strengthening and Training

Training	Attendees	Contents	Timing
Environmental laws, regulations and policies	PMO, IAs/Operators, Contractors	(i) Environmental laws and regulations (ii) Environmental policies and plans (iii) Basic environmental management (iv) Emergency preparedness and response	Prior to Project implementation
EMP implementation	IAs, Contractors	(i) Responsibility and duties for the project construction, management and environmental protection (ii) Task of environmental protection in the project construction (iii) Key environmental protection contents etc. in project construction (iv) Various environmental reporting (v) EMP improvement and corrective actions	Prior and during Project implementation
Crisis handling	IAs/Operators, contractors	(i) Crisis handling methods	Prior to Project implementation
		Sub-total CNY 1,127,000 (see Item 1.6 in Table I.3)	
Advanced Training on Wastewater Treatment, Landfill management, management.	IAs, PMOs, Operators	(i) Study the basics of theory and practice, (ii) Training on the international experiences and best practices (iii) Operation, control and maintenance management	Prior to and at beginning of Project implementation
Environmental and Hygiene Awareness Program	IAs/Operators, contractors	(i) Water savings (ii) 3R's (reduce, reuse, recycle) (iii) Wastewater minimization (iv) Solid waste minimization (v) Community, household and personal hygiene	During Project implementation
Environmental aspects of facility operation and maintenance	IAs/operators, contractors and county EPB staff	(i) Environmental "housekeeping" (ii) Safety operation regulations (iii) Emergency preparedness and response procedures	Prior to and during Project implementation
Environmental monitoring, inspection and reporting	IAs/operators, contractors, County EPB	(i) Monitoring and inspection methods, data collection and processing, interpretation of data, reporting system (ii) Environmental reporting requirements	Prior to Project implementation
		Sub-total CNY 363,000 *(see Item 3.8 in Table I.3)*	
Total			CNY 1,490,000

EPB = Environment Protection Bureau, IA = Implementing Agency, PMO = Project Management Office

Source: county PMOs

I. Reporting and Supervision

1. Internal Monitoring Reports

519. During the construction period, results from the internal monitoring conducted by the contractors and the IAs will be reflected in the periodic construction reports (see **Table I.8**). The reports will summarize (i) environmental issues during construction; (ii) mitigation measures taken, if any; and (iii) consequences of the impacts on the environment and/or surrounding communities.

520. The contractors will be trained and mandated to take immediate actions to remedy unexpected adverse impacts or ineffective or inefficient mitigation measures. The IAs will also respond to these reports in order to ensure that contractors have taken appropriate and timely action. Additional measures may be taken, if needed, to ensure that all issues raised by the reports are appropriately addressed.

521. Results from the detailed internal environmental monitoring program and mitigation actions for the construction phase will be submitted weekly to IAs, monthly to the County EPBs, and two times a year to the county PMOs and APMO. The County EPBs may request that further environmental mitigation actions be taken, as they deem necessary, and may determine further mitigation measures for different stages, if necessary.

522. During the operational phase, internal monitoring of the functioning or performance of the subcomponents will be an integral part of responsible operational management. Monitoring of environmental parameters will be part of this and internal monitoring reports during operations will be used to adjust operations and will be forwarded to county EPB.

2. External (Compliance) Monitoring Reports

523. Environmental Monitoring Centers (EMCs) will be authorized to carry out compliance monitoring on behalf of County EPB during construction and operation. The contractors, operators and IAs will pay for their services as appropriate. The compliance monitoring reports will include (i) project background, (ii) construction and operation activities, (iii) environmental conditions, (iv) measurement or sampling locations, (v) analytical results, (vi) interpretation and implication of the monitoring results, (vii) determination of the compliance status with regard to applicable regulations and standards, and (viii) recommendations for improvement. These reports will be submitted 4 times per year to the County EPB with a copy to the County PMOs, who will send consolidated reports to the APMO and XPMO.

3. Reports to ADB

524. The XPMO will submit to ADB the EMP progress reports and information on Project implementation and the environmental performance of the contractors, operators and IAs (based upon reports it receives from the APMO). These reports will include (i) semi-annual environmental reports on EMP implementation, and (ii) environmental compliance monitoring and audit report of the completion of each major component. ADB may request that further environmental mitigation actions be taken, as they deem necessary, and may determine further mitigation measures for different stages, if necessary.

Table I.8: Reporting Plan

Reports		From	To	Frequency of reporting
Construction Phase				
Internal monitoring and inspection	Weekly internal monitoring reports by construction contractors	Contractors	IAs	Weekly
	Monthly internal monitoring reports by IAs (or through environmental supervision consultants contracted by IAs)	IAs	County EPB	Monthly
	Semi-annual internal and external environmental monitoring and inspection reports based on the monthly reports	County EPB	PMO	Twice a year
External monitoring and inspection	Semi-annual external environmental monitoring and inspection reports based on the monthly reports	County EPB	PMO	Twice a year
Reports to ADB	Semi-annual progress reports based on all the internal and external reports	PMOs in conjuction with LIEC	ADB	Twice a year
Operation				
Internal monitoring	Routine environmental monitoring reports	IAs/Operators	County EPB and PMO	Monthly
External monitoring and inspection	Environmental compliance reports	EMCs on behalf of County EPB	PMO	Quarterly
Reports to ADB	Semi-annual reports based on all the internal and external monitoring inspection reports during operations	PMOs in conjuction with LIEC	ADB	Yearly (for 3 years following commencement of operation)

ADB = Asian Development Bank, EMC = Environmental Monitoring Centers, EPB = Environment Protection Bureau, IA = Implementing Agency, LIEC = Loan Implementation Environmental Consultant, PMO = Project Management Office.

J. Work plan

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

526. Before operation, the IAs will develop detailed work plans for environmental management and monitoring during operation based on the EMP. These work plans will be submitted to the county EPBs to help them to supervise implementation.

K. Cost Estimates

527. Cost estimates for mitigation measures and monitoring plans are summarized in Table I.3 and Table I.4. The IAs will bear all compliance monitoring costs and will ensure the necessary budgets are available for the PMOs and the EMCs. Internal monitoring costs will be borne by the IAs and contractors during construction, and by the IAs during operation. Before implementing a monitoring plan, responsible agencies will present a more detailed breakdown of the estimated budget. During sub-component implementation, the budgets will be adjusted based on actual requirements.

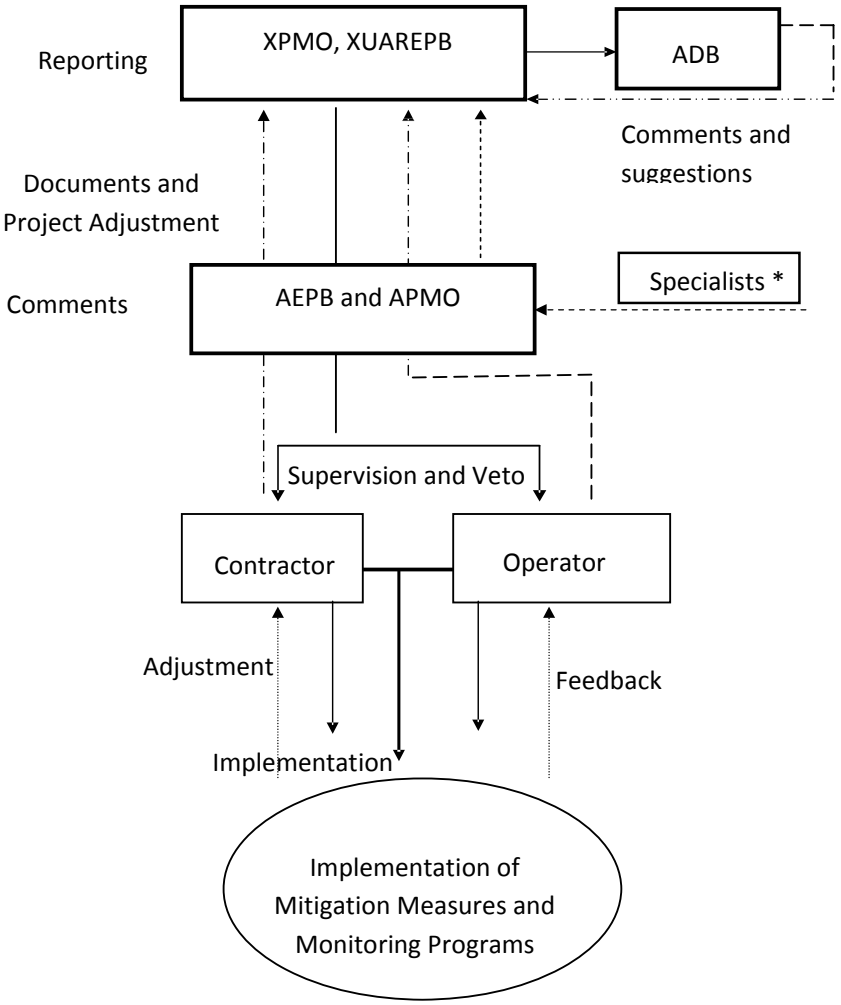
528. Contractors will bear the costs for all mitigation measures during construction, which will be included in the tender and contract documents. The IAs will bear the costs related to mitigation measures during operation and the costs related to environmental supervision

during construction and operation. The Project as a whole will bear the costs for training and the Loan Implementation Environment Consultant. Training programs budget will be included in the construction and operation contracts. During the operation phase the training budget will be included in the operation and maintenance budget.

L. Mechanism for Feedback and Adjustment

529. Based on the inspection and monitoring reports, environmental authorities will decide whether (i) further mitigation measures are required as corrective action, or (ii) some improvement is required to environmental management practices.

530. If it is found during inspection that there has been substantial deviation from the EMP or any changes made to the designs that may cause substantial adverse environmental impacts or increase the number of affected people, then the XUAR PMO should consult with environmental authorities and ADB immediately and form an environmental assessment team to conduct additional environmental assessment and, if necessary, further public consultation. The revised EIA report including EMP should be submitted to the environmental authorities for approval, and finally reported to ADB. The revised EMP will be passed to the environmental authorities for approval, and finally reported to ADB. The feedback and adjustment mechanism is shown diagrammatically in Figure I.1 below.



*: Environmental specialists from IAs and project environmental management consultants for project implementation

Figure I.1: Mechanism for Feedback and Adjustment of EMP

CHAPTER J. CONCLUSIONS AND RECOMMENDATIONS

531. The project has been planned to assist the people of five counties in northern Xinjiang, two of which are declared poverty counties, to raise their standard of living and economic prospects by the provision of essential urban and peri-urban infrastructure. The infrastructure subcomponents have also been selected and designed to provide significant environmental and socio-economic benefits for the target counties.

532. The potential environmental impacts arising from the implementation of the Project have been identified in twenty five individual EIAs and their findings integrated in this Consolidated EIA. During the feasibility and design phases of the subcomponents, many potentially significant impacts have been addressed by design features and operating regimes which avoid or minimize negative environmental effects. Construction impacts exist, but these are of a temporary nature and are covered by stringent site management and procedural provisions in the EMP. Finally, the monitoring of subcomponents in the construction and operational phases will check that the environmental performance of the Project remains high.

A. Benefits

533. All components will support approved development master plans. New roads, water supplies, sewerage and wastewater treatment plants, centralized heating facilities and landfills for solid wastes are planned for implementation in the counties of Buerjin, Habahe, Qinghe, Jimunai and Fuhai where local governments have shown interest and commitment.

534. Screening of the subcomponents was undertaken based on pre-selection criteria at fact-finding stage and selection criteria during the project preparatory TA stage. All counties in which components are proposed are autonomous, with ethnic minorities making up the majority of the population. The Project will improve the conditions of infrastructure and public amenities, increase employment and reduce the incidence of poverty, support tourism development to promote economic growth, and protect the environment in the participating counties. It is supportive of ADB's Country Strategy for the PRC to make markets work more efficiently through infrastructure development and to promote environmental sustainability and also of its Central Asia Regional Economic Cooperation strategy.

535. Cities of northern Xinjiang are centered on the sources of available water. Due to the concentration of urban and commercial development which is characteristic of these settlements, the new and upgraded roads, water supply, sewerage and wastewater treatment, heating and landfill facilities planned for the counties will bring benefits to all the city-dwellers. The majority of beneficiaries will receive multiple benefits from the combination of all subcomponents developed in their area. It is estimated that up to 19,000 households will have new access to wastewater services and 11,500 households will have new access to water supply. Because of the need to structure a network of connections focusing on specific neighborhoods, fewer household will benefit from new centralized heating connections (over 6,000 households). However all will benefit from improved garbage disposal and the increased capacity of urban roads to cope with traffic volumes.

536. The new water sources, treatment plants and expanded piped water supply coverage areas will reduce many households' dependence on potentially contaminated well water, improving water quality and creating a more reliable supply of domestic water. The improved wastewater disposal systems will result in cleaner and healthier living environment for town residents; elimination of occasional backflow of wastewater into buildings in some county seats, and reduced contamination of the underground water supply and/or of rivers.

537. Improved road networks will reduce traffic congestion, improve road safety conditions, facilitate the movement of residents, and, in some county seats, open up new

areas for urban expansion. Improved and expanded heating systems will result in energy savings, reduced air pollution, and reduced heating costs for those currently dependent on coal fires. Improved solid waste disposal will clean up urban areas and close down existing unsanitary landfills.

B. Impacts

538. **Design and Operation.** Impacts identified during the design and feasibility stages have been minimized through design revisions and site adjustments, and by the development of operational requirements which ensure a high level of environmental performance from the facilities.

539. Water availability for extraction without compromising beneficial downstream uses in normal and dry years has been confirmed through water balances for each water supply subcomponent. The impacts of water supply components of the major river systems have been checked by river basin analyses and shown to be negligible. At Takeshiken Landport the extraction point has been located far enough upstream (7 km) to avoid physical or hydrological impacts on the Provincial Beaver Protection Reserve. In the operational phase of all water supply subcomponents, watershed protection zone delineations and land use and pollution controls will be implemented.

540. The potential for new roads to open up areas for unplanned development or exploitation has been addressed by designing road subcomponents in connectivity networks to rationalize rather than extend traffic access. The exceptions are access roads to new plants (WTPs, WWTPs and landfills) which are to be covered by strict control of their use. In the operational phase traffic levels will be monitored and intersection and flow arrangements made as appropriate. Land use planning and development controls will respond to monitored traffic emissions and noise levels.

541. Environmental impacts inherent in the discharge of treated effluent from waste water treatment plants to receiving waters have been countered by the reuse of discharge water to provide irrigation for sand-stabilizing plants and windbreaks. In the dry desert environment, which pertains on the outskirts of the country seat urban areas, water for vegetation growth to combat desertification and to shelter residential areas from sand-laden winds has always been the limiting factor. Wastewater reuse in this way will therefore become a valuable element the region's sustainable development. Additionally, the development of new WWTPs will occasion the closure and rehabilitation of currently used, environmentally unsound sewerage treatment arrangements. In the operational phase of WWTP subcomponents, sludge treatment and disposal guidelines will be implemented, as well as odour control. Irrigation plans using the treated effluent will be formulated to suit local soil conditions.

542. The solid waste management and disposal subcomponents will introduce sanitary landfill technology to the counties, protecting groundwater and surface water resources by the containment of leachate. Operational management will focus on regular compaction and coverage of garbage and a small active tip face to minimize odor and wind-blown trash. Like the WWTPs, the implementation of new landfills will cause the closure and rehabilitation of existing poorly managed and sited landfills.

543. The new heating boiler subcomponents for Jimunai and Qinghe Counties include pollution control equipment with relatively low ratings for efficiency (65% for desulfurization and 90% for particulate scrubbers) but their proper maintenance is within the capabilities of plant staff. Point source emissions from new funded boilers comply with PRC atmospheric pollutant discharge standards. However, the induced environmental impact of all the heating subcomponents, including those only providing pipes to new areas, is the more significant effect. The new boilers will replace old, inefficient and polluting boilers resulting in net reductions in all emission levels. The expansion of areas covered by centralized heating

through new pipelines and heat exchange stations will phase out the domestic use of multiple small coal stoves for heating, again with net savings in emissions.

544. The facilities planned for the White Birch Forest in Habahe County are additional controlled access ways to protect natural areas and additional waste disposal services to safeguard the area's natural amenity in the face of rising visitor numbers. Operational maintenance is critical here to the sustainability of the subcomponent.

545. **Construction.** A range of potential construction impacts have been identified for all subcomponents. All will require earthworks, with potential for sediment runoff and erosion, and machinery operating on site with consequent noise, vibration and air emissions. Constructions will also generate construction wastewater and solid wastes. These impacts are mostly confined to short construction periods and as long as proper clean-up and site rehabilitation measures are implemented can be classed as temporary impacts. They are covered by stringent site management and procedural provisions in the EMP to ensure that impacts during the construction period are minimized and mitigated and that proper site restoration occurs at the completion of construction.

C. Environmental Health and Safety

546. This consideration combined occupational health and safety of staff/workers at the subcomponent facilities and community health and safety of people living nearby or potentially affected by failures or poor operation of facilities. The considerations of environmental health and safety in this CEIA include (i) an assessment of traffic accident hazards, including spillages of transported substances into waterways and emergency response planning; (ii) the on-site formulation, storage and handling of disinfection chemicals at WTPs, including staff emergency procedures; (iii) appropriate siting of WWTPs away from settlements; (iv) appropriate siting of landfills away from settlements; (v) CH4 monitoring of landfill surface atmosphere and downwind areas; (vi) personal noise protection gear for heating plant staff; and (vii) training and awareness programs for community (e.g road safety in schools) and facility operating staff.

D. Resettlement and Economic Displacement

547. Resettlement Plans ((RP) - one for each county) address the relocation and compensation needs of the 205 affected households and have identified resettlement site options. Detailed information will be collected for each site and the county governments will revise the draft RPs based on the physical indices survey and include details of the resettlement sites, location, number of affected households, and number of affected persons, land areas, and infrastructure plans. The RPs will be implemented in accordance with all applicable PRC laws and regulations, and ADB's Safeguard Policy Statement 2009.

548. The only potential economic displacement recorded during the course of the social impact assessment and resettlement planning was the effect of new solid waste disposal subcomponents on the informal scavenging industry. Latest investigations by PMO report no scavenger activity at current landfills, due to their significant distance from population centres. The county PMO advised that salaried landfill workers often separate "useful" waste for reselling and these activities will not be curtailed by the operational management of new landfills.

E. Climate Change

549. Climate change issues have been addressed by the Project. In total, the Project's subcomponents will achieve a net reduction of greenhouse gas emissions of 550,000 t/year of CO2e. This is mainly achieved by fuel savings from the roads component and the replacement of polluting equipment in the heating component. The subcomponents have been designed with climate change adaptation features. The water supply components will maintain supply in critically dry years and other infrastructure included design features for extreme weather events.

F. Risks

550. The majority of environmental risks relate to design features and operational plans which will avoid or mitigate impacts, but which rely on the IAs' commitment and capacity to implement and consistently follow-up. The remainder relate to the likelihood of unexpected negative impacts.

551. The risks are listed below under each subcomponent sector. Because of the multitude of subcomponents and the spread over different jurisdictions with different capacity levels, the list of potential risks is necessarily long. It should be noted that these risks do not pertain to every subcomponent.

Water Supply	Counties will not identify drinking water source protection zones (i.e. watershed management areas) in order to avoid the legal obligation to manage and monitor pollution sources
	Counties will not follow-through with appropriate water source protection activities after water source protection zones are delineated and declared
	Unforeseen impacts or developments indirectly facilitated by project infrastructure will cause ecological changes to the Xinjiang Beurgen River Beaver Natural Reserve in the long term
Roads and Pipelines	Spoil disposal will be unplanned and will occasion unacceptable environmental impacts
	Roads will become drainage washes for snow melt events
	Access roads to remote facilities (water extraction points and WTPs, WWTPs and landfills) will enable unplanned and uncontrolled exploitation of natural resources
Waste Water Treatment	Weaknesses in plant management may result in: • Poor maintenance and breakdowns • Low quality of treated water to irrigation • Improper sludge disposal
	The IAs will fail to safely rehabilitate existing settlement and oxidation ponds
	Irrigated windbreak forests are not well designed, and are implemented without irrigation plans which account for local conditions.
	Irrigation forests are not implemented on time.
	Pilot studies of sludge reuse on irrigation land will not be implemented or properly acted upon
Solid Waste/Landfill	The existing landfills will not be closed and rehabilitated to safely contain their pollutants and protect the surrounding environments.
	Poor or inadequately resourced on-site management will negate the engineered environmental protection measures
Heating	Management and maintenance of pollution control equipment is inadequate, resulting in emissions exceeding standards
	Demolition of replaced boilers will be undertaken without environmental safeguards or safe handling and disposal of waste
	Disposal of old household heating stoves will be undertaken without safe handling and disposal of waste
White Birch Forest	Weaknesses in maintenance may result in leakage of wastewater effluent

G. Assurances

552. The following assurances, addressing the risks identified above, should be incorporated into the loan documentation as loan covenants to ensure that the measures are implemented in a timely and complete fashion:

(i) A commitment from XUAR government and the respective subcomponent county governments on the declaration of water source protection areas, the delineation of water source protection zones, and the implementation of watershed protection regulations including the disclosure of land use and activity constraints before the processing of construction tenders.
(ii) The water balances in Chapter E confirm the adequacy of downstream flows for ecological function of the Xinjiang Beurgen River Beaver Natural Reserve after extraction. However, loan assurances will include a commitment to monitor the hydrological conditions of the habitat area and, in conjunction with Reserve managers, to respond to any changes.
(iii) A commitment to exercise strict control over the use of dedicated access roads to remote facilities and the protection of any natural resources in their vicinity.
(iv) A commitment that surplus spoil should be transported to suitable spoil disposal sites approved by the EPB.
(v) A commitment from XUAR government and the respective subcomponent county governments to adequately resource, train and support management and operational staff of WWTPs and landfill sites in environmental awareness and environmental management skills. (The TA has designed and scoped a capacity building program to support this).
(vi) A commitment from XUAR government and the respective subcomponent county governments for the preparation and implementation of time-bound landfill closure and rehabilitation plans before commissioning of new landfill sites.
(vii) A commitment from XUAR government and the respective subcomponent county governments for the preparation and implementation of time-bound closure and rehabilitation plans for existing settlement and oxidation ponds before commissioning of new WWTPs.
(viii) Commitments to prepare detailed irrigation plans to ensure that effluent flows are only released in accordance with horticultural needs and the available percolation rate at the time. Treated effluent should be contained in a bunded storage area to allow controlled release for irrigation.
(ix) Pilot projects for the use of stabilized sludge on irrigation forests in Buerjin and Takeshiken to be conscientiously undertaken and results reported to ADB through the routine project reporting
(x) The demolition of replaced boilers need to have approved EIAs and the demolition activities undertaken in compliance with standards for occupational health and safety and disposal of demolition wastes.

553. An additional assurance required is that XUAR Government and the subcomponent counties will undertake the full range of effective measures set out in the EIAs and EMPs to guarantee that the environmental management requirements and the environmental monitoring plan will be implemented effectively during project implementation, and that the implementation reports of the environmental management and monitoring plan in accordance with ADB requirements will be submitted in a timely fashion. Part of this monitoring and management commitment will be a commitment to implement and maintain appropriate Grievance Redress mechanisms in all project counties and covering the construction and operation of all project subcomponents.

H. Use of Irreplaceable Resources

554. The project infrastructure will occupy a total of 23 ha of agricultural land, 75 ha of wasteland/shrubland, 29 ha of community forest and 51 ha of grassland/meadow. Loss of these lands will have an environmental effect at the local level, and measures to minimize encroachment on natural areas and for the rehabilitation of damaged natural areas will be included in designs and construction contractual obligations. The loss of agricultural assets to developments has been calculated from the resettlement planning documents and field inspection. Farmers who lose land permanently will be compensated by replacement with land of equivalent quality and quantity, or through a lump sum payment. On the other hand, a total of about 1,000 ha of windbreak forest will be added in the five counties. Local, non-invasive native species will be used.

555. No rare, threatened, or protected species have been recorded at the project sites, and biodiversity values of the region will be unaffected. Extraction point of water supply project on the Buergen River has been selected to avoid impact on beaver habitat. No physical cultural resources have been recorded in or adjacent to the subcomponent localities.

I. Follow-Up Monitoring and Environmental Management Requirements

556. An EMP has been developed for the design, construction, and operation phases of the Project. The plan is appropriate for the environmental safeguarding of the planned works and forms part of a comprehensive set of environmental management documents. The EMP includes institutional responsibilities and costs for implementing the mitigation measures and the monitoring requirements.

J. Conclusion

557. It is concluded that the infrastructure subcomponents planned for the five counties will significantly benefit the populations of these areas, including the poor and vulnerable. It is also concluded that the design features and operational planning will minimize adverse environmental impacts and that the implementation of these features will be assured through loan assurances. It is further concluded that the design features, operational regimes and construction management safeguards will successfully address the range of potential environmental impacts and will be auctioned through the Project EMP and continuously checked in the environmental monitoring program.

APPENDIX 1. REFERENCES

A. Documents and Reports

Asian Development Bank. 2003. *Environmental Assessment Guidelines*. Manila.

Asian Development Bank. 2003. *Environmental Considerations in ADB Operations. Operations Manual, Section F1.* Manila.

Asian Development Bank. 2002. *Environment Policy of the Asian Development Bank.* Manila.

ADB 2008, *Strategy 2020, The Long-Term Strategic Framework of the Asian Development Bank 2008-2020*. Manila

ADB 2008, *Country Partnership Strategy, People's Republic of China 2008-2010*. Manila

ADB 2008, Climate Change Fund: Implementation Guidelines, 5

Asian Development Bank. 2009. *Safeguard Policy Statement*. Manila.

Asian Development Bank. 2006. *Environmental Assessment Guidelines in ADB Operations*. 1-175, Asian Development Bank.

Gatti, M 2007 *Best Practice in Water Supply and Sanitation: Learning from Successful Projects*, Asian Development Bank, Manila.

IFC/World Bank Group 2007, *Environmental, Health, and Safety (EHS) Guidelines*, Washington April 30, 2007

IFC/World Bank Group 2007, *Environmental, Health, and Safety Guidelines Waste Management Facilities*, Washington December 10, 2007.

IFC/World Bank Group 2007, *Environmental, Health, and Safety Guidelines Water and Sanitation*, Washington.

IFC/World Bank Group 2007, *Environmental, Health, and Safety Guidelines Plantation Crops*, Washington

Jackson, Sukhan and Adrian C. Sleigh (2001), *"The Political Economy and Socio-Economic Impact of China's Three Gorges Dam"*, Asian Studies Review, Volume 25, Number 1, March 2001, pp. 57-72 (16).

Jian Xie et al, 2009, *Addressing China's Water Scarcity*. World Bank, Washington.

National Development and Reform Commission 2007, *China's National Climate Change Programme*, Beijing June 2007

Pan B and Y Zhang 2002, Characteristics and conservation of biodiversity in Xinjiang, *Science in China (Series D)*, 45, December 2002.

Tennant, D L 1976. Instream flow regimens for fish, wildlife, recreation and related environmental resources. *Fisheries* 1(4): 6-10.

UNFCCC, 2009. Draft Bellagio Discussion Paper – Strategies for bringing land transport into the climate change negotiations.

World Bank, 2003. Environmental Flows: Concepts and Methods, *Water Resources and Environment Technical Note C.1*

World Wildlife Fund for Nature (WWF), 1996, Edited by Carey, Geoff 'A Biodiversity Review of China', World Wildlife Fund for Nature International China Programme.

B. National Laws, Regulations, and Policy Guidelines

1. Environmental Protection Law of the People's Republic of China (PRC) (26 December 1989)
2. Water Law of the PRC (1 October 2002)
3. Land Management Law of the PRC (29 August 1998)
4. Water and Soil Conservation Law of the PRC (29 June 1991)
5. Environmental Impact Assessment Act of the PRC
6. Water Pollution Prevention Act of the PRC (15 May 1996)
7. Solid Waste Pollution Control Act of the PRC (30 October 1995)
8. Noise Pollution Control Act of the PRC (29 October 1996)
9. Air Pollution Prevention Act of the PRC (29 April 2000)
10. Environmental Protection Management Regulations for Construction Projects, issued by the State Council of the PRC (December, 1998)

11. Environmental Protection Management Directories for Construction Projects (No.9, [1999]), issued by SEPA
12. Notice to Strengthen the Environmental Impact Assessment and Management of Construction Projects Financed by Loans from International Financial Organizations, jointly issued by SEPA, the State Planning Commission, the Ministry of Finance, and the People's Bank of China (21 June 1993)
13. Provision for Protecting Drinking Water Source Area, 1989, SEPA.

C. Standards and Technical Guidelines

1. Environmental Impact Assessment Technical Guideline (HJ/T2.1-2.3-93, HJ/T2.4-1995, HJ/T19-1997), issued by the State Environmental Protection Administration
2. PRC Provision of Public Consultations for Environmental Impact Assessment (SEPA, 2006)
3. Environmental Quality Standards for Surface Water of the PRC (GH3838-2002)
4. Discharge Standards of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002) and its Amendment (2006)
5. Water Quality Standards for Agricultural Irrigation (GB5084-92)
6. Integrated Emission Standards of Air Pollutants (GB16297-1996)
7. Ambient Air Quality Standards of the PRC (GB3095-1996)
8. Standards for Construction Noise Limits (GB12523-90)
9. Technical Code for Sanitary Landfill of Municipal Domestic Refuse (CJJ17-2004)
10. Technical Guideline for Delineating Source Water Protection Areas, SEPA, 2007
11. Technical Standard of Highway Engineering (JTJB01-2003)
12. Code for Seismic Design of Buildings (GB 50011-2001)
13. Code for Seismic Design of Highways (JTJ044-89)
14. Atmospheric Pollutant Discharge Standard for Boilers (GB13271-2001)

APPENDIX 2. CO_2 SAVINGS – ROAD SUBCOMPONENTS

Fuel Savings

During the feasibility study stage, the fuel consumption that will be generated by the traffic using the proposed road components has been briefly analyzed.

There are many factors that may affect the fuel consumption generated by the traffic on rural roads; the two major one are as follows:

(1) The fuel economy of the vehicles – The structure and manufacturing process of the vehicles determine this; the vehicle design will determine the energy use of the vehicles as manufactured.
(2) The running status of the vehicles – The actual running environment and the driving skills of the drivers determine this; the road design and management will determine this, involving four major aspects: (i) road conditions; (ii) vehicle features; (iii) traffic condition; and (iv) regional factors.

(i) Road conditions: including geometrical characteristics (radius of horizontal curve, longitudinal slope, curvature, road width, lateral clearance and cross slope etc) and road surface characteristics (smoothness)
(ii) Vehicle features: physical features and running features (engine power, rev and vehicle weight etc)
(iii) Traffic condition: the road service level, including motor vehicle flow, traffic composition, vehicle speed, non-motorized vehicle flow, pedestrians' interference and transverse interference, which cause the vehicles to accelerate or decelerate; stopping frequency. It costs less fuel than on an expressway. According to research, the fuel consumed by one starting and stopping operation is equivalent to that consumed when the vehicle runs 180 m. When the road condition and traffic condition change, the fuel consumption will change too. For roads with favorable road condition (smoothness, road width, horizontal and vertical alignment, etc.) and traffic conditions (fast and slow vehicles use separate lanes, non-motorized vehicles are separated, there is less transverse interference etc.), vehicles tend to have stable running status, with relatively less fuel consumption.
(iv) Regional factors: such as drivers' behavior and speed limit etc

For the Project, the TA Consultants adopted 'with and without project comparison' to carry out preliminary estimation of the fuel consumption calculation after the Project is completed. 'With project' refers to the vehicle fuel consumption situation when the Project is completed; 'without project' refers to the vehicle fuel consumption situation without the proposed Project. The fuel consumption disparity is the fuel saved. The preliminary estimations were made according to these different situations: i) fuel saved by the reduction of mileage and change of road condition; ii) fuel saved by the improvement of crowded road and traffic condition; and iii) fuel saved by the improvement of traffic condition caused by the upgrading of original roads.

The annual fuel consumption saved due to the 5 conties components are shown in the following table:

County	Road name	Road Grade	Construction Nature	Design speed(Km/h)	Q_t (AADT on 2015)	L(Km) Length of Road	F_0-F_n (L/car 100Km)	Q(10,000L) Annual fuel consumption saved
Buerjin	Youyifeng	Principal	Expansion	40	5861	0.68	4.48	648.27
	Yueliangwan	Secondary	Rebuilding	30	2652	1.47	4.48	639.93
	Shuanghubei	Secondary	Expansion	30	2459	1.03	4.93	456.79
	Wolongwan	Principal	Expansion	40	5892	0.83	4.80	853.28
	Hebin	Secondary	Rebuilding	30	2279	1.08	5.05	455.60
	Kanas	Principal	Expansion	40	1788	0.21	4.82	66.18
	Wucaitan	Principal	Rebuilding	40	3872	1.69	4.82	1153.06
	Shenxianwan	Secondary	New	30	397	0.11	4.81	7.59
	Baihuayuan	Secondary	New	30	517	0.38	3.85	27.36
	Xingjiang	Secondary	New	30	413	1.30	4.33	85.01
	Xingsheng	Secondary	New	30	438	1.35	4.62	99.86
	Minzu	Principal	New	40	817	1.61	4.43	212.19
Fuhai	Huancheng East	Secondary	Expansion	40	4808	1.53	4.59	1228.80
	Beixin	Collector	Expansion	30	2427	0.46	5.05	206.75
	Zhenxing East	Principal	Expansion	50	3720	0.88	4.65	553.42
	Xingfu	Collector	Expansion	30	2744	2.33	4.64	1080.64
	Tuanjie	Principal	Expansion	50	5579	0.82	5.05	846.44
	Wenxing	Principal	New	50	4941	1.40	4.81	1212.02
	Zongsi	Secondary	New	40	3280	1.20	4.33	622.26
	Hengsan	Secondary	New	40	5014	0.94	4.04	699.03
Habahe	Beihuan	Secondary	New	30	850	1.88	4.72	274.68
	Guihuasan	Secondary	New	30	766	1.87	4.62	241.30
	Tuanjie	Secondary	New	30	1083	0.62	4.52	110.80
	Wenhua	Principal	New	40	1333	0.62	4.43	133.18
	Xingfu	Secondary	New	30	1083	0.62	4.33	105.55
Jimunai	Guanghui	Principal	Rebuilding	40	2961	2.76	4.60	1371.99
	Caigang	Principal	Rebuilding	40	3285	2.16	4.87	1259.57
	Bian'an	Principal	Rebuilding	40	5030	2.04	4.09	1534.70
	Tuanjie	Secondary	Rebuilding	30	3662	2.75	4.81	1766.72
	Xingfu	Secondary	Rebuilding	30	2079	1.26	4.81	460.16
Takeshiken Port	Guihuaer	Secondary	New	30	665	0.62	4.75	70.96
	Guihuasan	Secondary	New	30	374	0.41	5.05	28.11
	Guihuawu	Secondary	New	30	457	0.23	4.72	18.44
	Wenhua	Principal	New	40	1123	1.64	4.65	313.09
	Zhongxin	Secondary	New	30	1123	0.21	5.05	42.59

Note: this calculation is based on the China respond plan to climate change National project and pilot provinces proposal report to compiled climate change, compiled by the national development and reform commission compiling in August 2010.

fuel consume in same speed 100 km means in plain hard roads, cars with most upscale and different speed run the distance using average driving speed, take an average trip, record oil consumption, then obtain the car fuel consume hundred km in different speed

Highway project in energy saving analysis is mainly fuel saving calculation quantity.

Highway project in energy saving analysis does not consider the energy saving of highway construction, only consider the energy saving of highway operation period, and calculate the evaluation period fixed by project design; that is the 15/20 years after project operation.

Research experience suggests that fuel consume is function of speed, and actual driving speed is concentrated reflection of traffic, traffic form and driving technology. Related research suggests different car types with lower speed increase the fuel consumption obviously when the speed is lower than normal speed; when the speed is higher than normal speed, the fuel consumption is also increased, and so there exists a fuel economy speed. Transverse interference is often difficult to determine, but its quantitative is already reflected in the average speed of highway, so highway project energy saving calculation is the calculation of fuel consumption in different speed.

In reference to China experience under the conditions of road, in combination with the conclusions of the fuel consumption and representative series, can get fuel consume rate about different type and different speed in senior high and high road surface. Highway project in energy saving is mainly fuel consume, combined by traffic prediction calculated assessment.

(1) Fuel saving calculation on new road

On new road fuel saving is after the implement of construction road, the fuel quantity because of the fuel consumption of unit mileage reduction. The calculation method is:

$$Q_1 = (F_0 - F_1) \times L_n \times Q_t \times 365 \times 10^{-4}$$

Where Q_1 is the Annual fuel consumption saved (10,000 l)

Q_t is the Numbers of AADT (Annual average daily traffic) on 2015

F_0 is when without the Project, the average fuel consume on the existing road (L/car 100km), the value is submitted by local traffic department (District/County).

F_1 is when with the Project, the average fuel consume on the new road (l/car 100km), the value is referred to the results on similarly road class and Consult experience.

L_n is the road design length (Km)

(2) Fuel saving calculation on existing high roads reduces congestion.

In the without Project condition, existing road traffic is improving, average driving speed is reducing, times of stop and brake is increasing. After the implement of planning construction highway, the original highway traffic generated transfer, thereby reducing the existing road congestion, the unit increasing fuel is no longer increases, driving conditions is improving, thus greatly improve the fuel economy.

Construction projects related to the original, highway traffic generated transfer part, thereby reducing the existing road congestion, the unit should increase fuel is no longer increases, driving conditions, thus greatly improve the fuel economy. The calculation method is:

$$Q_2 = (F_0 - F_1) \times L_n \times Q_t \times 365 \times 10^{-4}$$

Where Q_1 is fuel saving quantity of congestion reduction (10,000 l/y)

Q_t is the Number of AADT (Annual average daily traffic) on 2015

F_0 is when without the Project, the average fuel consumption on the existing road (L/car 100 km); the value is submitted by local traffic department (District/County).

F_1 is when with the Project, the average fuel consumption of related road (l/car 100 km); the value is referred to the results on similarly road class and Consultants' experience.

L_n is the road design length (km)

CO_2 Savings

To calculate the *CO_2* emission from a fuel the carbon content of the fuel must be multiplied with the ratio of molecular weight *CO_2* (*44*) to the molecular weight Carbon 12 -> *44 / 12 = 3.7*

Carbon Dioxide emission can be calculated as:

$q_{CO2} = c_f / h_f \, C_{CO2}/C_m$ *(1)*

where

q_{CO2} *= specific CO_2 emission (CO_2/kWh)*

c_f *= specific carbon content in the fuel (kg_C/kg_{fuel})*

h_f *= specific energy content (kWh/kg_{fuel})*

C_m *= specific mass Carbon (kg/mol Carbon)*

C_{CO2} *= specific mass Carbon Dioxide (kg/mol CO_2)*

Emissions of Carbon Dioxide – *CO_2* – in the combustion of some common fuels are indicated in the table below.

Fuel	Specific Carbon Content *(kg_C/kg_{fuel})*	Specific Energy Content *(kWh/kg_{fuel})*	Specific CO_2 Emission *(kg_{CO2}/kWh)*
Coal (bituminous/anthracite)	0.75	7.5	0.37
Gasoline	0.9	12.5	0.27
Light Oil	0.7	11.7	0.26
Diesel	0.86	11.8	0.24
LPG – Liquid Petroleum Gas	0.82	12.3	0.24

APPENDIX 3. IRRIGATION SPECIFICATIONS

A. Summary Table of the Planned Irrigation Forest relating Information

County	WWTP Capacity （m^3/d）	Annual Effluent Amount ($1\times10^4m^3$)	Annual Evaporation Amount ($1\times10^4m^3$)	Annual Irrigation Amount for forest ($1\times10^4m^3$)	Planned Forest Area (Hectare)	The area of the existing forest which can be used (Hectare)	The area of the forest which need to be planted (Hectare)
Buerjin	6,000	219	3.21	215.8	205	68	137
Habahe	8,000	292	3.8	288.2	274	34	240
Jimunai	5,000	182.5	3.4	179	170	0	170
Fuhai	7,000	255.5	3.7	251.8	240	0	240
Qinghe County Seat	4,000	146	1.98	144	137	20	117
Takeshiken landport of Qinghe	1,200	43.8	0.6	43.2	41	0	41

B. Wind-protection Forest Plantation Plan

Buerjin County

Item	Content	Index
Annual Effluent Amount from WWTP	$219\times10^4m^3$	Annual evaporation amount is $3.21\times10^4m^3$
The area of the planned Forest receiving all the effluent	205 Hectare	According to the standard irrigation quota, the gross irrigation quota for Xinjiang Poplar Tree, desertdate and Elm Tree of Altay Prefecture is $700m^3$/mu
The area of the existing forest which can be used	68 Hectare	
The area of the forest which need to be planted	137 Hectare	
Forest plantation location	Southwest of the WWTP	
The distance to effluent point of WWTP	2.0-3.0km	
The effluent transmission method	gravity	
The distance to surface water bodies	2-2.5km	
The ground water burial depth of forest plantation area	4.5-6m	
Vegetation/trees selection	Xinjiang Poplar Tree, desertdate and Elm Tree, etc. with anti-cold and anti-arid characteristics	Populus simonii, Ziziphus jujube, Ulnus pumila
Implementation schedule	Plantation will be implemented in five years since commencement of WWTP commissioning	

Habahe County

Item	Content	Index
Annual Effluent Amount from WWTP	$292\times10^4m^3$	Annual evaporation amount is $3.8\times10^4m^3$
The area of the planned Forest receiving all the effluent	274 Hectare	According to the standard irrigation quota, the gross irrigation quota for Xinjiang Poplar Tree, desertdate and Elm Tree of Altay Prefecture is

		700m³/mu/yr 10,500m3/ha/yr
The area of the existing forest which can be used	34 Hectare	
The area of the forest which need to be planted	240 Hectare	
Forest plantation location	Adjacent to WWTP	
The distance to effluent point of WWTP	0.5-1.0km	
The effluent transmission method	gravity	
The distance to surface water bodies	20km	
The ground water burial depth of forest plantation area	5-6.5m	
Vegetation/trees selection	Xinjiang Poplar Tree, desertdate and Elm Tree, etc. with anti-cold and anti-arid characteristics	
Implementation schedule	Plantation will be implemented in five years since commencement of WWTP commissioning	

Jimunai

Item	Content	Index
Annual Effluent Amount from WWTP	182.5×10⁴m³	Annual evaporation amount is 3.4×10⁴m³
The area of the planned Forest receiving all the effluent	170 Hectare	According to the standard irrigation quota, the gross irrigation quota for Xinjiang Poplar Tree, desertdate and Elm Tree of Altay Prefecture is 700m³/mu
The area of the existing forest which can be used	0	
The area of the forest which need to be planted	170 Hectare	
Forest plantation location	North of the WWTP	
The distance to effluent point of WWTP	0.1km	
The effluent transmission method	gravity	
The distance to surface water bodies	No surface water bodies	
The ground water burial depth of forest plantation area	no groundwater is found within 9 meter depth	
Vegetation/trees selection	Xinjiang Poplar Tree, desertdate and Elm Tree, etc. with anti-cold and anti-arid characteristics	
Implementation schedule	Plantation will be implemented in five years since commencement of WWTP commissioning	

Fuhai County

Item	Content	Index
Annual Effluent Amount from WWTP	255.5×10⁴m³	Annual evaporation amount is 3.7×10⁴m³
The area of the planned Forest receiving all the effluent	251.8 Hectare	According to the standard irrigation quota, the gross irrigation quota for Xinjiang Poplar Tree, desertdate and Elm Tree of Altay Prefecture is 700m³/mu
The area of the existing forest which can	0	

be used		
The area of the forest which need to be planted	240 Hectare	
The distance to effluent point of WWTP	0.2km	
The effluent transmission method	gravity	
The distance to surface water bodies	5.9km	
The ground water burial depth of forest plantation area	6-8m	
Vegetation/trees selection	Xinjiang Poplar Tree, desertdate and Elm Tree, etc. with anti-cold and anti-arid characteristics	
Implementation schedule	Plantation will be implemented in five years since commencement of WWTP commissioning	

Qinghe County Seat

Item	Content	Index
Annual Effluent Amount from WWTP	$146\times10^4m^3$	Annual evaporation amount is $1.98\times10^4m^3$
The area of the planned Forest receiving all the effluent	137 Hectare	According to the standard irrigation quota, the gross irrigation quota for Xinjiang Poplar Tree, desertdate and Elm Tree of Altay Prefecture is $700m^3$/mu
The area of the existing forest which can be used	20 Hectare	
The area of the forest which need to be planted	117 Hectare	
Forest plantation location	South of the WWTP	
The distance to effluent point of WWTP	2.0km	
The effluent transmission method	Lifting (pumping)	
- 与地表水体的距离 The distance to surface water bodies	0.8-1.6km	
- 种植地的地下水埋深 The ground water burial depth of forest plantation area	2-4m	
Vegetation/trees selection	Xinjiang Poplar Tree, desertdate and Elm Tree, etc. with anti-cold and anti-arid characteristics	
Implementation schedule	Plantation will be implemented in five years since commencement of WWTP commissioning	

Takeshiken Landport of Qinghe County

Item	Content	Index
Annual Effluent Amount from WWTP	$43.8\times10^4m^3$	Annual evaporation amount is $0.6\times10^4m^3$
The area of the planned Forest receiving all the effluent	43.2 Hectare	According to the standard irrigation quota, the gross irrigation quota for Xinjiang Poplar Tree, desertdate and Elm Tree of Altay Prefecture is $700m^3$/mu
The area of the existing forest which can be used	0	

Te area of the forest which need to be planted	41 Hectare	
Forest plantation location	South of the WWTP	
The distance to effluent point of WWTP	0.2km	
The effluent transmission method	gravity	
The distance to surface water bodies	3.0-3.5km	
The ground water burial depth of forest plantation area	3.6-4.5m	
Vegetation/trees selection	Xinjiang Poplar Tree, desertdate and Elm Tree, etc. with anti-cold and anti-arid characteristics	
Implementation schedule	Plantation will be implemented in five years since commencement of WWTP commissioning	

C. Soil types, salinity, permeability of different irrigation areas

Irrigation Site	Soil Type	Salinity	Percolation
Habahe	Brown calcic soil	0.084%～0.109%	1×10^{-7}cm/s
Jimunai	Brown calcic soil	0.084%-0.109%	15-20m/d (1.7×10^{-2}cm/s—2.3×10^{-2}cm/s)
Fuhai	Sandy brown desert soil	0.67%	4.15×10^{-5}—1.024×10^{-4}cm/s
Qinghe	Brown calcic soil	0.084%-0.109%	5×10^{-6}cm/s
Takeshiken Landport	Brown calcic soil	0.084%-0.109%	3.8m/d（4.39×10^{-3}cm/s)
Buerjin	Sandy brown desert soil	0.13%	1×10^{-1}—1×10^{-2}cm/s

APPENDIX 4. COAL AND EMISSIONS SAVINGS (DRAFT)

Coal Content Analysis for Qinghe County

Num.	Testing Index	Unit	Testing Value
1	Total Moisture（MT）	%	13.8
2	Total Moisture（Mad）	%	4.73
3	Ash（Aad)	%	12.52
4	Volatile Matter（Vdaf）	%	29.02
5	Characteristics of Charresidue（1-8）	/	2
6	Fixed Carbon（Fcad）	%	53.71
7	Hydrogen（Had）	%	3.87
8	Total Sulfur（Stad）	%	0.45
9	Calorific Value（Qgr，ad）	MJ/kg	23.10
	Calorific Value（Qnet，v，ar）	MJ/kg	21.99

Coal Content Analysis for Habahe, Jimunai and Fuhai County

Num.	Testing Index	Unit	Testing Value
1	Total Moisture（MT）	%	10.8
2	Total Moisture（Mad）	%	6.16
3	Ash（Aad)	%	13.13
4	Volatile Matter（Vdaf）	%	45.06
5	Characteristics of Charresidue（1-8）	/	2
6	Fixed Carbon（Fcad）	%	44.34
7	Hydrogen（Had）	%	5.15
8	Total Sulfur（Stad）	%	0.41
9	Calorific Value（Qgr，ad）	MJ/kg	27.09
	Calorific Value（Qnet，v，ar）	MJ/kg	24.71

A. Habahe

Currently, there are two heating plants in Habahe County. One is located in the south of the county seat and the other is located in the north of the county seat.
For this project,

One new 1×46MW(65t) boiler, which will be constructed by locals in the existing North heating plant, will be the heating source for this project mainly including heating pipes and heating exchange stations. The existing 1×10.5MW (15t) boiler and 1×14MW (20t) boiler in the north heating plant will be reserved as standby boilers. Thus, the heating source for this project will be the newly constructed 1×46MW (65t) boiler.

Currently, the central heating service area supplied by the north heating plant is 141,900m2, and after the implementation of the project, by 2015, the heating area supplied by the north heating plant will be 752,000m2.

Pollutants Emission prior to the Project (unit: t/a)

Table 1 Existing Central Heating

Boilers of the Existing Central Heating Source	Coal Consumption	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
1×10.5MW (15t) boiler and 1×14MW (20t) boiler	9342t+12456t =21798t	188.4 t/a	133.0 t/a	27643 t/a

Note: the pollutant amount calculation adopts dust removal rate of 70% and no desulfurization equipment

Table 2 Existing Small-sized Household Stoves (Removed or Demolished after the Project)

Small-sized Household Stove (one/per house) Reduced or demolished after the Project Implementation	Coal Consumption of the Small-sized Household Stove	Dust/Smoke Emission	Reduced SO_2 Emission	CO_2 Emission
1845	11254.5	324.3	68.7	14272

Note: Unit Coal consumption is 6.1t/a;

In flat areas, normally, the local household has two stoves. During summer, they use the stove in the kitchen room or storage room for cooking; and during winter, they use the stove in the resting room or other rooms for both heating and food cooking. Therefore, in summary, there is only one stove will be used through the year around.

Pollutants Emission after the Project Implementation (unit: t/a)

North heating plant (the new boiler will be constructed by locals) – the heating source for this project

Boilers	Coal Consumption	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
1 台 46MW（65t） 1×46MW (65t) boiler	21198	61.1	45.3	26882

Note: the pollutant amount calculation adopts dust removal rate of 90% and desulfurization rate of 65%

- The Coal saved after the implementation of the project will be 21798 + 11254.5 – 21198 = 11854.5t/a
- The Dust/Smoke Emission reduced after the implementation of the project will be 188.4 + 324.3 – 61.1 = 451.6t/a
- The SO_2 Emission reduced after the implementation of the project will be 133 + 68.7 – 45.3 = 156.4t/a
- The CO_2 Emission reduced after the implementation of the project will be 27643 + 14272 – 26882 = 15033t/a

B. Jimunai

Currently, the central heating service area for the whole county is 270,000m2, and after the implementation of the project, by 2015, the heating area supplied by the north heating plant will be 611,000m2.

Pollutants Emission prior to the Project (unit: t/a)

Table 1 Existing Central Heating

Boilers of the Existing Central Heating Source	Coal Consumption	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
1×7MW（10t）Boiler to be demolished in the north of County seat after the project	6228	53.8	37.9	7897
1×14MW（20t）Boiler to be reused in the north of	12456	107.7	75.9	15794

County seat after the project				
2×7MW（10t/set） Boilers to be demolished in the south of County seat after the project	12456	107.7	75.9	15794

Note: the pollutant amount calculation adopts dust removal rate of 70% and no desulfurization equipment

Table 2 Existing Small-sized Household Stoves (removed or demolished after the Project)

Small-sized Household Stove (one/per house) Reduced or demolished after the Project Implementation	Coal Consumption of the Small-sized Household Stove	Dust/Smoke Emission	Reduced SO_2 Emission	CO_2 Emission
1968	11808	340.2	71.9	14972

Note: Unit Coal consumption is 6t/a;

In flat areas, normally, the local household has two stoves. During summer, they use the stove in the kitchen room or storage room for cooking; and during winter, they use the stove in the resting room or other rooms for both heating and food cooking. Therefore, in summary, there is only one stove will be used through the year around.

Small-Sized Boilers (or decentralized heating boilers which are different central heating boilers)

Table 3 Existing Small-sized Boilers to be demolished after the Project

3 sets of boilers (two are 3t and one is 2t), totaling 8t	Coal Consumption of the Small-sized Boilers	Dust/Smoke Emission	Reduced SO_2 Emission	CO_2 Emission
	4982	43.1	30.4	6317.2

Pollutants Emission after the Project Implementation (unit: t/a)

Boilers for this project	Coal Consumption	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
The heating source for this project includes: 3×14MW （20t/set） Boilers	20001.8	57.6	42.7	25365

Note: the pollutant amount calculation adopts dust removal rate of 90% and desulfurization rate of 65%

- The Coal saved after the implementation of the project will be 6228 + 12456 + 12456 + 4982 + 11808 – 20001.8 = 27928.2t/a
- The Dust/Smoke Emission reduced after the implementation of the project will be 53.8 + 107.7 + 107.7 + 43.1 + 340.2 – 57.6 = 594.9t/a
- The SO_2 Emission reduced after the implementation of the project will be 37.9 + 75.9 + 75.9 + 30.4 + 71.9 – 42.7 = 249.3t/a
- The CO_2 Emission reduced after the implementation of the project will be 7897 + 15794 + 15794 + 6317.2 + 14972 – 25365 = 35409.2t/a

C. Qinghe

Currently, the central heating service area for the whole county is 421,300m2, and after the implementation of the project, by 2015, the heating area supplied by the north heating plant will be 1080,000m2.

Pollutants Emission prior to the Project (unit: t/a)

Table 1 Existing Central Heating

Boilers of the Existing Central Heating Source	Coal Consumption	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
1×29MW（40t） Boilers	27648	231.96	185.13	42469.7

Note: the pollutant amount calculation adopts dust removal rate of 70% and no desulfurization equipment

Table 2 Existing Small-sized Household Stoves Reduced or Demolished after the Project

Small-sized Household Stove (one/per house) Reduced or demolished after the Project Implementation	Coal Consumption of the Small-sized Household Stove	Dust/Smoke Emission	Reduced SO_2 Emission	CO_2 Emission
2156	11858	331.61	79.41	18214.9

Note: Unit Coal consumption is 5.5t/a;

In flat areas, normally, the local household has two stoves. During summer, they use the stove in the kitchen room or storage room for cooking; and during winter, they use the stove in the resting room or other rooms for both heating and food cooking. Therefore, in summary, there is only one stove will be used through the year around.

Small-Sized Boilers (or decentralized heating boilers which are different central heating boilers)

Table 3 Existing Small-sized Boilers to be demolished after the Project

11 boilers, totaling 45.6t, including 1×15t, 1×20t, 6t (2 sets), 3t (2 sets), 1×0.5t, 1×0.5t, and 0.6t (3 sets)	Coal Consumption of the Small-sized Boilers	Dust/Smoke Emission	Reduced SO_2 Emission	CO_2 Emission
	25215	211.54	168.84	38732.4

Pollutants Emission after the Project Implementation (unit: t/a)

Boilers for this project	Coal Consumption	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
1×46MW（65t） Boiler and 1×29MW（40t） Boiler, totaling 75MW and 105t	44381	124.11	104.01	68173

Note: the pollutant amount calculation adopts dust removal rate of 90% and desulfurization rate of 65%

- The Coal saved after the implementation of the project will be 27648 + 11858 + 25215 – 44381 = 20340t/a
- The Dust/Smoke Emission reduced after the implementation of the project will be 231.96 + 331.61 + 211.54 – 124.11 = 651t/a
- The SO_2 Emission reduced after the implementation of the project will be 185.13 + 79.41 + 168.84 – 104.01 = 329.37t/a
- The CO_2 Emission reduced after the implementation of the project will be 42469.7 + 38732.4 + 18214.9 – 68173 = 31244t/a

D. Fuhai County (heating pipes, no heating sources)

Pollutants Emission prior to the Project (unit: t/a)

Table 1 Existing Central Heating

Coal Consumption of the Existing Central Heating Source	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
3.12×10^4	172.06	139.75	18260.91

Note: the pollutant amount calculation adopts dust removal rate of 70% and no desulfurization equipment

Table 2 Existing Small-sized Household Stoves Reduced or Demolished after the Project

Small-sized Household Stove (one/per house) Reduced or demolished after the Project Implementation	Reduced Coal Consumption of the Small-sized Household Stove	Reduced Dust/Smoke Emission	Reduced SO_2 Emission	CO_2 Emission
1289	7269.96	209.49	44.38	9219.15

Note: Unit Coal consumption is 5.64t/a;

In flat areas, normally, the local household has two stoves. During summer, they use the stove in the kitchen room or storage room for cooking; and during winter, they use the stove in the resting room or other rooms for both heating and food cooking. Therefore, in summary, there is only one stove will be used through the year around.

Small-Sized Boilers

No Small-Sized boilers will be demolished or not used any more after the Project Implementation

Table 3 Reduced Pollutants from Central Heating Sources after the Implementation of the Project through the increasing heating efficiency (in this project, mainly through the heating pipe materials upgrading) (unit: t/a)

Reduced Coal Consumption	Reduced Dust/Smoke Emission	Reduced SO_2 Emission	CO_2 Emission
7871.8	43.41	35.26	4607.25

Note: the calculation is based on the reduced coal consumption, which has been calculated through the increasing heating efficiency (in this project, mainly through the heating pipe materials upgrading), and the reduced coal consumption equals the coal saved in the central heating source; then the pollutant amount calculation adopts dust removal rate of 70% and no desulfurization equipment

Pollutants Emission after the Project Implementation (unit: t/a)

Coal Consumption	Dust/Smoke Emission	SO_2 Emission	CO_2 Emission
23328.2	128.65	104.49	13653.66

- The Coal saved after the implementation of the project will be 7871.8 + 7269.96 = 15141.76t/a
- The Dust/Smoke Emission reduced after the implementation of the project will be 209.49 + 43.41 = 252.9t/a
- The SO_2 Emission reduced after the implementation of the project will be 37.9 + 44.38 + 35.26 = 79.64t/a
- The CO_2 Emission reduced after the implementation of the project will be 9219.15 + 4607.25 = 13826.

APPENDIX 5. BASELINE WATER QUALITY TABLES

Habahe County: Habahe River(see Chapter D, Section B)

Unit: mg/L (except pH)

Monitoring items	Monitoring results	Pollution index	Class II standard
pH	6.94	0.06	6～9
suspension	32.0	-	-
degree of mineralization	62.0	-	-
dissolved oxygen	10.40	-	≥6
index of permanganate	1.50	0.38	≤4
BOD_5	1.00	0.33	≤3
ammonia nitrogen	0.100	0.2	≤0.5
nitrate nitrogen	/	-	≤10
volatile phenol	0.001	0.5	≤0.002
cyanide	/	-	≤0.05
arsenic	/	-	≤0.05
mercury	0.00003	0.6	≤0.00005
hexavalent chromium	0.002	0.04	≤0.05
plumbum	0.005	0.5	≤0.01
cadmium	/	-	≤0.005
petroleum	0.005	0.1	≤0.05
COD	5.00	0.3	≤15
sulphate	/	-	≤250
chloride	/	-	≤250
selenium	/	-	≤0.01
cuprum	/	-	≤1
zincum	/	-	≤1
total nitrogen	0.205	0.4	≤0.5
total phosphor	0.019	0.19	≤0.1
fluoride	0.220	0.22	≤1
anionic surface active agent	/	-	≤0.2
sulfide	0.010	0.1	≤0.1
fecal coliform (number per liter)	130	0.065	≤2000

Fuhai County: Wulungu River (see Chapter D, Section B)

Unit: mg/L (except pH)

Monitoring site / Item	Wulungu River - Dingshan	Assessment index	Connecting point between large and small lakes of Wulungu Lake	Assessment index
pH	7.49	0.245	8.57	0.785
Permanganate index	2.20	0.367	7.70	1.283
BOD5	2.70	0.675	2.20	0.550
Ammonia nitrogen	0.080	0.080	0.384	0.384
Nitrate nitrogen	0.125	0.013	0.102	0.010
Volatile phenol	0.001	0.200	0.001	0.200
Cyanide	0.002	1.000	0.002	1.000

Arsenic	0.0018	0.036	0.00867	0.173
Mercury	0.00003	0.300	0.00003	0.300
Hexavalent chromium	0.002	0.040	0.002	0.040
Lead	0.05	1.000	0.005	0.100
Cadmium	0.00005	0.010	0.00005	0.010
Petroleum	0.005	0.100	0.033	0.660
CODcr	5.00	0.250	49.00	2.450
Sulphate	177.80	0.711	724.9	2.900
Chloride	47.40	0.190	534.9	2.140
Selenium	0.00003	0.003	0.00003	0.003
Copper	0.025	0.025	0.025	0.025
Zinc	0.025	0.025	0.025	0.025
Total nitrogen	0.264	0.264	1.353	1.353
Total phosphorus	0.072	0.360	0.089	0.445
Fluoride	0.350	0.350	2.78	2.780
Anionic surface active agent	0.025	0.125	0.025	0.125
Sulfide	0.010	0.050	0.010	0.050
Fecal coliform No. /L	20	0.002	20	0.002