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China-Qinghai Xining Water Environment Management Project

Environmental Impact Assessment

By: Environmental Quality Assessment & Research Center
(Class-A EIA Certificate No.3701, LDHP 2013) **of Lanzhou University**

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Project Name:	Qinghai Xining Water Environment Management Project
EIA Entrusted by:	Huangshui River Basin (Xining Section) Integrated Management Committee
Scope of EIA:	Community Area
EIA Institute:	Environmental Quality Assessment & Research Center of Lanzhou University
Legal Person of EIA Institute:	Zhou Xuhong
Responsible Person of EIA Institute:	Pan Feng (Professor)

EIA Task Team:

Position	Names	Title	EIA License No.	Responsibility	Signature
Responsible Person of Task Team	Yuan Jiuyi	Professor	A37010081000	Overall Responsibility	
Team Members	Chen Min	Associate Professor	A37010037	Chapters 1, 2, 4, 8	
	Yang Hong	Lecturer	A37010028	Chapters 3, 6, 11, 13	
	Wang Pengbo	Lecturer	A37010110700	Chapters 5, 7, 9, 10,12	
Reviewer	Tong Jilong	Associate Professor	A37010090900	Review of EIA	
Reviewer of Technical Committee	Pan Feng	Professor	A37010020400	Technical Review	

Project Implementing Unit:

Huangshui River Basin (Xining Section) Integrated Management Committee

Responsible Persons：

Wu Misen, Xu Jin

Staff Members:

Ma Guiqiang, Li Yajiao, Li Hui, Song Qingqin, Zhang Yongliang,
Chen Yan, Tan Guiqin, Gu Xipei

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1 General Introduction

1.1 Project Background

1.1.1 Description of the World Bank Loan Project Previously Implemented in 2009

Xining is the capital of Qinghai Province. With great support of provincial Development and Reform Commission, Xining started at the end of 2006 preparation of a World Bank loan funded project, i.e. Xining Flood and Watershed Management Project, the first standalone World Bank loan project of Qinghai Province, and the project was officially put into implementation at the end of 2009.

Xining Flood and Watershed Management Project was implemented in one city and three counties (i.e., Xining City, Datong County, Huangyuan County and Huangzhong County) and involved 6 components such as flood control and management, sewage collection, participatory small watershed management, institutional capacity building, resettlement and environmental management and project management, as shown in the following table (Table 1.1-1).

The above mentioned project has been successfully accomplished.

Table 1.1-1 Activities included in Xining Flood and Watershed Management Project

No.	Components	Activities	Description of Activities	Expected Results of Construction
1	Flood Control and Management	Gully Improvement: Gully mouth improvement and landscaping and recreation area development	Flood control embankment of 53.617 km in total along Beichuan River, Nanchuan River and mainstream Huangshui River; gully mouth section flood control construction of 35.006km in total for 28 gullies, and construction and development of 3 recreation areas totaling 2.62 km^2 in Xining City.	Flood control standard upgraded to 1 in 100 years for Xining, 1 in 50 years for the 3 counties and 1 in 30 years for the improved gullies.
		Development of flood early warning system	Information collection system, computer network system, information processing system and early warning information disclosure system	Flood control, early warning and protection capabilities of Xining greatly upgraded and losses of lives and property minimalized.
2	Sewage Collection	Xining City	Construction of 58.75km of sewage collection pipes	With newly built 72.5km of sewage and rainwater collection pipes, totally 66300m^3/d of wastewater can be intercepted at 103 discharge outlets.
		Huangzhong County	Construction of 3.2km of sewage and rainwater collection pipes	
		Datong County	Construction of 10.507km of sewage collection pipes	
3	Participatory Small Watershed Integrated Management	Water and soil conservation measures	Water conservation trees of 3019.82hm^2	Participatory small watershed management implemented in 17 small watersheds; water and soil erosion control coverage ratio increased from39.7% to79.7%;sediment load reduced by 658.5thousand tons; newly added water storage capacity of 1.6776 million m^3; per capita income increased from 3204 yuan to 3374 yuan.
		Engineering measures	3 medium size warp land dams, 4 small size warp land dams, 1087 check dams, 710m for slope improvement, 3 38.6km of rural roads, and reinforcement of 11 ponds.	
		Livelihood improvement measures	Terraces of 795.5hm^2, animal sheds of 67506m^2, 2048 biogas pits, 111 warm greenhouses, and 3996 solar stoves distributed to local farmer households.	
4	Institutional Strengthening and Capacity Building		Institutional strengthening and capacity building	Project management capacity enhanced
5	Resettlement and Environmental Management		Implementation of RAP and environmental management and monitoring tasks	RAP and EMP implemented
6	Project Management		Project management by PMOs and supporting expert panels	Project management tasks by PMOs and experts accomplished.

1.1.2 Origin of the Proposed Project

Under the previously implemented Xining Flood and Watershed Management Project, 17 small watersheds in the surrounding area of Xining were improved, a total of 72.5 km of sewage and rainwater collection pipes were installed to intercept 66,300 m^3/d of wastewater from 103 wastewater discharge outlets in Xining, and construction of embankment along some key river sections of Beichuan River, Nanchuan River and main stream Huangshui River and improvement of 28 gullies greatly upgraded flood control standard and protection capacity of Xining, as well as its flood early warning capacity.

Implementation of the project not only accomplished to a great extend a complete flood control system and a small watershed management system, which was not possible before the project due to financial limitation of Xining City, it also played an important role in bringing in new project concepts, staff training and capacity building, and therefore laid a good foundation to guarantee future development and implementation of other projects in Xining.

Thanks to national and the World Bank funded projects, a fundamental flood control system has been formed in Xining and a waste water collection pipe network has been installed in the main urban area of the city.

However, water quality of the rivers in the city is still not up to standard and water quality at Xiaoxiakou control cross-section is poor, characterized by serious pollution and higher sediment content. Currently, the main environmental problem with Xining can be summarized as ‘dirty water and turbid water’, which can be embodied in the following four aspects:

(1) Water pollution: direct wastewater discharge into river still exist in the suburb of Xining;
(2) Lack of environmental water: seasonal water shortage of rivers in Xining results in reduced overall assimilative capacity of the rivers and reuse of reclaimed water is still inadequate;
(3) Solid waste dumping into river, improper filling of river floodplain for land reclaimation, inadequate urban service infrastructure and poor living environment are problems found in some riverine areas of Xining City;
(4) River sediment problem: gravity erosion of the gullies in Xining is serious. Without adequate engineering facilities, rainwater washes sediment directly into rivers in rainy days. In the gully head areas, solid waste dumping and direct sewage discharge make the local environment lousy and unpleasant.

At the same time, water shortage is a serious challenge to Xining to cope with overall growth of future water demands, since its water resources utilization ratio is now 51.4% and available water resources are scarce.

Based on the current situation, the newly approved Xining City plan clearly states its objectives as ‘reaching waste water treatment ratio of above 90%,with a treatment capacity of 440 thousand m^3/day; reaching reclaimed water reuse ratio of above 30%, with a total reclaimed water amount of 164 thousand m^3/day; fully implementing river channel and river bank improvement; strengthening Huangshui River eco-environmental development and further upgrading vegetation coverage ratio; continuing to implement water and soil conservation and ecological recovery projects in watersheds of Xining City so as to reduce discharge of sediment and wastewater into the rivers'.

In order to realize the above objectives and address the problems of serious water pollution and water shortage, Xining City deems it appropriate and necessary to propose use of the World Bank loan to support an integrated environmental improvement project consisting of components of rainwater and sewage collection pipelines, integrated river bank environment improvement, reuse of reclaimed water, and integrated gully improvement. The proposed project has been listed by NDRC as the World Bank loan pipeline project.

In March 2013, Huangshui River Basin (Xining Section) Integrated Management Committee entrusted Environmental Quality Impact Assessment and Research Center of Lanzhou University to conduct environmental impact assessment of the proposed project. Following that, the task team of Lanzhou University conducted data collection and discussions on potential environmental issues relating to the proposed project, as well as field surveys and monitoring to the planned project sites, with cooperation and support of relevant local departments, and thereby prepared the report Environmental Impact Assessment for the project.

The task team expresses hereby its sincere gratitude to the Project Management Office and other relevant local departments for their great support and assistance it received in the preparation process of this report.

1.2 Purposes and Procedure of This EIA

1.2.1 Purposes of This EIA

(1) To conduct field surveys and assessment of natural and social environment of the evaluation scope, so as to evaluate current environmental quality and identify pollution sources and environmental problems in the evaluation scope;

(2) To conduct analyses of planned construction activities under the project, so as to understand types, concentrations, and discharge methods of pollution sources of the planned construction activities; use environmental impact prediction to analyze and evaluate the characteristics, scope and degree of the environmental impacts caused by the planned construction activities during their construction and operation;

(3) To analyze and expound environmental feasibility of the selected project sites based on Xining city plans, current status of environmental quality and impacts on

ambient environment caused by the planned constructions after completion;

(4) To discuss and expound feasibility of environmental improvement and up-to-standard discharge schemes of the project in line with local environmental protection requirements, economic development level.

(5) To propose practical pollution control measures for the planned project activities to control pollution discharges, and conduct technical and economic feasibility analyses to provide scientific reference for preliminary design, construction and environmental supervision of the planned construction activities;

(6) To avoid or mitigate impacts of the project construction on ecological, social and living environment in the project area through effective information disclosure and public consultation, to serve the purpose of implementing a harmonious and ecologically friendly project;

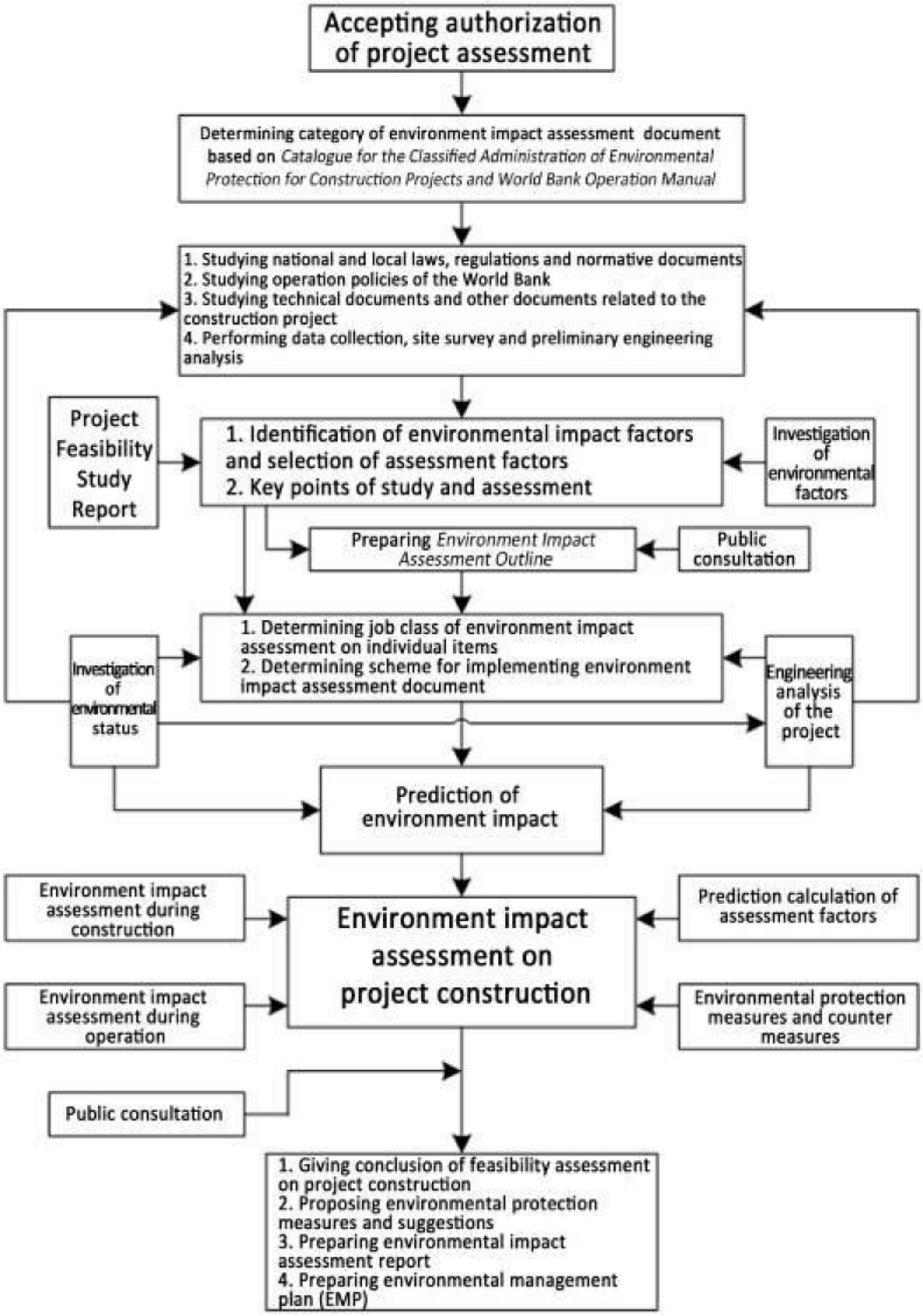
(7) To provide scientific reference for project environmental management and economic development planning by local environmental protection departments at all levels, so as to realize harmonious economic and environmental protection development;

(8) To draw a conclusion on whether the project is feasible from environmental perspective, and provide scientific reference for pollution control and environmental management under the project;

(9) To ensure that environmental impact assessment for the project is in compliance with both national and the World Bank’s requirements.

1.2.2 Procedure of This EIA

Procedure of This EIA is illustrated as follows (Figure 1.2-1).



* At least two rounds of public consultations (refer to the chapter about public consultation for detailed requirements)

Fig. 1.2-1 Working Procedures of Environment Impact Assessment

1.3 References Used in This EIA

1.3.1 Relevant National Laws and Regulations

(1) *Environmental Protection Law of the People's Republic of China,* December 26, 1989;

(2) *Environmental Impact Assessment Law of the People's Republic of China*, September 1, 2003;

(3) *Water and Soil Conservation Law of the People's Republic of China*, June 29, 1991;

(4) *Regulations for the Implementation of the Law on Water and Soil Conservation of the People's Republic of China*, August 1, 1993;

(5) *Land Administration Law of the People's Republic of China*, August 29, 1998;

(6) *Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution*, September 1, 2000;

(7) *Law of the People's Republic of China on the Prevention and Control of Water Pollution*, June 1, 2008;

(8) *Rules for Implementation of the Law of the People's Republic of China on the Prevention and Control of Water Pollution*, March 20, 2000;

(9) *Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes*, April 1, 2005;

(10) *Law of the People's Republic of China on Prevention and Control of Pollution From Environmental Noise*, March 1, 1997;

(11) *Law of the People’s Republic of China on Promotion of Cleaner Production*, June 29, 2002;

(12) *Law of the People's Republic of China on Conserving Energy*, January 1, 1998;

(13) *Law of the People's Republic of China on the Protection of Cultural Relics*, December 29, 2007;

(14) *Law of the People's Republic of China on the Protection of Wildlife*, August 28, 2004;

(15) *Law of the People's Republic of China on Wild Plants Protection*, January

1, 1997;

(16) *Regulations for the Implementation of the People's Republic of China on the Protection of Terrestrial Wildlife*, March 1, 1992;

(17) *Law of the People's Republic of China on Conserving Energy*, January 1, 1998;

(18) *National Programme for Ecological Environment Protection*, November, 26, 2000;

(19) *Regulations on the Administration of Construction Project Environmental Protection*, November 29, 1998;

(20) *Regulations on the Protection of Basic Farmland*, Order No. 257 issued by the State Council [1998];

(21) *Decision of the State Council on Several Issues Concerning Environmental Protection*, GF [1996] No. 31;

(22) *Transportation Construction Project Environmental Protection Management Law*, Order No.5 issued by the Ministry of Transportation [2003];

(23) *Notice on Further Strengthening Land Management and Protecting Farmland*, ZF [1997] No. 11;

(24) *Opinions of the State Council Concerning Several Policies on Promoting the Increase of Farmers' Income*, Order No. 1 issued by the Central Committee of the Communist Party of China [2004];

(25) *Emergency Notice on Resolutely Forbidding Occupying Basic Farmland for Tree Planting*, March 20, 2004;

(26) *Decision of the State Council on Implementing the Scientific View of Development and Strengthening Environmental Protection*, GF [2005] No. 39;

(27) *Catalogue for the Classified Administration of Environmental Impact Assessments for Construction Projects*, (Order of the Ministry of Environmental Projection of the People's Republic of China), 2009.10.

(28) *Catalogue for the Classified Administration of Environmental Protection for Construction Projects*, (2002.10.13);

(29) *Suggestions on Strengthening the Work of Water-Saving* (GJMZY [2000]

No. 1015);

(30) *China's Industrial Technology Policy* (State Economic and Trade Commission, Ministry of Finance of the People's Republic of China, Ministry of Science and Technology, State Administration of Taxation, 2002.6.21);

(31) *Notice on Strengthening Environmental Impact Assessment Management and Preventing Environmental Risk* (State Environmental Protection Administration, HF [2005] No. 152);

(32) *Temporary Methods of Public Consultation for EIA* (HF [2006] No. 28);

(33) *Industrial Structure Adjustment Catalogue* (Order No. 40 issued by National Development and Reform Commission [2005]);

(34) *Land Administration Law of the People's Republic of China*;

(35) *Regulations for the Implementation of the Land Administration Law of the People's Republic of China*;

(36) *Regulations Concerning the Expropriation and Compensation of Premises on Stated-owned Land*

1.3.2 Local Laws and Regulations

(1) *Methods of Qinghai Province to Implement the Land Administration Law of the People's Republic of China*;

(2) *Temporary Methods of Expropriation Management of Collective Land in Xining Municipality*;

(3) *Interim Provisions Concerning Compensation Standards for Expropriation of Collective Land in Xining Municipality*;

(4) *Regulation on the Dismantlement of Urban Houses in Xining Municipality*;

(5) *Notice on Issuance of the Standard of Compensation for Demolition and Relocation of Houses in Xining Municipality and the Rules for Price Evaluation*

1.3.3 Relevant Policies of the World Bank

(1) *Safeguard Policies of the World Bank;*

(2) *Environment, Health and Safety Guidelines (*EHS Guidelines*)*, International

Finance Corporation (IFC)

1.3.4 Technical Standards and Referential Documents

(1) *Technical Guidelines for Environmental Impact Assessment - General Programme*, (HJ2.1-2011);

(2) *Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment*, HJ/T2.2-2008;

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

(4) *Technical Guidelines for Environmental Impact Assessment - Acoustic Environment*, HJ/2.4-2009;

(5) *Technical Guidelines for Environmental Impact Assessment - Ecological Impact*, HJ/19-2011;

(6) *Technical Guidelines for Environmental Impact Assessment – Groundwater Environment*, HJ/610-2011;

(7) *Technical Regulation on Water and Soil Conservation Plan of Development and Construction Projects*, SL204-98;

(8) *Technical Specification for Comprehensive Control of Water and Soil Conservation*, SL/T16455-96;

(9) *Technical Guidelines for Environmental Risk Assessment on Projects*, HJ/T169-2004;

(10) *Ambient Air Quality Standard*, GB3095-2012;

(11) *Environmental Quality Standard for Surface Water*, GB3838-2002;

(12) *Environmental Quality Standard for Noise*, GB3096-2008;

(13) *Integrated Emission Standard of Air Pollutants*, GB16297-1996;

(14) *Maximum Allowable Concentration of Pollutants in Atmosphere for Protected Crops*, GB9137-88;

(15) *Integrated Wastewater Discharge Standard* (GB8978-1996);

(16) *Standards for Irrigation Water Quality* (GB5084-2005);

(17) *Standard for Pollution Control on the Storage and Disposal Site for General Industrial Solid Wastes*, GB18599-2001;

(18) *Standards for Classification and Gradation of Soil Erosion* (SL190-2007);

(19) *Proposals on Strengthening Management of Environmental Protection of Construction Projects in the Large-scale Development of the Western Region*, No.4 [2003] of the State Environmental Protection Administration;

(20) *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB 18918-2002)

(21) *Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Water Consumption* (GB/T 18920-2002)

(22) *Disposal of Sludge from Municipal Wastewater Treatment Plant - Quality of Sludge for Co-landfilling* (GBT 23485-2009)

1.3.5 Other Relevant Documents

(1) *Letter of Attorney for Environment Impact Assessment of Qinghai Xining Water Environment Management Project*

(2) *Proposal for World Bank Loan Funded Qinghai Xining Integraed Water Environment Management Project ,* CSCEC AECOM Consultants Co., Ltd.

(3) *Resettlement Plan of Qinghai Xining Water Environment Management Project,* Resettlement Center of Hoihai Univesity(4) *The 12th Five-Year Development Program for National Economy of Xining Municipality*

(5) *Integrated Management Plan for Water Environment of Huangshui River Basin (2011-2015)*

1.4 Environmental Function Zoning

(1) Function Zoning of Ambient Air Quality

According to function zoning of ambient air quality in Xining, each of the areas to be assessed is such area defined in Xining Municipality Plan as residential area, compound area of commercial, traffic and residential purposes, cultural area, or rural area, for which the Class II standards in *Ambient Air Quality Standard* (GB3095-2012) are adopted.

(2) Function Zoning of Surface Water

According to requirements as stated in *Function Zoning of Water Environment in Qinghai,* Xichuan section of Huangshui River to be assessed is Class IV water function area, the section below Beichuan River section to be assessed and above Sunjiazhai is Class III water area, and the section below Sunjiazhai is Class IV water area. Water function zoning in Qinghai is shown in Figure 1.4-1.

(3) Function Zoning of Ground Water

Referring to the zoning method of environmental function area in *Quality Standard for Ground Water* (GB/T14843-1993), the ground water in each area to be assessed is mainly used as centralized domestic drinking water and for industries and agriculture. It is determined as Class III water area.

(4) Function Zoning of Acoustic Environment

Referring to zoning method of acoustic environment function area in *Environment Quality Standard for Noise* (GB3096-2008), in the area of proposed project, the range 35m from both sides of trunk roads is Class 4a environmental function area. The area besides 35m on both sides of the trunk road is mainly functioned for commerce & finance & fair & trade or for resident & commerce & industry. Residential area requiring silence is Class 2 function area. Class 2 requirements on acoustic environment function area are implemented for the village where traffic artery passes through. The standard of daytime 60dB and nighttime 50dB is implemented for such special and sensitive buildings to be assessed as school and hospitals; Class 2 standard of acoustic environment quality is implemented for the area where re-use works of reclaimed water and lifting pump station are.

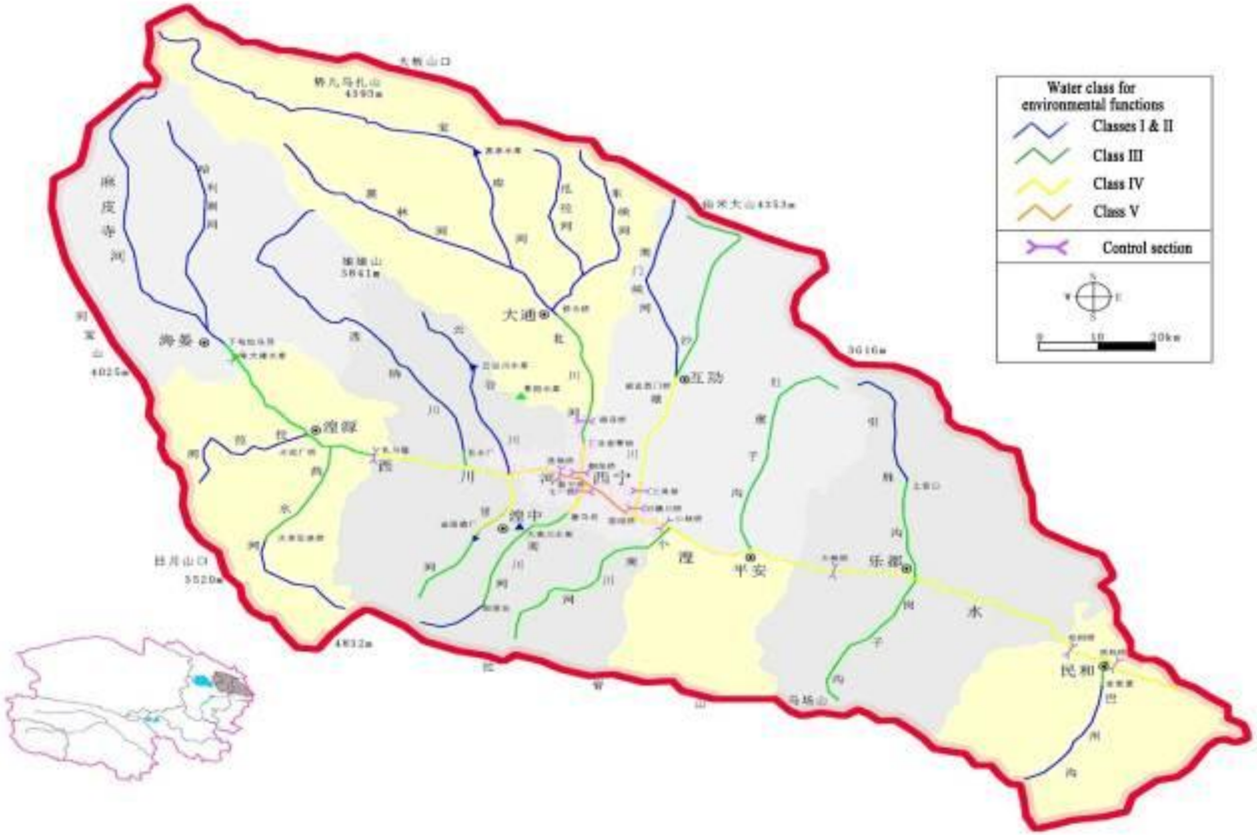


Figure 1.4-1 Water Function Zoning in Qinghai Province

1.5 Assessment Grade

According to grading principle of environmental impact assessment regarding atmospheric environment, surface water environment, acoustic environment, ecological environment and environmental risks as specified in *Technical Guidelines for Environmental Impact Assessment* (HJ/T2.1-93, HJ/T2.2-2008, HJ/T2.3-93, HJ/2.4-2009, HJ/19-2011, HJ/T169-2004 and HJ/610-2011), in combination with the engineering characteristics of proposed project, the assessment grade of each special subject in the project is determined.

According to composition characteristics of the project, in combination with current situation of environmental quality & water environment characteristic & water area function in assessment area, based on grading principle and determination index of environmental impact assessment as stated in *Technical Guidelines for Environmental Impact Assessment,* the grade of environmental impact assessment for each environmental factor is determined.

(1) Assessment grade of surface water environment impact: The proposed project includes pipe network works for urban wastewater collection, comprehensive renovation works for river bank environment, re-use works of reclaimed water and comprehensive treatment works for gully. After implementation of the proposed project, the wastewater to be directly discharged into Xichuan River and partial sections of Beichuan River can be effectively intercepted and discharged into the pipe network, so as to improve the urban water environment in Xining Municipality. Besides, after construction and operation of the proposed project, the wastewater treated by wastewater treatment plants can be reused, further reducing the pollutants discharged into Huangshui River and saving water resources.

No wastewater will be generated by the proposed project, and other wastewater collected will be delivered to urban wastewater treatment plants and will not be discharged into local water area, therefore according to *Technical Guidelines for Environmental Impact Assessment-Surface Water Environment* (HJ/T2.3-93), the assessment grade of the proposed project is lower than Grade 3. According to requirements as stated in the Technical Guidelines, for projects with assessment grade of surface water environment impact being lower than Grade 3, assessment of surface water environment impact may not be carried out, just some factors need to be briefly described as per provisions of environmental impact report, including pollutant type, quantity, water supply and drainage, drainage direction, and simple analyses on environmental impact need to be conducted.

(2) Assessment grade of ambient air: During construction of proposed project, the air pollutants mainly are construction fugitive dust and tail gas of transport vehicle; during operation, air pollutants mainly are vehicle tail gas on road network of Beichuan Area. For the proposed project, the road network in Beichuan Area is 27km long in total, including 8.452km of trunk roads, 1.549km of secondary trunk roads and 16.963km of branch roads. Pmax value (maximum ground concentration to standard concentration) of vehicle tail gas is far less than 10%. The terrain in Beichuan Area is flat with relatively good diffusion condition, and there are no other large stationary pollution sources in the project area, therefore, the assessment grade of atmospheric environmental impact is Grade 3 according to *Technical Guidelines for Environmental Impact Assessment-Atmospheric Environment* (). According to requirements as stated in the Technical Guidelines, prediction may not be carried out for atmospheric environmental impact. In this environmental impact assessment, analogy analysis is adopted to analyze environmental impact caused by vehicle tail gas during operation.

(3) Assessment grade of acoustic environmental impact: During construction of the proposed project, the noise source is mainly from mechanical noise in construction site with point source as the major. The point source is temporary noise source and will disappear after the end of construction. During operation, the noise source is mainly from the noise generated by submersible pump used in water reuse works of wastewater plant and the traffic noise on road network of Beichuan Area. According to grading basis of assessment as stated in *Technical Guidelines for Environmental Impact Assessment-Acoustic Environment* (HJ/2.4-2009), the increment of the noise impact generated by submersible pump used in water reuse works of wastewater plant is small and the population affected is also small. However, the road network in Beichuan Area is newly constructed road, and the area is currently used as land for urban planning and construction. The land is now empty without any people. The road here is designed according to planning and design for Beichuan Area, and the area is planned and positioned as a commercial, cultural, administrative and residential area. After construction of the proposed road, the people will be affected in relatively large scale, therefore, the assessment grade of acoustic environmental impact in proposed project is determined as Grade 2.According to requirements as stated in the Technical Guidelines, current situation of acoustic environment quality in project construction area shall be assessed, analysis on noise impact during construction shall be carried out, and impact caused by road traffic noise during operation shall be predicted by using noise pattern recommended in the Technical Guidelines.

(4) Ecological environment: *According to grading basis of assessment as stated in Technical Guidelines for Environmental Impact Assessment-Ecological Impact* (HJ/19-2011), the proposed project is municipal construction project and does not involve natural reserve, scenic area and other ecologically sensitive areas, thus the proposed project belongs to general area. The proposed project covers such linear works as pipe network and road, and some regional works including restoration of river bank environment and comprehensive treatment of gully. According to estimates, linear works of the proposed project have total length being less than 100km, treatment area being less than 20km^2. Besides, the restoration works of river bank environment are dominated by landscape engineering, which is conducive to the improvement of ecological system and environment quality. According to relevant provisions as stated in *Technical Guidelines for Environmental Impact Assessment-Ecological Impact* (HJ/19-2011), the assessment grade of the ecological environment is Grade 3. According to requirements as stated in the Technical Guidelines, the existing data shall be collected and used to assess the current situation of ecological environment in project construction area, and analysis shall be conducted for the impact of ecological system change caused by project construction.

(5) Environmental risk: Analysis shows that the main risk resources of the project are wastewater overflow caused by fracture of wastewater collection pipe network during operation period and traffic accident of vehicle transporting dangerous chemicals. There is no major hazardous source in the project and does not involve environmentally sensitive area, therefore, according to *Technical Guidelines for Environmental Risk of Construction Project* (HJ/T169-2004), the assessment grade of environmental risk for the proposed project is Grade 2.Assessment shall be conducted for risks generated by wastewater overflow and corresponding preventive measures shall also be put forward.

1.6 Assessment Scope

For better scientificity of the assessment and its accordance with sensibility of local environment, the assessment scope shall be determined according to engineering properties, field investigation results, influence area (including work development area, off-site works and relevant area affected by the project, such as borrow pit/ material yard, waste disposal site) and regional environmental characteristics of each project, with comparison of regulations in *Technical Guidelines for Environmental Impact Assessment* and relevant special assessment guidelines and reference to environmental impact assessment experience of equivalent development project. The assessment shall be performed according to basic requirements of guidelines. See Table 1.6-1 for determination principle of assessment scope and Table 1.6-2 for assessment scope.

Table 1.6-1 Determination Principle of Assessment Scope

Assessment Factor	Assessment Scope
Social Environment	Xining Municipality
Surface water	Determined according to wastewater characteristics, discharge, the way to discharge and characteristics of receiving water.
Underground water	Determined according to effects of project development on underground water quality and utilization of water resources.

Air	The area influenced by atmospheric pollution due to project development; It is determined according to current situation of the area where the project is located, atmospheric pollution sources and local weather and topographic conditions.
Acoustic environment	Determined according to applicable division of noise in the area where the project is located.
Solid waste	Environmental issues involved in collection, storage, transportation and final disposal of solid waste and the whole process of solid waste disposal
Ecosystem	The area influenced by the project development, following the ecological integrity principle

Table 1.6-2 Assessment Scope of Environmental Influence of Projects

Assessment Factor Project Name	Social Environment	Surface Water Environment	Underground Water Environment	Atmospheric Environment	Noise Environment	Solid Waste	Ecological Environment
Pipe network works for rainwater and wastewater collection	Administrative districts involved in the project	Surface water that 200 m within both sides of wastewater interception main	Underground water unit where the project development area is located	The scope of 200 m within boundaries at both sides of pipelines and roads	The scope of 200 m within boundaries at both sides of pipelines and roads	Relevant external field areas set for the project development, such as borrow pit, temporary soil storage yard, and collection, storage, transportation and disposal process of solid wastes	200 m within both sides of pipelines and roads (including external field areas such as borrow pit), following the ecological integrity principle. The scope is expanded properly in key region.
Low-impact development and environmental restoration works on river bank	Administrative districts involved in the project	Surface water involved in river bank training works	Underground water unit where the project development area is located	The scope of 200 m within boundaries of project area	The scope of 200 m within boundaries of project area	Relevant external field areas set for the project development, such as borrow pit, spoil ground, and collection, storage, transportation and disposal process of solid wastes	200 m within boundaries of project area, following the ecological integrity principle. The scope is expanded properly in key region.
Reclaimed water recycling works of wastewater treatment plant	Administrative districts involved in the project	Surface water of 200 m within the project area	Underground water unit where the project development area is located	200 m within reclaimed water plant and pipe network project	200 m within reclaimed water plant and pipe network project	Collection, storage, transportation and disposal process of construction wastes due to project development excavation	Project development area and off-site works such as temporary soil storage yard

Comprehensive management works for gully	Administrative districts involved in the project	Surface water involved in gullies	Underground water unit where the project development area is located	The scope of 200 m within project development area, mainly the influence during construction period	The scope of 200 m within project development area, mainly the influence during construction period	Relevant external field areas set for the project development, such as borrow pit, spoil ground, and collection, storage, transportation and disposal process of solid wastes	200 m within the project development area and off-site works involved in the project development, such as borrow pit

1.7 Assessment Standards

1.7.1 Quality Standards

(1) Atmospheric environment: Class-II standards in the *Ambient Air Quality Standard* (GB3095-2012) are applied for ambient air quality assessment. For details, see Table 1.7-1.

Table 1.7-1 Standards for Ambient Air Quality Assessment **Unit (ug/Nm^3)**

Name of Pollutant	Value-taking Time	Class II	Standard
NO_2	Annually average value	40	*Ambient Air Quality Standard* (GB3095-2012)
	Average value per 24 hours	80	
	Average value per hour	200	
SO_2	Annually average value	60	
	Average value per 24 hours	150	
	Average value per hour	500	
PM_{10}	Annual Average	70	
	Average value per 24 hours	150	
$PM_{2.5}$	Annual Average	35	
	Average value per 24 hours	75	
TSP	Annual Average	200	
	Average value per 24 hours	300	

(2) Acoustic environment: class-II standards in the *Environmental Quality Standard for Noise* (GB3096-2008) are applied for acoustic environment quality assessment. For roads with buildings mainly three-storey high or above at the side, class 4a standards in the *Environmental Quality Standard for Noise* (GB3096-2008) are applicable for acoustic environment quality assessment of the side area facing the buildings in the first row and class 2 standards for other area. For roads with buildings mainly less than three floors (including open ground) at the side, class 4a standards in the *Environmental Quality Standard for Noise* (GB3096-2008) are used for the area of 35m within the red line and class 2 standards for other area. For special and sensitive buildings within the assessment scope such as school, hospital and home for the aged, 60dB is enforced for outdoor area in the daytime and 50dB at night. Class 2 standards of the *Environmental Quality Standard for Noise* are applied for the place where wastewater reclamation plant is located according to relevant regulations in the *Environmental Quality Standard for Noise* (GB3096-2008). For details, see Table 1.7-2.

Table 1.7-2 Class-II Standards of the *Environmental Quality Standard for Noise* Assessment (GB3096-2008) Unit: dB (A)

Category of Standard	Daytime	Nighttime
Class 2	60	50
Class 4a	70	55

(3) Surface water: the *Environmental Quality Standard for Surface Water* (GB3838-2002) is applied for surface water assessment. Class III standards are applied for Huangshui River (Xichuan section), Beichuan River (assessment section) and class IV standards for Huangshui River (Dongchuan section). For details, see Table 1.7-3.

Table 1.7-3 *Environmental Quality Standard for Surface Water* (GB3838-2002)

(Unit: mg/L Except PH Value)

No.	Indicator/Standard Value		Class III	Class IV
1	Water temperature (℃)		Environmental temperature variation due to human activities shall be limited to: maximum weekly temperature rise ≤1; maximum weekly temperature drop ≤2	
2	PH value (dimensionless)		6-9	
3	Dissolved oxygen	≥	5	3
4	Index of permanganate	≤	6	10
5	Chemical oxygen demand (COD)	≤	20	30
6	Five-day biochemical oxygen demand (BOD_5)	≤	4	6
7	Ammonia nitrogen (NH_3-N)	≤	1.0	1.5
8	Total phosphorus (calculated based on P)	≤	0.2 (lake, reservoir 0.05)	0.3 (lake, reservoir 0.1)
9	Total nitrogen (lake, reservoir, calculated based on N)	≤	1.0	1.5
10	Chrome (hexavalent)	≤	0.05	0.05
11	Lead	≤	0.05	0.05
12	Cyanide	≤	0.2	0.2
13	Volatile phenol	≤	0.005	0.01
14	Petroleum	≤	0.05	0.5
15	Fluoride (calculated based on F)	≤	1.0	1.5
16	Sulfide	≤	0.2	0.5

No.	Indicator/Standard Value		Class III	Class IV
17	Mercury	≤	0.0001	0.001
18	Copper	≤	1.0	
19	Zinc	≤	1.0	2.0
20	Selenium	≤	0.01	0.02
21	Arsenic	≤	0.05	0.1
22	Cadmium		0.005	0.005

Note: Refer to standard limits of specific items about central living drinking surface water source for standard values of benzene, methylbenzene, dimethyl benzene, benzopyrene and methyl aldehyde.

(4) Groundwater: Class-III standards of the *Quality Standard for Groundwater* (GB/T14848-93) are applied for groundwater assessment. For details, see Table 1.7-4.

Table 1.7-4 *Quality Standard for Groundwater* (GB/T14848-93)

(Unit: mg/L Except PH Value)

Assessment Item	Standard (mg/L)	Assessment Item	Standard (mg/L)	Assessment Item	Standard (mg/L)
PH	6.5-8.5	Fluoride	≤1.0	Lead	≤0.05
Ammonia nitrogen	≤0.2	NO^{3-}	≤20	Cadmium	≤0.01
Index of permanganate	≤3.0	NO^{2-}	≤0.02	Arsenic	≤0.05
Total hardness	≤450	Manganese	≤0.1	Mercury	≤0.001
Chloride	≤250	Zinc	≤1.0	Petroleum	≤0.05
Cyanide	≤0.05	Copper	≤1.0	Benzene *	≤0.01
Volatile phenol	≤0.002	Selenium	≤0.01	Methylbenzene *	≤0.7
Total coliform group	≤3.0 Nr./L	Sulfide *	≤0.02		

1.7.2 Discharge Standard

(1) *Discharge Standards of Pollutants from Urban Wastewater Treatment Plant* (GB18918-2002) is used for tail water discharge of wastewater treatment plant planned in the proposed project, and *Emission Standards for Odor Pollutants* (GB14554-93) for emission of odor gases, *The Disposal of Sludge from Municipal Wastewater Treatment Plant - Quality of Sludge for Co-Landfilling* (GB/T 23485-2009) for sludge discharge. Dewatering of sludge from municipal wastewater treatment plant should be conducted. After dewatering, water percentage of the sludge should be lower than 80%. *Emission Standards for Odor Pollutants* (GB14554-93) is applied for emission of odor gas from the reclaimed water plant proposed to be located in the wastewater treatment plant.

Table 1.7-5 Discharge Standards of Pollutants from Urban WWTP
(Daily Average Value) Unit: mg/l

<table>
<tr><th rowspan="2">No.</th><th rowspan="2" colspan="2">Basic Control Item</th><th colspan="2">Class-1 Standards</th></tr>
<tr><th>A</th><th>B</th></tr>
<tr><td>1</td><td colspan="2">Chemical oxygen demand (COD)</td><td>50</td><td>60</td></tr>
<tr><td>2</td><td colspan="2">Biochemical oxygen demand (BOD_5)</td><td>10</td><td>20</td></tr>
<tr><td>3</td><td colspan="2">Suspended solid (SS)</td><td>10</td><td>20</td></tr>
<tr><td>4</td><td colspan="2">Animal and vegetable oils</td><td>1</td><td>3</td></tr>
<tr><td>5</td><td colspan="2">Petroleum</td><td>1</td><td>3</td></tr>
<tr><td>6</td><td colspan="2">Anionic surfactant</td><td>0.5</td><td>1</td></tr>
<tr><td>7</td><td colspan="2">Total nitrogen (calculated based on N)</td><td>15</td><td>20</td></tr>
<tr><td>8</td><td colspan="2">Ammonia nitrogen (calculated based on N) ②</td><td>5(8)</td><td>8(15)</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Total phosphorus (calculated based on P)</td><td>Developed before Dec. 31, 2005</td><td>1</td><td>1.5</td></tr>
<tr><td>Developed since Jan. 1, 2006</td><td>0.5</td><td>1</td></tr>
<tr><td>10</td><td colspan="2">Chroma (dilution ratio)</td><td>30</td><td>30</td></tr>
<tr><td>11</td><td colspan="2">pH</td><td>6-9</td><td>6-9</td></tr>
<tr><td>12</td><td colspan="2">No. of fecal coliform group (Nr./ l)</td><td>10^3</td><td>10^4</td></tr>
</table>

Notes: ① In following cases, removal rate indicators shall be: when influent COD is more than 350mg/l, the removal rate shall be more than 60%; when BOD is more than 160mg/l, the removal rate shall be more than 50%.
② Values outside the brackets are the control indicators when the water temperature is more than 12 ℃, and those inside are the control indicators when the water temperature is not more than 12 ℃.

Table 1.7-6 Emission Standard of Odor Pollutants Unit: mg/m^3

No.	Control Item	Primary Standard	Secondary Standard	Level 3 Standard
1	Ammonia	1.0	1.5	4.0
2	Sulfuretted hydrogen	0.03	0.06	0.32
3	Odor concentration (dimensionless)	10	20	60
4	Methane (maximum volume concentration in the plant area %)	0.5	1	1

Table 1.7-7A Basic Indicators and Limits

No.	Basic Indicator	Limit
1	Water percentage of sludge/ %	<60
2	PH	5-10

3	Mixing ratio/ %	≤8
Note: For the PH indicators in the table, it is not limited to the measure that using hydrophilic materials (such as lime) to mix with sludge to reduce water content in sludge.		

Table 1.7-7B Pollutant Indicators and Limits

No.	Pollutant Indicator	Limit
1	Total cadmium (mg/kg dry sludge)	<20
2	Total mercury (mg/kg dry sludge)	<25
3	Total lead (mg/kg dry sludge)	<1000
4	Total chromium (mg/kg dry sludge)	<1000
5	Total arsenic (mg/kg dry sludge)	<75
6	Total nickel (mg/kg dry sludge)	<200
7	Total zinc (mg/kg dry sludge)	<4000
8	Total copper (mg/kg dry sludge)	<1500
9	Mineral oil (mg/kg dry sludge)	<3000
10	Volatile phenol (mg/kg dry sludge)	<40
11	Total cyanide (mg/kg dry sludge)	<10

(2) Re-use Standard of reclaimed water: See Table 1.7-8 for standards for reuse of reclaimed water as urban municipal miscellaneous water.

1.7-8 Standard for Reuse of Reclaimed Water as Urban Municipal Miscellaneous Water

No.	Item Indicator	Toilet Flushing	Road Cleaning, Fire Prevention	City Greening
1	PH	6.0~9.0		
2	Chroma ≦	30		
3	Smell	No displeasure		
4	Turbidity (NTU) ≦	5	10	10
5	Total dissolved solid (mg/l) ≦	1500	1500	1000
6	BOD_5 (mg/L) ≦	10	15	20
7	Ammonia nitrogen (mg/l) ≦	10	10	20
8	Anionic surfactant (mg/l) ≦	1.0	1.0	1.0
9	Iron (mg/L) ≦	0.3	-	-
10	Manganese (mg/l) ≦	0.1	-	-
11	Dissolved oxygen (mg/l) ≧	1.0		
12	Total residual chlorine (mg/l)	More than 1.0 after 30 min of contact and more than 0.2 at ends of pipe network		
13	Total coliform group (Nr./ L)	3		

(3) *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011) is applied for assessment of noise during construction period. For details, see Table 1.7-9.

Table 1.7-9 *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011)

Standard Value LAeq (dB)	
Daytime	Nighttime
70	55

(3) See Table 1.7-10 for class 2 standard in the *Standard of Noise at Boundary of Industrial Enterprises* (GB12348-2008).

Table 1.7-10 Standard of Noise at Boundary of Industrial Enterprises Unit: dB (A)

Category	Daytime	Nighttime
2	60	50

1.7.3 Safeguard Policies of the World Bank

(1) Interviews and Filed Survey

The proposed project is mainly located in the urban area and peripheral main gullies in Xining Municipality. After field survey, no natural habitat or cultural relic unit is found. Neither the sensitive area, such as natural reserve, drinking water source and forest, nor cultural relic on the ground surface, such as place of interest and religious site is involved.

After the field survey, accompanied by the staff of Huangshui River Basin (Xining Section) Integrated Management Committee, the task team interviewed relevant units, such as Xining Municipal Culture Radio and Television Bureau, Xining Forestry Bureau, Agriculture and Animal Husbandry Bureau in Xining Municipality and investigated the project influence area. According to consultation and site visit, it is affirmed that there is no natural habitat or cultural relic unit in the area involved in the project. See Attachment II for certificate provided by relevant units.

(2) Safeguard Policies Triggered

World Bank operational policies triggered by the project are marked with a tick in the following table (Table 1.7-11).

Table 1.7-11 World Bank Operational Policies

World Bank Operational Policies		Whether or not triggered	Remarks
OP4.01	Environmental Assessment	√	The project may cause certain impacts on ambient environment during construction and operation periods and thus needs an assessment of the environmental impacts.
OP4.04	Natural Habitat		Field survey confirmed that the project sites are located in Xining City urban and suburb rural areas with frequent human activities but far away from the existing natural reserves, so this policy is not triggered.
OP4.09	Pest Management	√	Since greening and tree planting are included in the project component relating to low impact development and river bank environmental improvement, use of pesticides may increase in the process of maintenance of greening and tree planting areas.
OP4.10	Indigenous Peoples		The policy is triggered.
OP4.11	Physical Cultural Heritage		There are neither cultural relic sites nor tombs identified in the project construction areas. However, the 'Chinace Finds Procedure' shall be adopted.
OP4.12	Non-voluntary Resettlement	√	OP4.12 is triggered by the project, thus RAP of the project has been prepared by the Resettlement Center of Hoihai University.
OP4.36	Forests		The policy is not triggered because the project does not have the potential to have impacts on the health and quality of forests or the rights and welfare of people and their level of dependence upon or interaction with forests, or aims to bring about changes in its management or protection.
OP4.37	Dam Safety		The project involves no dams.
OP7.50	International Water Ways		The project construction sites are all within the territory of the P.R.C, without involving any international water ways.
OP7.60	Project in Disputed Area		The project does not involve any disputed area.
BP17.50	Information Disclosure	√	At least two rounds of information disclosure and public consultations shall be conducted.

1.8 Objects and Sensitive Receptors for Environmental Protection

Environmental protection objects identified based on project proposal, feasibility study report and field surveys are described in the following sections.

1.8.1 Objects and Sensitive Receptors for Ambient Air and Acoustic Environmental Protection

Residents were identified during the detailed survey to the assessment area of the project. Table 1.8-1, 1.8-2 and Figure 1.8-1 give the details.

Table 1.8-1 Objects of Environmental Protection in the Project Area

No.	Project Components	Construction Activities	Objects of Environmental Protection in The Project Area	
			Acoustic, atmospheric and social environmental protection objects	Surface water
1	Urban Wastewater Collection Pipe Network	Wastewater interception main pipes along Xichuan River	Zhangjiawan Village, Xiaozhai Village, Weijiazhuang Village, Duoba Town	Xichuan River
		Wastewater interception main pipes along Beichuan River	Hetan Village, Wangjiazhuang Village, Qinglv living Quarters	Beichuan River
		Pipe network for rainwater and sewage collection in Beichuan Zone	/	Beichuan River
		Ancillary road network	Kunlun College of Qinghai University, No.4 High School of Xining	Beichuan River
2	Low Impact Development and River Bank Environmental Improvement	LID design, landscape engineering and relevant ancillary works on both banks of Beichuan River	/	Beichuan River
3	Reuse of Reclaimed Water	Reclaimed water plant and reclaimed water pipe network of No.5 wastewater treatment plant	Shuangsubao Village	Beichuan River
4	Integrated Gully Improvement	Integrated environmental treatment of Liujiagou, Shengou gullies & Chaoyangdianqu Canal	Shuangsubao Village, Guojiata Village, Jiujiawan Village, Xin Village, Xiachaoyang	Beichuan River

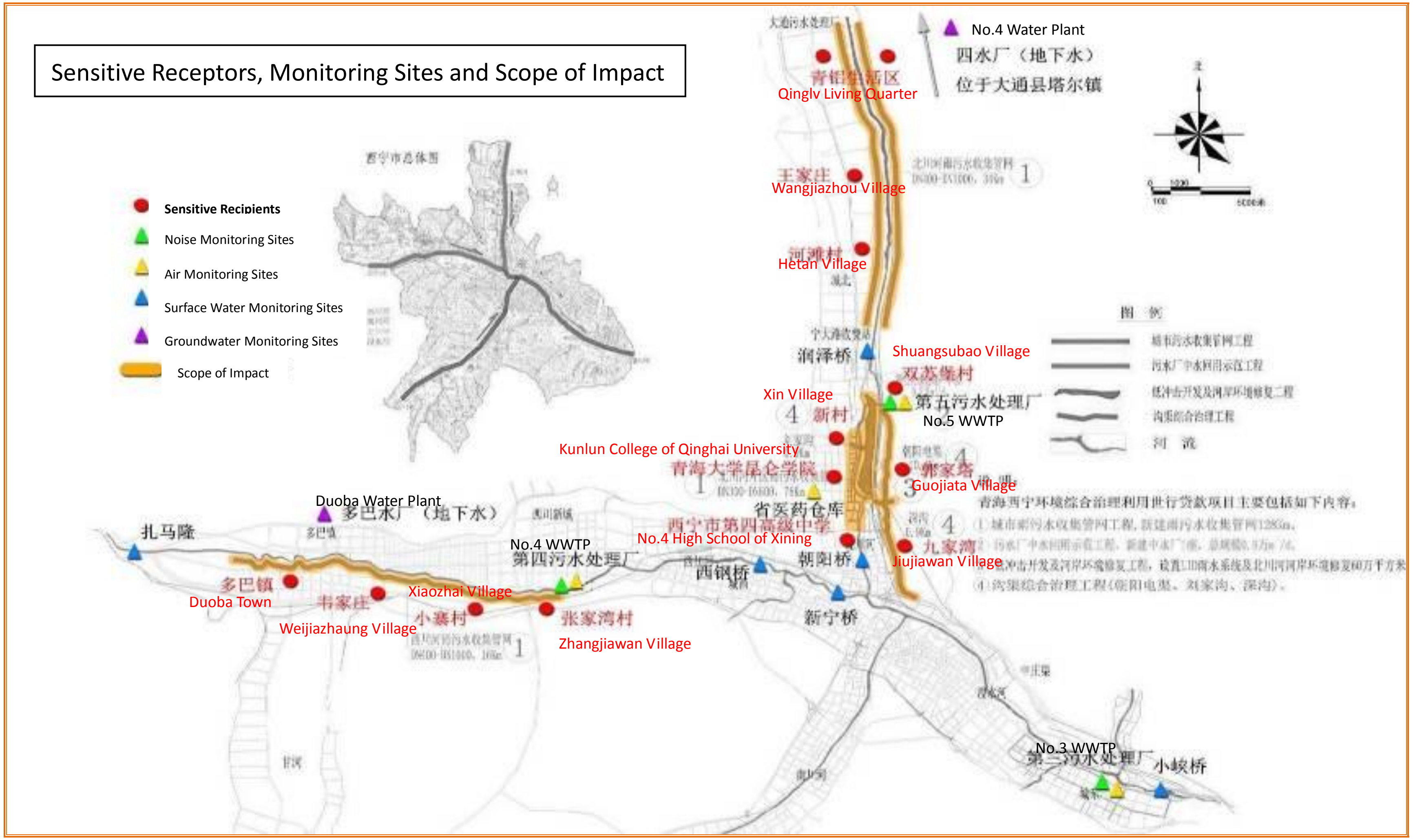
Table 1.8-2 Summary Description of Sensitive Receptors

Subproject Name	No.	Name	Distance to Pipe Center (m) （m）	Location on Map	Photo	Environment Characteristic	Number of People that may be Affected within 200m
Wastewater interception main pipes along Xichuan River	1	Zhangjiawan Village	15			Rural environment. Pipes are arranged through north side of village periphery along the river. Houses are distributed at south side of pipes with brick-concrete structure.	50 household,200 persons
	2	Xiaozhai Village	30			Rural environment. Pipes are arranged through north side of village periphery along the river. Houses are distributed at south side of pipes with brick-concrete structure.	15 households, 60 persons
	3	Weijiazhuang Village	90			Rural environment. Pipes are arranged through north side of village periphery along the river. Houses are distributed at south side of pipes with brick-concrete structure.	50 households, 200 persons

	4	Duoba Town	40			Urban environment. Pipes are arranged through the middle of Duoba Town and along south side of the river. Houses are distributed at both sides of pipes, all building housing estates.	200 households, 800 persons
Wastewater interception main pipes at Beichuan River	1	Hetan Village	15			Rural environment. Pipes are arranged from the right side through the village along Beichuan River. Houses are distributed at west side of pipes with brick-concrete structure.	21 households, 84 persons
	2	Wangjiazhuang Village	160			Rural environment. Pipes are arranged from the left side through the village along Beichuan River. Houses are distributed at east side of pipes with brick-concrete structure.	10 households, 40 persons
	3	Qinglv Living Quarters	20			Residential district. Pipes are arranged through middle of the district and laid along both side of the river. Houses are distributed at both sides of pipes, all being building housing estates.	200 households, 800 persons
Demonstration of Reuse of Reclaimed Water	1	Shuangsubao Village	100			Rural environment at northeast and southeast sides of No. 5 WWTP, with buildings of brick-concrete structure.	60 households, 240 persons

Integrated Gully Improvement	1	Shuangsubao Village	10			Rural environment. Gully improvement of Chaoyangdianqu goes through the middle of Shuangsubao Village, with buildings of brick-concrete structure	80 households, 320 persons
	2	Guojiata Village	10			Rural environment. Gully improvement of Chaoyangdianqu goes through the middle of Guojiata Village, with buildings of brick-concrete structure	80 households,320 persons
	3	Jiujiawan Village	40			Rural environment. Gully improvement of Chaoyangdianqu goes through east side of Jiujiawan Village, with buildings of brick-concrete structure	40 households, 160 persons
	4	Xin Village	5			Suburban area in the north of Xining, with residents living along both sides of gullies, with buildings of brick-concrete structure	60 households, 240 persons
Wastewater pipes and roads in Beichuan Area	1	Kunlun College of Qinghai University	130			Located on west of Xining-Zhangye Highway in Beichuan Area, mainly impacted by the road noise. Teaching building and dormitory building are sideways to Xining-Zhangye Highway and the planned Erwei Road	1000 persons

	2	No.4 HighScho ol of Xining	160			Located on south of Tianjin Road, mainly impacted by noise of Tianjin Road and Beijing-Tibet Expressway; Teaching building is directly facing Xining-Zhangye Highway and sideways to planned Tiedong Road south extension section.	500 persons


Sensitive Receptors, Monitoring Sites and Scope of Impact
Sensitive Recipients
Noise Monitoring Sites
Air Monitoring Sites
Surface Water Monitoring Sites
Groundwater Monitoring Sites
Scope of Impact
No.4 Water Plant
四水厂（地下水）
位于大通县塔尔镇
Qinglv Living Quarter
Wangjiazhou Village
Hetan Village
Shuangsubao Village
Xin Village
第五污水处理厂
No.5 WWTP
Kunlun College of Qinghai University
Guojiata Village
No.4 High School of Xining
Jiujiawan Village
Duoba Water Plant
多巴水厂（地下水）
扎马隆
No.4 WWTP
第四污水处理厂
Duoba Town
Weijiazhaung Village
Xiaozhai Village
Zhangjiawan Village
西钢桥
朝阳桥
新宁桥
润泽桥
No.3 WWTP
小峡桥

1.8.2 Objects for Surface Water Environmental Protection

Objects for surface water environmental protection under the proposed project are the river sections that are located within the evaluation area of the project and therefore to be evaluated, and the protection aims at ensuring that they meet Class-III or IV water quality standards as defined in the Quality Standards for Surface Water Environment (GB3838-2002), and also functional requirements as per the surface water environment function zoning of Qinghai Province. Table 1.8-1 gives the details.

1.8.3 Objects for Social Environmental Protection

Villages, schools and hospitals and other sensitive receptors that may be impacted by the project are the main objects for social environmental protection, as summarized in Table 1.8-2.

Table 1.8-2 Objects for Social Environmental Protection in the Project Area

No.	Objects for Protection	Focus of Protection
1	Residential Area	Inconveniences caused to daily travelling of people due to construction interferences; noise, dust that impact on living environment during construction period; traffic blocked during road construction; noise during operation period, and etc.
2	Schools, Hospitals and Other Sensitive Receptors	Traffic block, noise and dust during construction; noise and exhaust during operation and etc.
3	Households to be resettled	Living quality and arrangements made for the households resettled, opinions and wishes of the resettled residents, and etc.
4	Cultural Relics	Cultural relics of protected nature identified during construction

1.8.4 Objects for Ecological Environmental Protection

The main object for ecological environmental protection under the proposed project is vegetation in areas surrounding the project construction sites and borrow area.

1.9 Focus of This EIA

This EIA will be focused on: impact analyses of the project components and the included construction activities; improvement of urban environmental quality of Xining City through upgrading of environmental management and infrastructure; analyses of impacts during construction (such as impacts of construction on traffic and the lives of local residents, impacts of noise and dust, etc.); mitigation measures to address the adverse impacts; risks during operation; and environmental management plan (EMP) and etc.

2. Project Overview

2.1 Project Name

Qinghai Xining Water Environment Management Project

2.2 Project Development Objectives

To increase water resources utilization efficiency and upgrade water quality of Huangshui River (Xining section) in Xining Municipality, through improving urban water environmental infrastructure in the municipality.

2.3 Geographical Location of the Project

The proposed project is mainly located in Chengbei District and Chengxi District, as well as governed villages and towns of Xining Municipality, Qinghai Province. For details of geographical location of the project, see Figure 2.3-1.

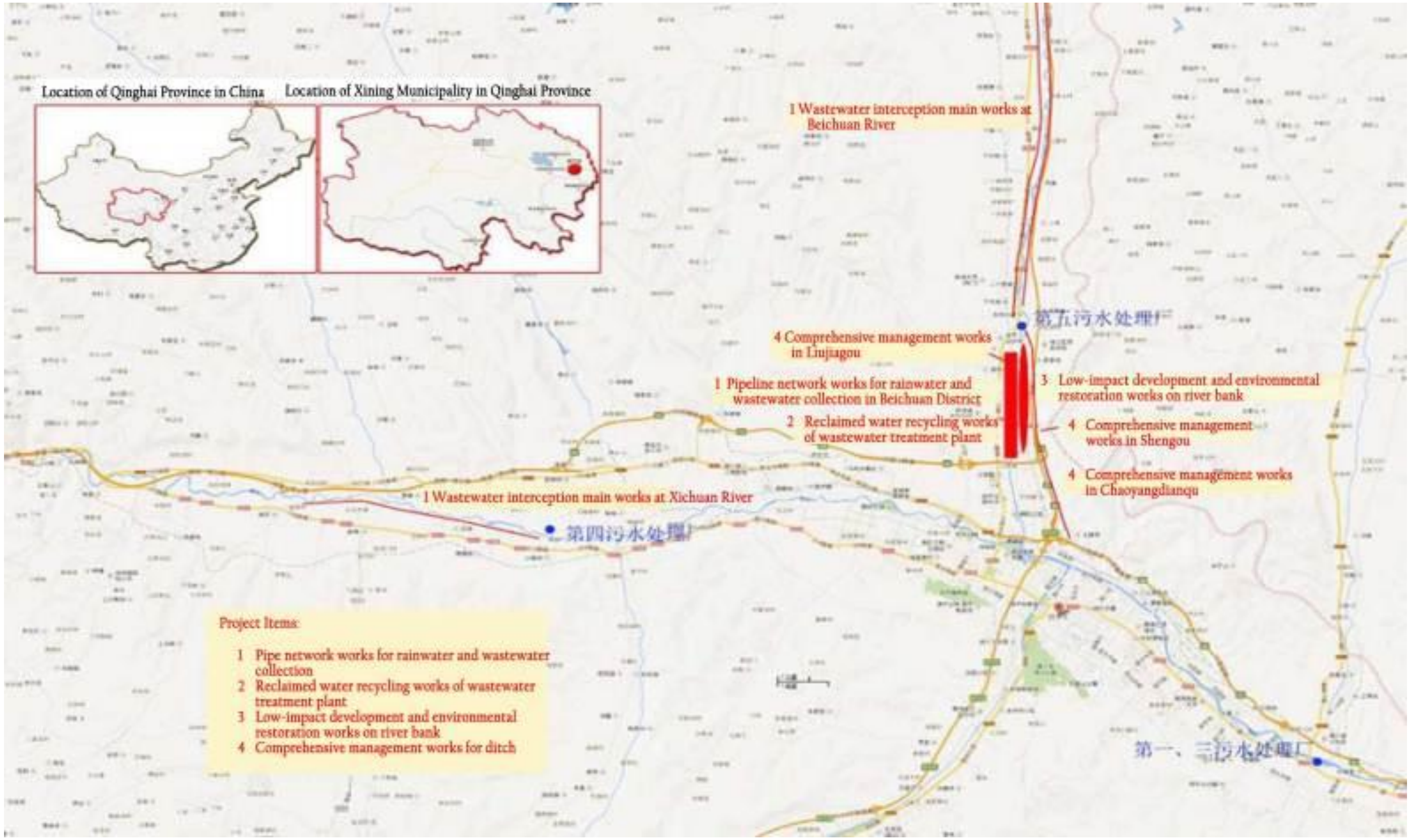


Figure 2.3-1 Geographical Location of the Project

2.4 Project Components

Qinghai Xining Water Environment Management Project consists of four parts as shown in Table 2.4-1. See Figure 2.4-1 for the total plane distribution.

Given the great number of activities included in the project, in this assessment report, works are analyzed according to category of project construction. At the same time, influences of various works on the environment during construction and operation are analyzed and specific environmental protection measures are proposed.

Table 2.4-1 List of Project Components

No.	Project Components	Activities	Type of Works
1	Urban Wastewater Collection Pipe Network	Newly built wastewater collection pipe network on south bank of Xichuan River (Yangjiawan Village – Duoba Town): its service area is about 1,442 hectares; service population is 172,000; total length of pipe network is about 16 Km; DN400-1000; collected wastewater is delivered into No. 4 wastewater treatment plant.	Pipe network
		Newly built wastewater collection pipe network on both banks of Beichuan River (Xining-Datong railway toll station – Datong wastewater treatment plant): its service area is about 4,740 hectares; service population is 83,500; total length of pipe network is about 34 Km; DN400-1000; collected wastewater is delivered into No. 5 wastewater treatment plant through existing wastewater pipe network.	Pipe network
		Newly built wastewater collection pipe network in Beichuan area: its service scope is westwards to Xining – Datong railway; service area is about 290 hectares; service population is 40,000; total length of pipe network is about 34 Km; DN300-600; collected wastewater is delivered into No. 3 WWTP through existing urban wastewater pipe network.	Pipe network
		Newly built rainwater pipes of 44 km in Beichuan area, including north-south branch pipes DN400-DN500 and west-east main pipes DN400-DN600, to collection and drain rainwater to treatment system along Beichuan River bank and then discharge into Beichuan River after treatment	Pipe network
		Newly built ancillary road of 27km in Beichuan area, including main roads, secondary roads and tertiary roads. Main roads total 8452m in length, with red line width of 32-45m and design speed of 50km/h; secondary roads total 1549m in length, with red-line width of 22-30m and design speed of 40 km/h; tertiary roads total 16963m, with red-line width of 10-20m and design speed of 30 km/h.	Road
2	Low Impact Development and River Bank Environmental Improvement	1. Improving area along both banks of Beichuan River, including cleaning and transport of dumped spoil of 2300 m^3 and land leveling. 2. Greening on both banks with the area about 600,000 m^2. 3. Ancillary scenic road of 119775.19 and associated facilities 4. LID rainwater collection system including pervious surface, biro-retention cells, vegetated swales, rain barrels etc..	Environmental improvement
3	Reuse of Reclaimed Water	Demonstration of reuse of reclaimed water, including construction of a reclaimed water plant within the No. 5 WWTP, with a designed capacity 5,000 m^3/d, including a reclaimed water storage pond of 1000 m^3, two submerged pumps, one for operation and the other as back-up. After	Reclaimed water plant and pipe network

		sterilization process, the discharged water from the reclaimed water plant will be used mainly as municipal miscellaneous water in core area of Beichuan for purposes of greening and road watering; ancillary reclaimed water pipe of 5 Km.	
4	Integrated gully improvement	Improvement of Liujiagou gully section (from Xining-Datong highway to river mouth of Beichuan River), with a total length of 0.9 km, mainly including improvement of flood discharge cross-section of gullies(using flood discharge ditch+ slope protection, trapezoid cross-section, gabion cushion lining, slope 1:1; slope protection by using reinforced Mike mat, with a slope 1:2), and earth backfilling and landscape engineering at the top;	Ecological management
		Treatment of Shengou gully section (from Chaoyangdianqu flood discharge culvert to river mouth of Beichuan River), with a total length of 0.9km, including improvement of flood discharge cross-section of gullies(using flood discharge ditch+ slope protection, trapezoid cross-section, gabion cushion lining, slope 1:1; slope protection by using reinforced Mike mat, with a slope 1:2), and earth backfilling and landscape engineering at the top;	
		Treatment for an artificial Chaoyangdianqu water diversion canal, with a total length of 10.4 km. After backfilling at bottom and both sides of original channel, it will be entirely raised by 1.5 m based on originally designed gradient. Renovation is still along the original alignment, on both banks a sidewalk of 1.0m wide is arranged, with a trapezoid cross-section of 1.5m wide at the bottom, slope of 1.25, height of 1.6m. In sections with dense population and frequent human activities, rectangle cross-section with cover on top will be used.	

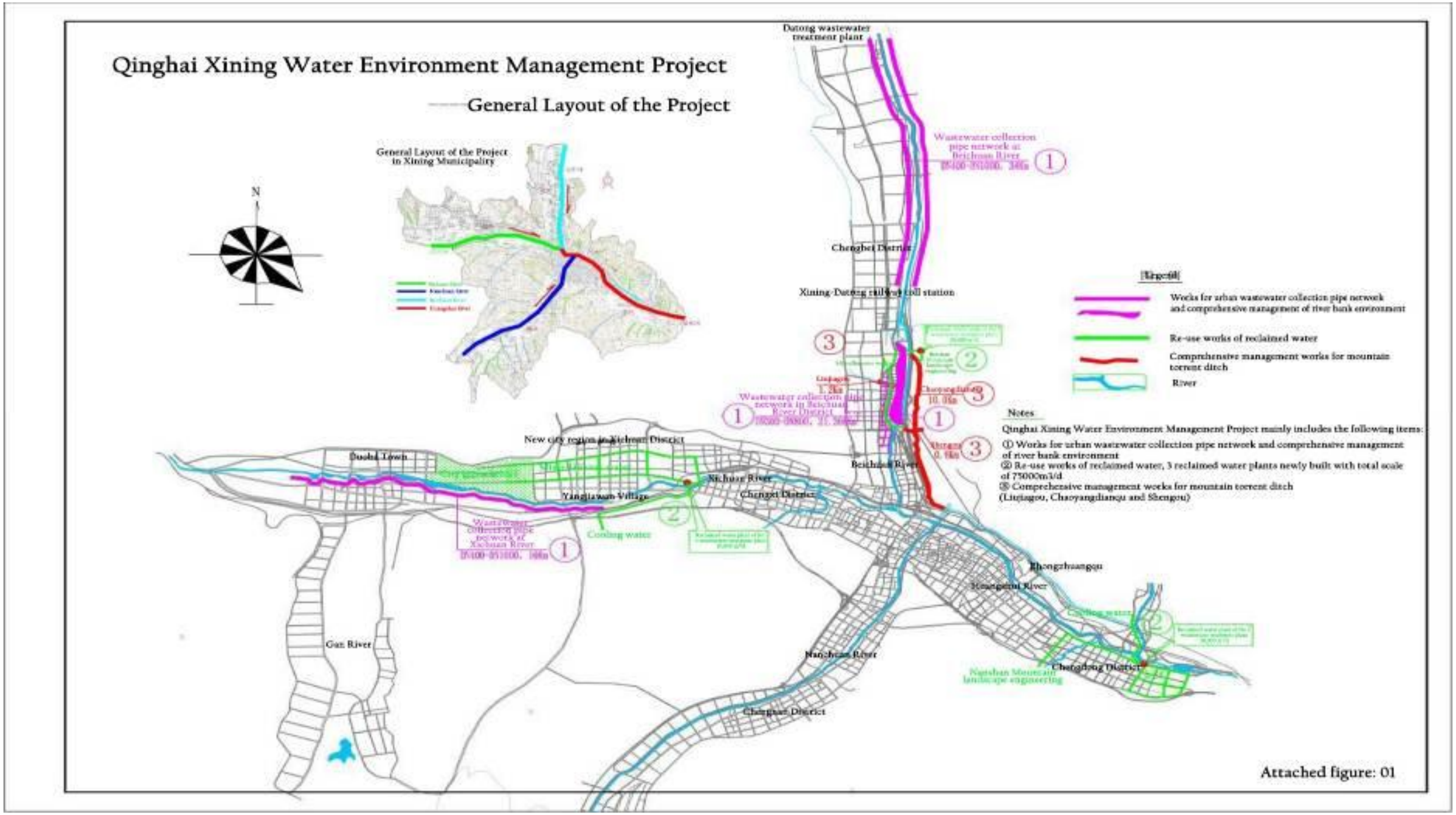


Figure 2.4-1Total Plane Distribution of Project Components

2.5 Pipe Network Works for Rainwater and Wastewater Collection

For details of project activities, see Table 2.4-1.

2.5.1 Waste Water Collection Pipe Network

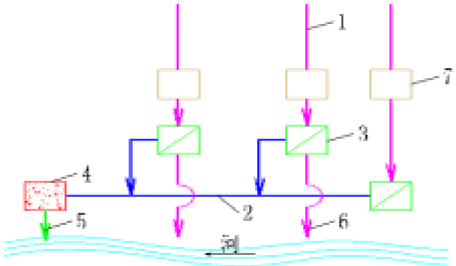
(1) Works and the Layout

Waste water collection pipe network will cover areas of Xichuan River, Beichuan River and Beichuan Zone(Area).

1) Layout of Waste Water Collection Pipeline on South Bank of Xichuan River

It is planned in the Project to arrange a main waste water collection pipe on the south bank of the Xichuan River from Yangjiawan Village to Duoba, which will collect all the waste water on the south bank of the Xichuan River from Duoba to Yangjiawan Village, which will flow into the existing downstream waste water collection pipes and finally flow into the No.4 WWTP for treatment.

Figure 2.5-3 Layout of Waste Water Collection Pipeline on South Bank of Xichuan River



1: Main combined waste water collection pipe; 2: Main interception pipe; 3: Overflow well; 4: The fourth WWTP; 5: Outlet; 6: Overflow outlet; 7: Sedimentation well

Figure 2.5-4 Waste Water Collection System on the South Bank of Xichuan River

Gravel Road

Irrigated Land

Woodland

Figure 2.5-5 Current Status of Areas across/along Which the Pipeline on South Bank of Xichuan River Is Planned

Combined system will be adopted for short term for waste water collection pipeline along Xichuan and Beichuan rivers. Along with completion of road construction along both banks of the rivers in the long run and rainwater collection system and preliminary rainwater treatment system put into place gradually, the combined system will be changed to separate system consecutively. Such arrangement for waste water collection pipe system also couples with construction and development of waste water treatment plants in the short and long terms.

(1) Waste water collection pipes are designed based on needs of 2030, since sewage amount in the short term will be relatively small, combined system can make better use of the available pipe space. Along with increase of sewage from the service areas, the combined system can be gradually changed to separate system, and the current pipe diameter can still meet sewage collection requirement then.

(2) Sewage from both banks of Xichuan River and Beichuan River will flow into No.4 and No.5 WWTPs after being collected. At present, construction of both WWTPs are based on a treatment capacity of 30 thousand m^3/d for the short term, while it is predicted that the flowing-in sewage will be only around 23 thousand m^3/d in the near future. Therefore, use of combined system can meet the treatment requirement of combined waste water, and ensure better use of capacity of the WWTPs.

Since the road along Xichuan River is not yet constructed, the waste water collection pipeline will be installed along the existing gravel road or in the irrigated land or woodland.

2) Layout of Waste Water Pipeline on Both Banks of Beichuan River

It is planned in the Project to arrange main waste water collection pipe along the Beichuan River on both banks from Ningda Road toll-gate to Datong Waste Water Treatment Plant, with diameters ranging from DN800 to DN1000.

Combined waste water collection system will be adopted in the short term and it will be changed gradually to separate system when the road system and rainwater discharge system are completed in the area.

Since the roads along Beichuan River are not yet constructed, the waste water collection pipeline will be installed along the existing gravel road or in the irrigated land or woodland.

3) Layout of Waste Water Pipeline in Beichuan Zone

As the land relief in the Beichuan Zone is high in the north and the west and low in the south and the east, the layout is made in accordance with the road directions: the master main sewer (waste water pipe) is arranged along the Tiedong Road which is a south-north road, the main sewers are arranged along Binghe Road which is a south-north road, and branch sewers (branch waste water pipes) are arranged along other east-west roads. In this zone, the waste water will be collected into the main interception pipe of the Beichuan River, flowing into the main interception pipe on the north bank of the Huangshui River and then entering into the No.3 WWTP for treatment.

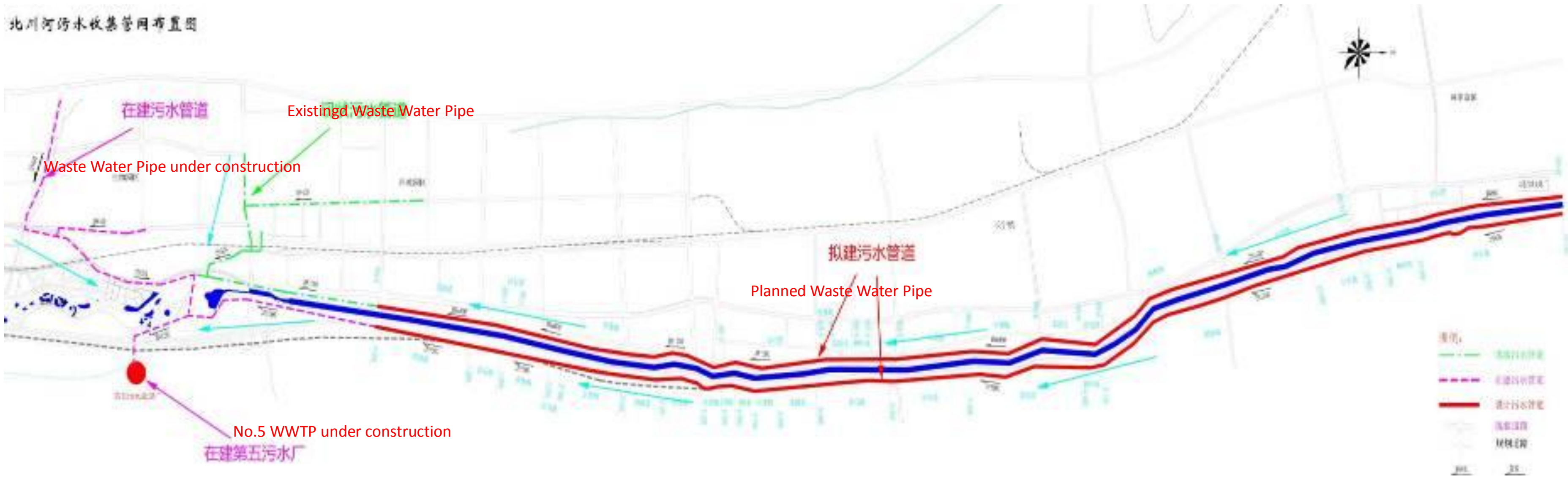
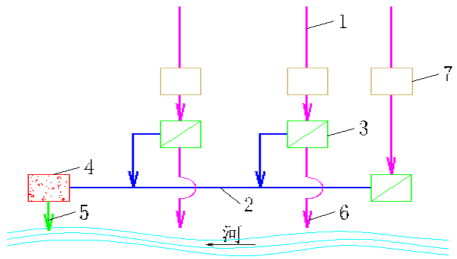


Figure 2.5-6 Layout of Pipeline along Both Banks of Beichuan River



1: Main combined waste water collection pipe; 2: Main interception pipe; 3: Overflow well; 4: No.5 WWTP; 5: Outlet; 6: Overflow outlet; 7 : Sedimentation well

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Figure 2.5-7 Waste Water Collection System along Both Banks of Beichuan River

Gravel Road　　Irrigated Land　　wood Land

Figure 2.5-8 Current Status of Areas across/along Which the Pipeline on Both Banks of Xichuan River Is Planned

Figure 2.5-9 Layout of Wastewater Pipes in Beichuan Area

Figure 2.5-10 Illustration of Altitudes of Beichuan Area

Figure 2.5-11 Current Status of Site

(2) Prediction of Waste Water Amount and the Transfer Scheme

Results of predicted waste water collection amounts in 2030 are included in the following table.

Table 2.5-2 Summary of Predicted Waste Water Collections in 2030

No.	Areas	Population Served （10^4 persons）	Service Area （ha）	Waste Water Collected （10^4 m^3/d）	Discharged to
1	South Bank of Xichuan River	17.2	1442	4.36	The Fourth WWTP
2	East Bank of Beichuan River	2.45	940	0.80	The Fifth WWTP
3	West Bank of Beichuan River	5.90	3800	1.64	The Fifth WWTP
4	Beichuan Zone	4.00	290	1.10	The Third WWTP

(3) Type of Foundation for the Pipeline

For the reinforced concrete sewer pipe, 120º plain concrete foundation will be used, and C35 concrete is the casting standard. The foundation is illustrated as follows.

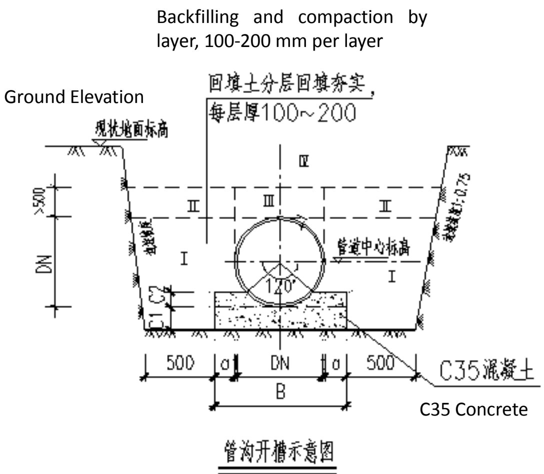


Figure 2.5-12 Illustration of Foundation of Pipeline

Table 2.5-3 Dimensions of Plain Concrete Foundation

DN	Thickness of Pipe Wall	Dimensions of the Foundation				Slope
		a	B	C1	C2	
300	40	80	540	80	95	1:0.75
400	47	100	694	100	123	1:0.75
600	60	100	920	100	180	1:0.75
800	80	120	1200	120	240	1:0.75
1000	100	150	1500	150	300	1:0.75

(4) Main Quantities

The main quantities of the urban waste water collection pipe network are shown in Tables 2.5-4 through to 10.

1) Xichuan River Waste Water Collection Pipeline(Yangjiawan village-Duoba)

Table 2.5-4 Pipe Material and Quantities of Well Chambers for Xichuan River

No.	Description	Specification	material	Unit	Quantity	Remarks
1	Reinforced concrete pipe	DN800	Reinforced concrete	m	2600	Main pipe
2	Reinforced concrete pipe	DN1000	Reinforced concrete	m	10920	Main pipe
3	Reinforced concrete pipe	DN400	Reinforced concrete	m	2480	Branch pipe
4	Rectangular waste water pipe manhole	1100X1100	Reinforced concrete	No.	65	
5	Rectangular waste water pipe manhole	1100X1300	Reinforced concrete	No.	218	In branch pipe
6	Circular waste water pipe Manhole	Φ1000	Brick	No.	82	In branch pipe
7	Sedimentation Well	Φ1250	Reinforced Concrete	No.	7	In branch pipe
8	Overflow Well	1650x1650	Reinforced Concrete	No.	7	In branch pipe

Table 2.5-5 Activities Needed to Be Accomplished before Construction of the Pipeline

No.	Activities	Unit	Quantity	Remark
1	Construction of Temporary Roads	m^2	18830	For pipeline located in flood land, irrigated land areas, 5380m
2	Compensation to Green Crops	m^2	40140	For pipeline located in irrigated land, 4460m
3	Restoration of gravel road surface	m^2	13360	For pipeline located along gravel road, 3340m
4	Land Acquisition for Manholes	mu	0.7	For manholes located in irrigation land areas (90 such manholes)
5	Compensation for tree seedlings	No.	9600	For pipeline located in the woodland, 4800m
6	Stone Masonry	m^3	3750	River channel slope protection

2) Waste Water Collection Pipeline along Both Banks of Beichuan River (Ningda Road toll-gate-Datong WWTP)

Table 2.5-6 Pipe Material and Quantities of Well Chambers for East Bank of Beichuan River

No.	Description	Specification	material	Unit	Quantity	Remarks	Remarks
1	Reinforced concrete pipe	DN800	Reinforced concrete	m	2665	Main pipe	Main pipe
2	Reinforced concrete	DN1000	Reinforced	m	12500	Main pipe	Main pipe

	pipe		concrete				
3	Reinforced concrete pipe	DN400	Reinforced concrete	m	1835	Branch pipe	Main pipe
4	Rectangular waste water pipe manhole	1100X1100	Reinforced concrete	No.	66		Branch pipe
5	Rectangular waste water pipe manhole	1100X1300	Reinforced concrete	No.	278	In branch pipe	
6	Circular waste water pipe Manhole	Φ1000	Brick	No.	52	In branch pipe	
7	Sedimentation Well	Φ1250	Reinforced Concrete	No.	9	In branch pipe	
8	Overflow Well	1650x1650	Reinforced Concrete	No.	9	In branch pipe	To be provided in branch pipes

Table 2.5-7 Activities Needed to Be Accomplished before Construction of the Pipeline on East Bank of Beichuan River

No.	Activities	Unit	Quantity	Remark
1	Construction of Temporary Roads	m^2	20090	For pipeline located in flood land, irrigated land areas, 5740m
2	Compensation to Green Crops	m^2	30600x1.5	For pipeline located in irrigated land, 5100m
3	Restoration of gravel road surface	m^2	13360	For pipeline located along gravel road, 3340m
4	Land Acquisition for Manholes	mu	540	For manholes located in irrigation land areas (104 such manholes)
5	Compensation for tree seedlings	No.	8480	For pipeline located in the woodland, 4240m

Table 2.5-8 Pipe Material and Quantities of Well Chambers for West Bank of Beichuan River

No.	Description	Specification	Material	Unit	Quantity	Remarks
1	Reinforced concrete pipe	DN800	Reinforced concrete	m	2665	Main pipe
2	Reinforced concrete pipe	DN1000	Reinforced concrete	m	12500	Main pipe
3	Reinforced concrete pipe	DN400	HDPE	m	1835	Main pipe
4	Manhole	1100X1100	Reinforced concrete	No.	35	
5	Manhole	1100X1300	Reinforced concrete	No.	275	
6	Circular Manhole	Φ1000	Brick	No.	52	In branch pipe
7	Sedimentation Well	Φ1250	Reinforced concrete	No.	12	In branch pipe
8	Overflow Well	1650x1650	Reinforced concrete	No.	12	In branch pipe

Table 2.5-9 Activities Needed to Be Accomplished before Construction of the Pipeline on West Bank of Beichuan River

No.	Activities	Unit	Quantity	Remark
1	Construction of Temporary Roads	m^2	23905	For pipeline located in flood land, irrigated land areas, 6830m
2	Compensation to Green Crops	m^2	35820x1.5	For pipeline located in irrigated land, 5970m
3	Restoration of gravel road surface	m^2	18860	For pipeline located along gravel road, 4715m
4	Land Acquisition for Manholes	mu	624	For manholes located in irrigation land areas (120 such manholes)
5	Compensation for tree seedlings	No.	4040	For pipeline located in the woodland, 2020m

3) Waste Water Collection Pipeline in Beichuan Zone

Table 2.5-10 Main Works of Waste Water Collection Pipe Network in Beichuan Zone

No.	Road Description	Reinforced Concrete Pipe (m)			Reinforced concrete pipe (m)	Brick Manhole (No.)	Reinforced concrete Manhole (No.)
		DN300 (mm)	DN400 (mm)	DN500 (mm)	DN600 (mm)	Φ1000 (mm)	1000x1000 (mm)
1	Jinyi Road	189	-	-	-	-	5
2	Beiyuanbei Road	203	-	-	-	-	6
3	Beiyuan Road	578	-	-	-	-	16
4	Goubei Road	675	-	-	-	-	19
5	Liujiagou Road	1372	-	-	-	-	39
6	Weisi Road	459	-	-	-	-	13
7	Huijin Road	553	-	-	-	-	16
8	Erweibei Road	666	-	-	-	-	19
9	Erwei Road	1320	-	-	-	-	38
10	Erweinan Road	689	-	-	-	-	19
11	Huiwen Road	482	-	-	-	-	14
12	Sanweibei Road	306	-	-	-	-	8
13	Sanwei Road	356	-	-	-	-	10
14	Jinshui Road	374	-	-	-	-	11
15	Yuquan Road	490	-	-	-	-	14
16	Siweibei Road	496	-	-	-	-	14
17	Siwei Road	288	248	-	-	-	14
18	Tiedong Road	548	906	674	1198	-	95
19	Binghexi Road	-	4744	-	-	135	-
20	Zhenxing Road	2337	-	-	-	-	66
21	Zhenxingdong Road	809	-	-	-	-	23
22	Zhenshui Road	940	-	-	-	-	27
23	Weishisan Road	509	-	-	-	-	14

24	Weishisi Road	390	-	-	-	-	11
25	Tiedong Road South Extension	-	-	-	872	-	25
26	Zhenxing Road South Extension	799	-	-	-	-	24
27	Binhexi Road North Extension	-	350	-	-	-	10
28	Reserved Branch Pipe	9180	-	-	-	262	-
Subtotal		25008	6248	674	2070	397	570
Total		34,000m				397	570

2.5.2 Associated Rainwater Pipeline

(1) Engineering Scheme

The rainfall in the Beichuan Zone will be drained using two approaches: the first approach is to use the rainwater drainage system based on Low Impact Development (LID) techniques to drain the initial rainwater on the roads into green belts along the roads for reuse, so as to regulate runoff formation and pollution caused by rainstorm right at the source of rainwater; in order to prevent the roads from logging, the second approach is to collect rainfall from the inlets by the curbstones and discharge into municipal rainwater pipeline connecting to the sedimentation wells along the Beichuan River banks, this part of rainfall will be discharged into Beichuan River after the sedimentation process.

Design of the rainwater drainage system based on Low Impact Development (LID) techniques is described in relevant sections in the Chapter ‘ Low Impact Development and River Bank Environmental Recovery’.

The land relief in the Beichuan Zone is high in the west and north and low in east and south. In order that the rainwater can be collected at the closest location, DN400-DN500 branch pipes are arranged on such north-southward roads and DN400-DN600 main pipes are arranged on west-eastward roads, so that rainwater can be collected in a distributed way into the sedimentation system along Beichuan River before being discharged into the river at closeby locations.

Layout of rainwater collection pipeline is shown in Figure 2.5-13.

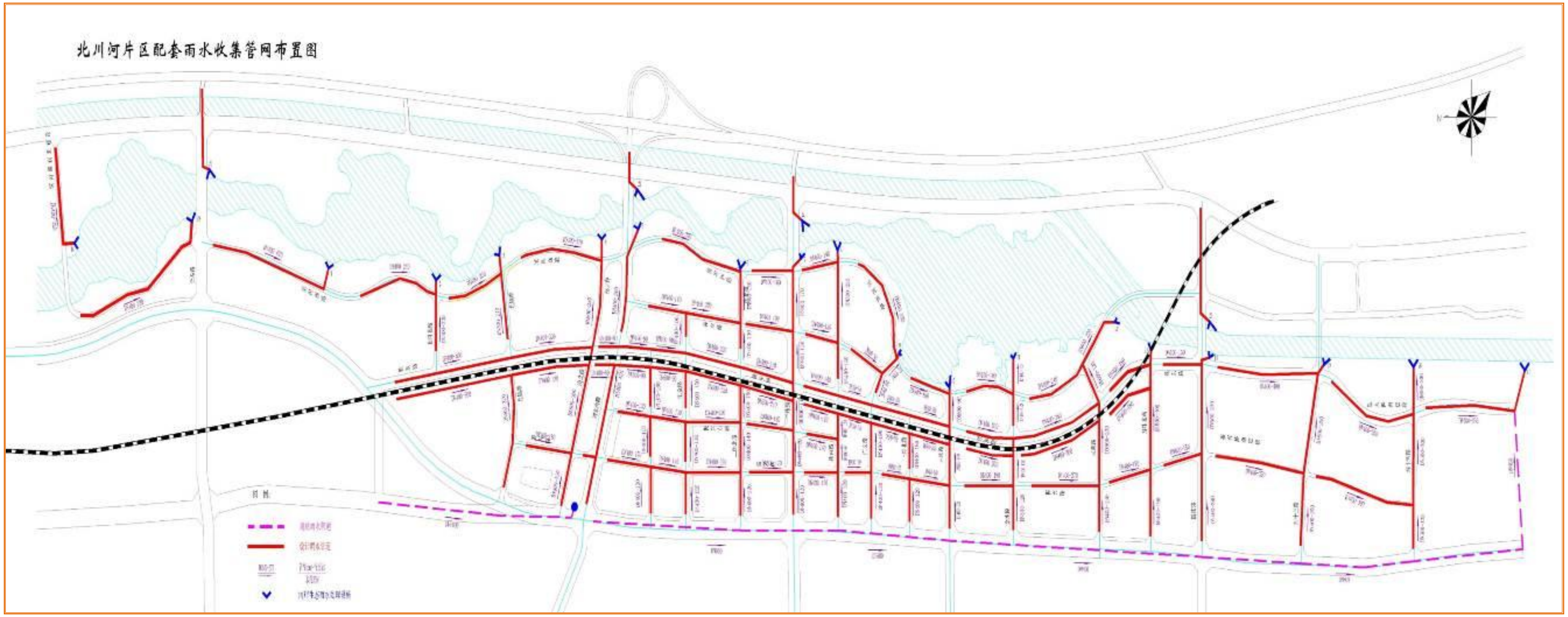


Figure 2.5-13 Layout of Rainwater Collection Pipeline

(2) Calculation of Rainwater Flow

1) Formula Used to Calculate Design Flow

Design flow for the pipe to collection rainwater relates to catchment area, ground coverage condition and rainfall pattern, and the formula for the calculation is as follows:

$Q = \phi \cdot F \cdot q$

Where：Q——Design flow of rainwater in the pipe section（l/s）;

ϕ——Runoff coefficient, relating to ground coverage condition;

F——Catchment area corresponding to the pipe section ($10^4 m^2$)；

q——Design storm intensity（$l/s \cdot 10^4 m^2$）。

2）Formula for Storm Intensity

The formula developed by Xi'an University of Architecture and Technology in 1998 is used in the calculation of storm intensity:

$$q = \frac{461.9(1+0.9931\text{g}\, p)}{(t+3)^{0.686}} (L/s \bullet ha)$$

Where：q—design storm intensity（l/s·ha）

p—Recurrence interval of design storm（year）

t—Duration of rainfall（mm）

3）Design Parameters

① Runoff Coefficient Φ

Comprehensive runoff coefficient is adopted and its value is calculated as weighted average of runoff coefficients of ground surfaces of various land uses.

Table 2.5-11 Results of Calculation of Runoff Coefficient

Land Uses	Area of the Land Use（%）	ϕ
Residential Area	19	0.6
Commercial Facilities	10	0.6
Entertainment Uses	7	0.6
Office Buildings	4	0.6
Public Green Space	36	0.15
Roads	14	0.9
Water Bodies	8	-

Land Uses	Area of the Land Use（%）	ϕ
Outward Transport Roads	2	0.9
Weighted Average	100	0.48

Since initial rainwater on roads is directly reused for green belts along the roads, in calculating diameter of municipal rainwater collection pipe, ϕ is set at 0.4.

② Recurrence Interval (T)

Calculation of recurrence interval is based on magnitude of road and street. Considering that the rainwater collection pipeline is located in the northern surburb of the city where the slope is great, T is set at 1 year, the minimal limiting value of the allowance range of 1 to 3-year as defined in the design norm.

③ Duration of Rainfall (t)

The following formula is used:

$t = t1+mt2$

Where：t1—runoff accumulation time, since the overall greening rate of Beichuan Zone is higher, resulting in longer runoff accumulation period, t1 is set at 15min；

m—reduction factor, m=1.2～2.0, since concealed pipe is used for rainwater collection, m is set at 2.0；

t2—in-pipe travel time（min）。

(3) Hydraulic Calculation

Table 2.5-12 Results of Hydraulic Calculation

(Recurrence interval=1 year, runoff coefficient=0.4）

Starting Point	Ending Point	Length of Pipe (m)	Catchment Area (ha)	Design Flow (l/s)	Pipe Diameter (mm)	Slope（‰）	Velocity（m/s)
（1）Binhexi Road							
A1	A2	470	8.98	228.44	400	15.00	2.03
（2）Beiyuanbei Road							
B1	B2	220	4.17	106.08	500	3.00	1.05
B2	B3	40	11.00	279.82	500	10.00	1.92
（3）Beiyuan Road							
C1	C2	240	3.74	95.15	500	3.00	1.05
C2	C3	50	5.92	150.60	500	3.00	1.05
（4）Goubei Road							
D1	D2	150	2.10	53.42	400	3.00	0.91

D2	D3	300	5.26	111.41	500	3.00	1.05
D3	D4	250	27.97	592.44	600	10.00	2.17
D4	D5	60	36.85	618.48	600	10.00	2.17
（5）Liujiagou Road							
E1	E2	300	2.56	65.12	400	3.00	0.91
（6）Erweibei Road							
F1	F2	130	1.37	34.85	400	3.00	0.91
F2	F3	140	10.87	266.45	600	3.00	1.19
（7）Erwei Road							
G1	G2	120	1.46	37.14	400	3.00	0.91
G2	G3	120	3.06	66.98	400	3.00	0.91
G3	G4	140	5.08	98.32	500	3.00	1.05
G4	G5	130	34.72	605.03	800	3.00	1.44
G5	G6	170	36.29	593.76	800	3.00	1.44
G6	G7	50	38.16	579.49	800	3.00	1.44
（8）Erweinan Road							
H1	H2	150	1.40	35.61	400	3.00	0.91
H2	H3	220	5.58	118.19	500	3.00	1.05
（9）Huiwen Road							
I1	I2	150	1.40	35.61	400	3.00	0.91
I2	I3	220	6.79	152.07	500	3.00	1.05
（10）Sanwei Road							
J1	J2	120	1.87	47.57	400	3.00	0.91
J2	J3	160	6.06	132.65	500	3.00	1.05
J3	J4	90	24.40	464.45	600	8.00	1.94
（11）Jinshui Road							
K1	K2	120	1.79	45.53	400	3.00	0.91
K2	K3	100	3.00	65.67	400	3.00	0.91
（12）Yuquan Road							
L1	L2	130	3.45	87.76	400	3.00	0.91
L2	L3	230	6.70	145.04	500	3.00	1.05
L3	L4	130	18.65	333.78	600	5.00	1.54
L4	L5	220	20.81	350.20	600	5.00	1.54
（13）Siweibei Road							
M1	M2	190	2.87	73.01	400	3.00	0.91
M2	M3	300	5.35	108.70	500	3.00	1.05
M3	M4	50	7.49	122.01	500	3.00	1.05
（14）Siwei Road							
N1	N2	240	2.07	52.66	400	3.00	0.91
N2	N3	250	4.55	88.06	500	3.00	1.05
N3	N4	50	6.68	108.27	500	3.00	1.05
(15) Weishisan Road							

P1	P2	200	5.53	140.67	500	3.00	1.05
P2	P3	200	20.81	430.52	600	5.00	1.54
(16) Weishisi Road							
Q1	Q2	120	4.29	109.13	500	3.00	1.05
Q2	Q3	300	11.27	251.41	500	5.00	1.36
Q3	Q4	130	18.24	333.33	600	3.00	1.19
(17) Tiedong Road South Extension							
R1	R2	350	7.01	178.32	400	10.00	1.66
(18) Binhexi Road North Extension (1)							
S1	S2	320	5.60	142.46	400	5.00	1.17
(19) Binhexi Road North Extension (2)							
T1	T2	520	4.18	106.33	400	3.00	0.91
(20 Jinyi Road							
U1	U2	250	2.95	75.04	400	3.00	0.91
(21) Liujiagou Road（East）							
V1	V2	130	6.89	175.27	400	10.00	1.66
(22) Liujiagou Road（West）							
W1	W2	150	3.20	81.40	400	3.00	0.91
(23) Siwei Road（East）							
X1	X2	150	7.53	191.55	400	10.00	1.66

（4）Pipe Material

Same as pipe material selected for the waste water pipeline, reinforced concrete pipe will be used for rainwater collection, and rubber ring bell sockets will be used for the joints.

（5）Design of Pipe Structure

Rainwater collection pipe adopts the same structure as is used for the reinforced concrete waste water, i.e. 120º plain concrete foundation and C35 concrete for foundation casting standard.

(6) Main quantities

Table 2.5-13 Quantities of Works

No.	Roads	Reinforced Concrete Pipe（m）					Brick Manhole（No.）	Reinforced Concrete Manhole（No.）		Reinforced Concrete Overflow Well（No.）	Brick Rainwater Outlet（No.）
		DN300（mm）	DN400（mm）	DN500（mm）	DN600（mm）	DN800（mm）	Φ1000（mm）	1000x1000（mm）	1100x1100（mm）	Φ1000（mm）	380X680
1	Jinyi Road	280	520					13		7	26
2	Beiyuanbei Road	110		220				6		3	12
3	Beiyuan Road	290		370	240			16		7	32
4	Goubei Road	330	150	300	250			18		7	36
5	Liujiagou Road	880	880					22		8	44
6	Weisi Road	180	400					10		6	20
7	Huijin Road	290	480					12		8	24
8	Erweibei Road	310	540		140			17		10	34
9	Erwei Road	950	390	140		300		21		4	42
10	Erweinan Road	320	480	220				18		10	36
11	Huiwen Road	310	420	100				13		8	26
12	Sanweibei Road	110	270					7		4	14
13	Sanwei Road	320	120	160	90			10		6	20
14	Jinshui Road	290	340	130				12		6	24
15	Yuquan Road	230	130	230	130			13		7	26
16	Siweibei Road	210	190	300				13		4	26
17	Weishisan Road	160		200	200			10		5	20
18	Weishisi Road	340		420	300			18		5	36
19	Siwei Road	870	580	250				21		7	42
20	Tiedong Road	2630	4940	720	210			76		17	152
21	Tiedong Road South Extension	1600	1100					28		5	56

No.	Roads	Reinforced Concrete Pipe（m）					Brick Manhole（No.）	Reinforced Concrete Manhole（No.）		Reinforced Concrete Overflow Well（No.）	Brick Rainwater Outlet（No.）
		DN300（mm）	DN400（mm）	DN500（mm）	DN600（mm）	DN800（mm）	Φ1000（mm）	1000x1000（mm）	1100x1100（mm）	Φ1000（mm）	380X680
22	Binhexi Road	1570	2790		220		76			21	152
23	Binhexi Road North Extension	1030	840					21		4	42
24	Zhenxing Road	1670	2160					54		33	108
25	Zhenxing Road South Extension	820	750					19		7	38
26	Zhenxingdong Road	980	810					21		10	42
27	Zhenshui Road	980	820					21		8	42
Subtotal		18060	20100	3760	1780	300	76	510	0	227	1172
Total		44,000m					76	510		227	1172

2.5.3 Roads

(1) Plan Design of Roads and Relations with Nearby Roads

In accordance with the corresponding plan, it is determined that the main roads designed for the project in the Beichuan River Area are urban traffic roads, the secondary roads and the tertiary roads are acciliary roads. On the basis of understanding of the plans and analysis of the alignments of the planned road network drawing, taking into account of the nature of the planned land, and on the basis of the field investigation, the design institute regulates the unrationalities in alignments of roads of various classes in the planned road network, let the plan curve of each road satisfy the specifications for design of municipal roads. The roads connecting the roads of the proposed project are Ning-Zhang Highway, Ningzhang Road, Erwei Road, Sanwei Road and Siwei Road, to the west; Xining-Datong Highway and Chaoyangxi Road to the east. The plan design of the roads and the relations of the roads are shown in Fig. 2.5-13.

Figure 2.5-13 Plan Design of Roads

Main roads to be supported by the project are 8,452m long in total, with a red-line width of 32-45m and designed speed of 50 km/h; secondary roads are 1,549m in length, with a red-line width of 22-30m and design speed of 40 km/h; tertiary roads are 16,963m long in total, with a red-line width of 10-20m and design speed of 30km/h.

(2) Profile Design

The area for road construction has a south-to-north length of about 6.3 km and the south-to-north altitude difference of about 26m; and an east-to-west length of around 1km, with the altitude difference of about 25m. Road elevation is designed based on the site elevation in accordance with the overall topographic feature.

Minimal slope is designed as 0.3% to meet road drainage requirement. Maximal slopes of the main, secondary and tertiary roads are set within 5.5%, 6% and 7%, respectively, to meet road safety requirements. Standards stipulated in ‘Urban Road Design Norm’ are followed in design of the roads.

(3) Design of Cross-sections

The main roads have a red-line width of 32-45m and two-way 6 motorized lanes; secondary roads have a red-line width of 22-30m and two-way 4 motorized lanes; tertiary roads have a red-line width of 10-20m, and two-way 2 lanes for both motorized and non-motorized vehicles, or, in some sections, one lane for two ways.

The cross sections of the roads are shown in Tables 2.5-14 through to 16.

Table 2.5-14 Designed Cross Sections of Main Roads

<table>
<tr><th rowspan="2">Class</th><th rowspan="2">Roads</th><th>Width of Red- line</th><th colspan="2">Layout</th></tr>
<tr><th>m</th><th>Cross-section</th><th>Road Way Form</th></tr>
<tr><td rowspan="8">Main Road</td><td>Erwei Road</td><td>45</td><td>Side Walk（4.5m）+ Non-motorized Lane（4m）+ Lateral Partition（3m）+ Motorized Lanes（22m）+ Lateral Partition（3m）+ Non-motorized Lane（4m）+ Side Walk（4.5m）</td><td rowspan="3">3 Roadways</td></tr>
<tr><td>Jinyi Road</td><td rowspan="2">40</td><td rowspan="2">Side Walk（4m）+ Non-motorized Lane（3m）+ Lateral Partition（2m）+ Motorized Lanes（22m）+ Lateral Partition（2m）+ Non-motorized Lane（3m）+ Side Walk（4m）</td></tr>
<tr><td>Liujiagou Road</td></tr>
<tr><td>Sanwei Road</td><td rowspan="4">32</td><td rowspan="4">Side Walk（5.5m）+ Vehicle Lanes（21m）+ Side Walk（5.5m）</td><td rowspan="4">1 Road Way</td></tr>
<tr><td>Siwei Road</td></tr>
<tr><td>Tiedong Road</td></tr>
<tr><td>Tiedong Road South Extension</td></tr>
</table>

Table 2.5-15 Designed Cross-sections of Secondary Road

Class	Roads	Width of Red-line	Layout	
		m	Cross-section	Roadway Form
Secondary Road	Huijin Road	24	Side Walk（5m）+ Vehicle Lanes（14m）+ Side Walk（5m）	1 Road Way
	Huiwen Road			
	Jinshui Road			

Table 2.5-16 Designed Cross-sections of Tertiary Roads

Class	Roads	Width of Red-line	Layout	
		m	Cross-sections	Roadway Form
Tertiary Roads	Beiyuanbei Road	18	Side Walk（3.5m）+ Vehicle Lanes（11m）+ Side Walk （3.5m）	1 Road Way
	Beiyuan Road			
	Goubei Road			
	Weisi Road			
	Erweibei Road			
	Erweinan Road			
	Sanwei Road			
	Yuquan Road			
	Binhexi Road			
	Binhexi Road North Extension			
	Zhenxing Road			
	Zhenxingdong Road			
	Zhenshui Road			
	Siweibei Road	16	Side Walk（3.5m）+ Vehicle Lanes（9m）+ Side Walk（3.5m）	
	Weishisan Road			
	Weishisi Road			
	Zhenxing Road South Extension			

(4) Design of Road Foundation

1）Fill Subgrade

Since building material of Xining is mainly sand gravel, the slope of the backfilling foundation is designed as 1:1.5.

2) Excavated Subgrade

Based on geological survey data, the exposed strata after excavation for the new roads under the project will be mixed soil for the first layer and pebble bed for the second layer. Slope of the excavation is designed as Class I, 1:1.

3) Filling of Subgrade

Based on actual topographic, geological and groundwater conditions at the site, certain engineering treatment may be needed, normally including removing of top soil of 40 to 60cm, chopping trees down and digging out the roots and tampering for compaction of the subgrade, and then backfilling with natural sand gravel. For subgrade with special bearing capacity requirements, additional treatment will be needed.

Filling material of subgrade will be earth or mixture of earth and stone. Filling technology requirements for earth subgrade and mixed earth and stone subgrade shall be followed, and the filling and then compacting using machines will be done layer by layer. The fill lay-down thickness should be limited within 30cm for earth road section; and within 40cm for earth and stone mixed section.

4) Fill and Spoil

Included in profile design, vertical earthwork design of the overall construction site is conducted for balance of cut and fill. Excavation and fill for roads can both use earth at site, the insufficient amount can be taken from/to the borrow/spoil area assigned by the project owner.

Spoil from the construction process will be mainly top cultivated soil, which can be used as soil for greening along the roads or for other greening programs in Beichuan core area.

After earth borrowing, the local vegetation needs to be recovered to ensure sustainable ecological development. Based on actual situation, native herbal plants, bushes or desert plants of Xining characteristics can be selected for re-vegetation, and favorable micro-environment should be created for growth of the plants.

(5) Road Surface Design

Asphalt concrete road is designed for Beichuan Area, as shown in Table 2.5-17.

Table 2.5-17 Road Surface Structure for Beichuan Area

<table>
<tr><th colspan="2">Class of Road</th><th colspan="2">Roadway</th><th>Sidewalk</th></tr>
<tr><td rowspan="8">Main Road</td><td rowspan="4">Motorized Lane</td><td rowspan="2">Surface</td><td>4cm Fine Granule Asphalt Concrete （AC-13）</td><td></td></tr>
<tr><td>8cm Coarse Granule Asphalt Concrete（AC-25）</td><td></td></tr>
<tr><td>Primary Layer</td><td>30cm 5% Cement Stabilization Gravel</td><td>6cm Water Permeable Brick</td></tr>
<tr><td>Under Layer</td><td>30cm Natural Gravel</td><td></td></tr>
<tr><td rowspan="4">Non-motorized Lane</td><td rowspan="2">Surface</td><td>4cm Fine Granule Asphalt Concrete （AC-13）</td><td></td></tr>
<tr><td>8cm Coarse Granule Asphalt Concrete（AC-25）</td><td>3cm M7.5 Cement Mortar</td></tr>
<tr><td>Primary Layer</td><td>30cm 5% Cement Stabilization Gravel</td><td></td></tr>
<tr><td>Under Layer</td><td>30cm Natural Gravel</td><td></td></tr>
<tr><td colspan="2" rowspan="4">Secondary Road</td><td rowspan="2">Surface</td><td>4cm Fine Granule Asphalt Concrete （AC-13）</td><td>15cm 5% Cement Stabilization Gravel</td></tr>
<tr><td>8cm Coarse Granule Asphalt Concrete（AC-25）</td><td></td></tr>
<tr><td>Primary Layer</td><td>30cm 5% Cement Stabilization Gravel</td><td></td></tr>
<tr><td>Under Layer</td><td>30cm Natural Gravel</td><td>20cm Natural Gravel</td></tr>
<tr><td colspan="2" rowspan="4">Tertiary Road</td><td rowspan="2">Surface</td><td>4cm Fine Granule Asphalt Concrete （AC-13）</td><td></td></tr>
<tr><td>8cm Coarse Granule Asphalt Concrete（AC-25）</td><td></td></tr>
<tr><td>Primary Layer</td><td>30cm 5% Cement Stabilization Gravel</td><td></td></tr>
<tr><td>Under Layer</td><td>30cm Natural Gravel</td><td></td></tr>
</table>

Note：1 Bridge top uses 7cm thick, fine granule asphalt concrete (AC-13C）.
2 At locations where groundwater table is higher, 40cm natural gravel will be used to replace original earth beneath the roadbed.

(6) Road Surface Drainage

Ecological rainwater drainage technology is adopted for urban roads in Beichuan river area to collect and drain initial rainwater on the roads to green belts in the urban areas for reuse. The rest of the rainwater will be collected for sedimentation and filtration before overflowing into Beichuan River to supplement water supply for landscaping. For details see the sections on rainwater collection and drainage.

(7) Barrier Free Design

Design of curb ramp and sidewalk for the blind in the project adopts the concept of barrier free design.

At both ends of the level intersection, the curb ramps adopt slope pattern in three sides, with a width smaller than or equal to that of the sidewalk and accurate alignment. Four pairs, or 8 curb ramps should be arranged at a crossroad, and 3 pairs, or 6 curb ramps for a T road. At small intersection or inlets/outlets along the road, curb ramp with slope in one side should be arranged. Slope of curb ramp is 1/10 to 1/12, and width of the front slope should be no less than 1.20m. The slope should be flat but rough, and the exposure height of the rimstone on the front slope should not be more than 20mm, for convenience of wheelchairs. On the sidewalk, the blind track can be connected to curb ramp, but with a spacing of 20-30cm.

Sidewalk is an important part of urban road and the safest and most convenient walking track for people. Sidewalk for the blind should be included in main urban road to assist the blind to walk safely and conveniently using a tactile stick or by foot touch.

(8) Greening of Roads

Under this project, design of greening of the roads is for the area within land use scope for the road construction. Areas that can be used for greening are the separator between motorized and non-motorized lane, some of the sidewalk and slope along the roads, and etc.

Planting is planned for the separator, sidewalk and road slope. For the lane separator, bush of about 1 m high can be planted and interplanting of bushes for special landscaping effect can also be done. Trees can be planted along the sidewalk to beautify environment, induce sight and provide sun shade. On slopes along both sides of the road, grass seeds or turf can be used for environmental beautification and slope stability.

(9) Illuminating Engineering

High pressure sodium lamp (HPSL) will be used for motorized lane, and the light will be of water and dust proof type. Protection standards for the light source cavity and electric cavity are set as more than IP54 and IP43, respectively. HPSL is also selected for non-motorized lane and sidewalk. Light source at the converging part of roads will use medium-height-pole lights, corresponding to lights of motorized lane.

The lamps will be arranged in the separators, with a distance of 1.0m from the center of the poles to rimstones. Symmetrically along both side of the road, the HPSLs (250/150w) will be installed on single pole (12m high, with a spacing of 30-35m) with two overhanging arms (at an angle of 10°).

(10) Bridges and Culverts

1) Crossing-river Bridges

Roads involving crossing-river bridges include mainly 5 roads along the artificial lake or crossing artificial waterways, such as Binhexi Road, Jinyi Road, Liujiagou Road extension section, Erwei Road and Siwei Road extension section. Simple supported beam bridge is designed for these roads, with details shown in the following table.

Table 2.5-18 Design of Crossing-river Bridges

No.	Roads	Length of Bridge	Width of Bridge
		m	m
1	Binhexi	150	18
2	Jinyi	100	40
3	Liujiagou Rd Extension	80	40
4	Erwei	60	45
5	Siwei Rd Extension	70	32

2) Crossing-railway Bridges

Roads involving crossing-railway bridge are Liujiagou Road, Erwei Road and Sanwei Road, for which simple supporting beam bridges are designed. See Table 2.5-19 for details of the bridges.

Table 2.5-19 Design of Crossing-Railway Bridges

No.	Roads	Length of Bridge	Width of Bridge	Area of Bridge
		m	m	m2
1	Liujiagou	160	26	4160
2	Erwei	150	26	3900
3	Sanwei	100	26	2600

3) Undercut Railway Culvert

Totally, 3 such culverts are needed for the roads included in the project, as shown in the following table.

Table 2.5-20 List of Undercut Railway Culverts

No.	Roads	Length of Culvert	Width of Culvert	Area of Culvert
		m	m	m^2
1	Huijin	15	18	270
2	Huiwen	15	18	270
3	Jinshui	15	18	270

(11) Main Quantities

For roads in Beichuan Area, Table 2.5-21 shows the amounts of works and Table 2.5-22 amounts of earthworks.

Table 2.5-21 Amounts of Works for the Roads

No.	Names of Roads	Length of Road m	Class of Road	Red-line Width m	Width of Motorized Lanes m	Width of Non-motorized Lanes m	Width of Side walks m	Green Belts		Trees along Side walks No.	Lights No.	Signal Lights No.
								m	Area m^2			
1	Jinyi	528.157	Main	40	22	6	8	4	2112.63	170	30	78
2	Beiyuanbei	215.885	Tertiary	18	11	——	7	——	——	70	12	
3	Beiyuan	651.596	Tertiary	18	11	——	7	——	——	210	37	
4	Goubei	734.952	Tertiary	18	11	——	7	——	——	237	42	
5	Liujiagou	987.717	Main	40	22	6	10	4	3950.87	319	56	
6	Weisi	497.723	Tertiary	18	11	——	7	——	——	161	28	
7	Huijin	600.546	Secondary	24	15	——	9	——	——	194	34	
8	Erweibei	718.518	Tertiary	18	11	——	7	——	——	232	41	
9	Erwei	947.004	Main	45	22	8	9	6	5682.02	305	54	
10	Erweinan	749.423	Tertiary	18	11	——	7	——	——	242	43	
11	Huiwen	529.737	Secondary	24	15	——	9	——	——	171	30	
12	Sanweibei	338.572	Tertiary	18	11	——	7	——	——	109	19	
13	Sanwei	407.538	Main	32	22	——	10	——	——	131	23	
14	Jinshui	419.102	Secondary	24	15	——	9	——	——	135	24	
15	Yuquan	549.778	Tertiary	18	11	——	7	——	——	177	31	
16	Siweibei	534.422	Tertiary	16	9	——	7	——	——	172	31	
17	Weishisan	513.6	Tertiary	16	9	——	7	——	——	166	29	
18	Weishisi	420.5	Tertiary	16	9	——	7	——	——	136	12	
19	Siwei	988.449	Main	32	22	——	10	——	——	319	28	
20	Tiedong	3346.366	Main	32	22	——	10	——	——	1079	191	
21	Tiedong Rd South Extensi	1246.8	Main	32	22	——	10	——	——	402	71	

No.	Names of Roads	Length of Road m	Class of Road	Red-line Width m	Width of Motorized Lanes m	Width of Non-motorized Lanes m	Width of Sidewalks m	Green Belts m	Green Belts Area m^2	Trees along Sidewalks No.	Lights No.	Signal Lights No.
	on											
22	Binhexi	4347.195	Tertiary	18	11	——	7	——	——	1402	248	
23	Binhexi Rd North Extension	1192	Tertiary	18	11	——	7	——	——	385	68	
24	Zhenxing	2709.145	Tertiary	18	11	——	7	——	——	874	155	
25	Zhenxing Rd South Extension	882.05	Tertiary	16	9	——	7	——	——	273	24	
26	Zhenxingdong	912.765	Tertiary	18	11	——	7	——	——	294	52	
27	Zhenshui	1030.46	Tertiary	18	11	——	7	——	——	332	59	
	Total	**27000**							**11745.52**	**8698**	**1476**	

Table 2.5-22 Amounts of Earthworks for the Roads

No.	Names of Roads	Length of Road	Class of Road	Red-line Width	Fill	Excavation	Replacement	Remark
		m		m	m^3	m^3	m^3	
1	Jinyi	528.157	Main	40	204678.50	123.28	9506.83	Replacing the original soil with natural gravel after top layer clearance
2	Beiyuanbei	215.885	Tertiary	18	7067.92	1349.28	1748.67	
3	Beiyuan	651.596	Tertiary	18	21332.78	4072.47	5277.93	
4	Goubei	734.952	Tertiary	18	24061.80	4593.44	5953.11	
5	Liujiagou	987.717	Main	40	101341.91	6406.23	17778.91	
6	Weisi	497.723	Tertiary	18	6316.43	12551.12	4031.56	
7	Huijin	600.546	Secondary	24	10161.77	20192.03	6485.90	
8	Erweibei	718.518	Tertiary	18	9118.47	18118.93	5820.00	
9	Erwei	947.004	Main	45	21878.14	11355.71	15341.46	
10	Erweinan	749.423	Tertiary	18	2670.85	16025.11	6070.33	
11	Huiwen	529.737	Secondary	24	2517.22	15103.35	5721.16	
12	Sanweibei	338.572	Tertiary	18	1206.63	7239.78	2742.43	
13	Sanwei	407.538	Main	32	2933.40	44001.03	5868.54	
14	Jinshui	419.102	Secondary	24	16857.70	4888.95	4526.30	
15	Yuquan	549.778	Tertiary	18	16585.44	4809.99	4453.20	
16	Siweibei	534.422	Tertiary	16	14740.29	4274.87	3957.78	
17	Weishisan	513.6	Tertiary	16	16380.69	3206.66	3697.92	
18	Weishisi	420.5	Tertiary	16	13411.37	2625.39	3027.60	
19	Siwei	988.449	Main	32	12604.00	58475.74	16267.04	
20	Tiedong	3346.366	Main	32	243917.39	113613.58	48187.67	
21	Tiedong Rd South Extension	1246.8	Main	32	90879.54	42330.51	17953.92	
22	Binhexi	4347.195	Tertiary	18	400308.77	54920.39	35212.28	
23	Binhexi Rd	1192	Tertiary	18	109764.60	15059.16	9655.20	

No.	Names of Roads	Length of Road	Class of Road	Red-line Width	Fill	Excavation	Replacement	Remark
		m		m	m^3	m^3	m^3	
	North Extension							
24	Zhenxing	2709.145	Tertiary	18	180273.47	42982.14	21944.07	
25	Zhenxing Rd South Extension	882.05	Tertiary	16	50063.67	11936.55	6094.08	
26	Zhenxingdong	912.765	Tertiary	18	57504.20	13143.82	7393.40	
27	Zhenshui	1030.46	Tertiary	18	59354.50	14467.66	8346.73	
Total		**27000**			**1697931.45**	**547867.17**	**283064.02**	

2.6 Demonstration for Reuse of Reclaimed Water

2.6.1 Relationship between the No.5 WWTP and this Project Component

No.5 WWTP was established with a total investment of RMB 118 million and is located in Shuangsubao Village of Ershilipu Town in the Chengbei District of Xining, with a daily capacity of 30 thousand tons/day and a total of 17.6 km of pipeline. After being constructed, the WWTP has been functioning in collecting and treating sewage from residential areas in the towns/townships and of enterprises in Beichuan Area. In the WWTP, multiple-step AO denitrificaiton and phosphorous removal +coagulating sedimentation +filtration technology is used to meet Class-1A treatment standards for discharge of effluent. The following table gives the details.

Table 2.6-1 Discharge Standards of Pollutants from WWTP
(Daily Average Value) Unit: mg/l

No.	Basic Control Item		Class-1 Standard	
			A	B
1	Chemical oxygen demand (COD)		50	60
2	Biochemical oxygen demand (BOD_5)		10	20
3	Suspended solid (SS)		10	20
4	Animal and vegetable oils		1	3
5	Petroleum		1	3
6	Anionic surfactant		0.5	1
7	Total nitrogen (calculated based on N)		15	20
8	Ammonia nitrogen (calculated based on N) ②		5(8)	8(15)
9	Total phosphorus (calculated based on P)	Developed before Dec. 31, 2005	1	1.5
		Developed since Jan. 1, 2006	0.5	1
10	Chroma (dilution ratio)		30	30
11	pH		6-9	6-9
12	No. of fecal coliform group (Nr./ l)		10^3	10^4

Notes: ① In following cases, removal rate indicators shall be: when influent COD is more than 350mg/l, the removal rate shall be more than 60%; when BOD is more than 160mg/l, the removal rate shall be more than 50%. ② Values outside the brackets are the control indicators when the water temperature is more than 12 ℃ and those inside are the control indicators when the water temperature is not more than 12 ℃

It is planned in the project to use the discharged water from the No.5 WWTP to produce reclaimed water through further treatment including sterilization, and reuse the reclaimed water for greening and road watering in the city.

2.6.2 Identification of Users of Reclaimed Water

As per the project feasibility study, reuse of reclaimed water will be included as a demonstration under the project, mainly for urban miscellaneous water uses such as greening and road watering.

2.6.3 Amount of Reclaimed Water Supply

Based on information collected from Beichuan Garden and Greening Division, the greening area in Beichuan Area in 2012 totaled 9 ha., costing 110 thousand yuan for water tariff payment. Data from Xining Water Supply Company indicate that water tariff for greening purpose was 1.48 yuan/m^3 in 2012, and the greening water use in Beichuan Area totaled 74,324.32 m^3 for 217 days, or 3.80 l/m^2.d, higher than the national standard of 1-3l/m^2.d. Considering that Xining is in arid area and needs more water for irrigation of greening area, the actual higher water use quota, i.e. 3.8 l/m^2.d is adopted for calculation. Since no data are available for water usage for road watering purpose in Beichuan, medium value (2.5 l/m^2.d) of the standard water use for road watering as stipulated in the national norm is applied for calculation.

Water use for greening in Beichuan Area:

103x10000x3.8/1000=3914 m^3/day.

Water use for road watering in Beichuan Area:

42x10000x2.5/1000=1050 m^3/day.

Thus, reuse of reclaimed water as urban miscellaneous water uses in Beichuan Area can be 4964 m^3/day for 217 days from March to October each year.

2.6.4 Scale of Reclaimed Water Plant

Based on data from investigations on actual water uses and planning indexes, urban miscellaneous water uses in Beichuan Area is 4964 m^3/day. Accordingly, the reclaimed water facility in the existing No.5 WWTP is designed with a capacity of 5000 m^3/day, and its water storage tank , together with pipeline for reclaimed water, are all designed based on this capacity.

2.6.5 Quality of Produced Reclaimed Water

Quality of reclaimed water discharge from the reclaimed water plant is shown in Table 2.6.2 that follows.

Table 2.6-2 Quality of Reclaimed Water Discharge from the Reclaimed Water Plant

No.	Basic Parameters	Discharge Standard	Unit
1	SS	≦10	mg/L
2	BOD_5	≦10	mg/L

3	COD_{cr}	≦50	mg/L
4	NH_4-N	≦5(8)	mg/L
5	TN	≦15	mg/L
6	TP	≦0.5	mg/L
7	Animal and Vegetable Oils	≦1	mg/L
8	Petroleum	≦1	mg/L
9	Anionic Surfactant	≦0.5	mg/L
10	Chroma	≦30	
11	PH	6~9	
12	Number of Fecal Coliforms	≦1000	（No./l）
13	Fe	≦0.3	
14	Mn	≦0.2	
15	TDS	≤1000	
16	Free Chlorine Residue	0.1~0.2 at end of pipe	

2.6.6 Selection of Treatment Technology for the Reclaimed Water Plant

Based on quality analysis of discharged water from No.5 WWTP, the discharged water can directly meet quality requirements for reuse for greening and road watering purposes without any other additional treatment than sterilization. Therefore, the workflow of reusing about 5000 m^3/day of reclaimed water for greening and road watering under this project will be:

Discharged Tail Water from WWTP → Sterilization → Reclaimed Water Storage Pond for Reutilization → Submerged Pump → Users

2.6.7 Site Selection for the Reclaimed Water Plant

To the west of the No.5 WWTP is an open space, large, flat and immediately adjacent to the WWTP, and thus suitable for layout of treatment process. Therefore, the space is selected to accommodate the reclaimed water plant to be constructed under the project.

According to Construction Land Index for Municipal Solid Waste Disposal and Waste Water Treatment Projects and technology of the reclaimed water plant, the reclaimed water plant will use 1.78 mu of land in total.

2.6.8 Engineering Analysis of the Reclaimed Water Facility

Details of the planned reclaimed water plant are shown in the following tables.

Table 2.6-3 Engineering Analysis of the Reclaimed Water Facility

Location	West of the No. 5 WWTP
Capacity	5000m^3/d
Area	1.78 mu
Inflow Quality as Designed	Discharge water from No. 5 WWTP meeting Class 1A standard as per Standard for Discharge of Pollutants from Municipal Sewage Treatment Plants（GB18918-2002）
Outflow Quality	Class 1A standard as per the Standard for Discharge of Pollutants from Municipal Sewage Treatment Plants（GB18918-2002）, including fecal coliform (No./L)≤3, Turbidity《5
Processing Technology	Sterilization
Construction Activities	1 storage pond of 1000 m3, 15.9x15.9x4.5m ,with effective water depth of 4.0m, reinforced concrete structure, and monolithic raft foundation
	2 submerged pumps, including one for back-up, each with flow capacity of 630m3/hr, lift of 14m, power of 37kW
	Pipes for reclaimed water of 4650m，DN200～400, layout of pipes see Table 2.6-4, foundation shown in Table 2.6-5 and Fig.2.6-1
Plan Layout	Layout of the reclaimed water plant is shown in Fig.2.6-2
	Layout of pipes is shown in Fig.2.6-3

Table 2.6-4 Quantities for Pipes

No.	Locations	Pipes of Reclaimed Water		Type of Wells		Crossing or Undercut
		DN	m	Diameter	No.	
1	Connection Section with WWTP	DN400	340			1 crossing through Chaoyangdianqu Canal, 1 undercut thru High Speed Rail, 1 crossing thru expressway
2	Beiyuan Rd Extension Section	DN400	350	1800	2	1 crossing with Liujiagou extension section
3	Binhe Road	DN400	940	Recharge Well:1500	6	1 crossing thru Huangshui River
		DN300	1450			
		DN200	1920			
4	Blast Pit			1500	4	
5	Drainage Well			1500	4	
Total			4650		16	

Table 2.6-5 Design of Minimal Ditch Width and Slope

Depth（m） Dimension （mm） DN(mm)	Ditch Depth H≤4.0m		Ditch Depth 5.0m＞H＞4.0m	
	Ditch Width Lmin （mm）	Slope （H：W）	Ditch Width Lmin （mm）	Slope （H：W）
<300	1000	1:0.75	1100	1:1
400	1100	1:0.75	1200	1:1
500	1300	1:0.75	1400	1:1
600	1600	1:0.75	1800	1:1

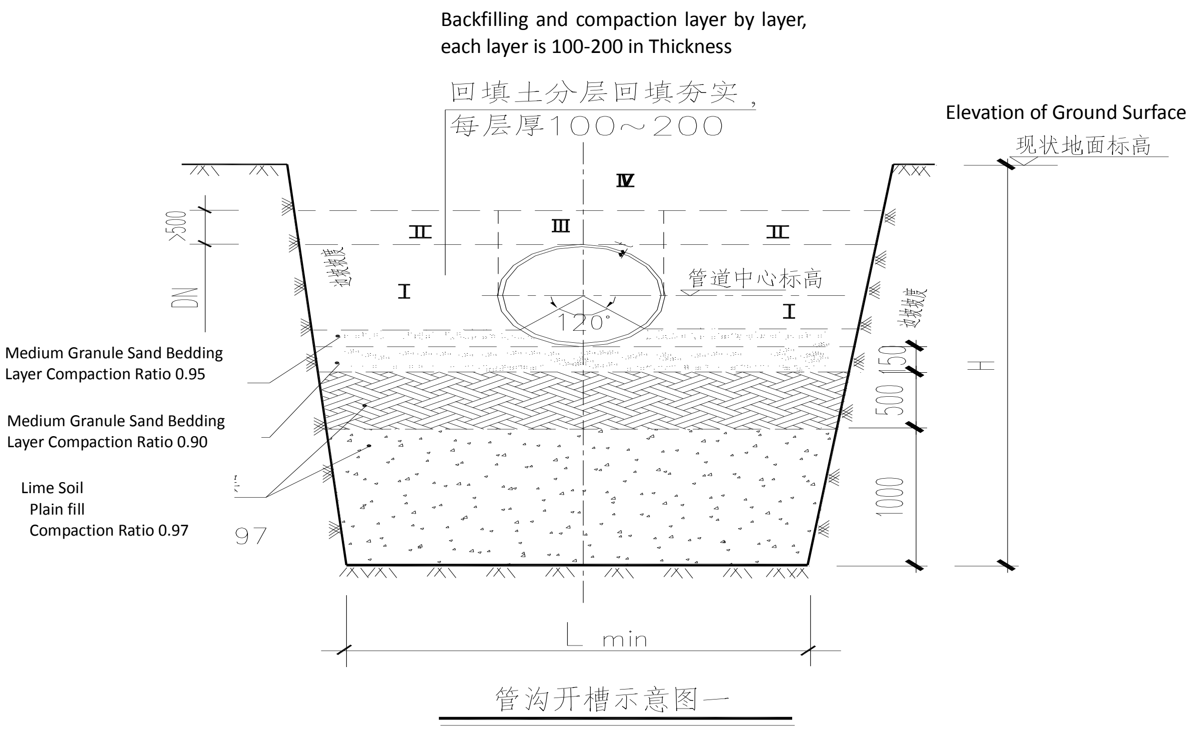


Figure 2.6-1 Illustration of Excavation of Ditch for Pipes

2.6.9 Monitoring of Outflow Quality

Water quality monitoring should be conducted in the storage pond to ensure quality of the reclaimed water meeting specifications in Standard for Discharge of Pollutants from Municipal Sewage Treatment Plants（GB18918-2002）for greening and road watering uses. Such quality specifications are shown in Table 2.6-6.

Table 2.6-6 Water Quality Indexes and Threshold Limits
(for Municipal Miscellaneous Water Uses)

No.	Item Indicator	Toilet Flushing	Road Cleaning, Fire Prevention	City Greening	Car Washing	Building Constructio n
1	PH	6.0~9.0				
2	Chroma ≦	30				
3	Smell	No displeasure				
4	Turbidity (NTU) ≦	5	10	10	5	20
5	Total dissolved solid (mg/l) ≦	1500	1500	1000	1000	–
6	BOD_5 (mg/L) ≦	10	15	20	10	15
7	Ammonia nitrogen (mg/l) ≦	10	10	20	10	20
8	Anionic surfactant (mg/l) ≦	1.0	1.0	1.0	0. 5	1. 0
9	Iron (mg/L) ≦	0.3	-	-	0. 3	–
10	Manganese (mg/l) ≦	0.1	-	-	0. 1	–
11	Dissolved oxygen (mg/l) ≧	1.0				
12	Total residual chlorine (mg/l)	More than 1.0 after 30 min of contact and more than 0.2 at ends of pipe network				
13	Total coliform group (Nr./ L)	3				
Note: For water used for concrete mixing, requirements in JBJ63 should be met.						

Outflow from the WWTP is monitored by using the on-line water quality monitoring system installed by local environmental protection bureau. Testing of the outflow quality is done and recorded every day by the WWTP, and the monitored indexes include BOD_5, COD, ammonia nitrogen, DO, PH, TN and TP, for which data can be made available upon request to the WWTP. For other indexes, such as TDS, LAS, Fe, Mn, turbidity, chromaticity and etc., the suggestion is to entrust the WWTP testing lab to test three times a week during usage period of reclaimed water and prepare monthly reclaimed water quality report.

2.6.10 Personnel Allocation

In accordance with the Standard for Construction of Municipal Sewage Treatment Plant Projects and based on specific features of this project and the reclaimed water plant, 4 persons will be needed for operation and maintenance of the pumps and pipes of the reclaimed water plant.

2.6.11 Plan for Use of Reclaimed Water as Municipal Miscellaneous Water

As a pilot to demonstrate reuse of reclaimed water in Beichuan Area as municipal miscellaneous water, it is not appropriate for the project to construct big scale pipelines for reclaimed water. Therefore, a main pipe is proposed to be arranged along a road with bigger greening area and convenient condition for water tanker replenishment, and the selected road is Binhe Road. Along both sides of the Binhe Road are bigger greening areas, and the road has lower elevation that means easier pipe water conveyance and thus smaller lift of pumping.

In Beichuan Area, water tankers will be used for reuse of reclaimed water for greening and road watering. Two water tankers, each with storage of 25 m^3, will be provided for road watering and drive along set routes to spray water on roads. Two water tankers, each with storage of 25 m^3, will be used for irrigating greening areas along roads with wider cross-section, such as Erwei Road, Beiyuan Road extension section, and Tiedong Road; Two water tankers, each with storage of 10 m^3, will serve irrigation of greening areas along roads with narrow cross-sections, such as Weiyi Road, Weier Road, Weisan Road, Weisi Road, Weishisan Road and Jingyi Road south extension section. All these water tankers will get replenishment at closest filling point along the reclaimed water pipeline. Costs incurred for procurement of these water tankers and incremental personnel will be responsibilities of Beichuan Area Garden and Greening Division, instead of costs to be included in project.

Fig. 2.6-1 Layout of Reclaimed Water Plant

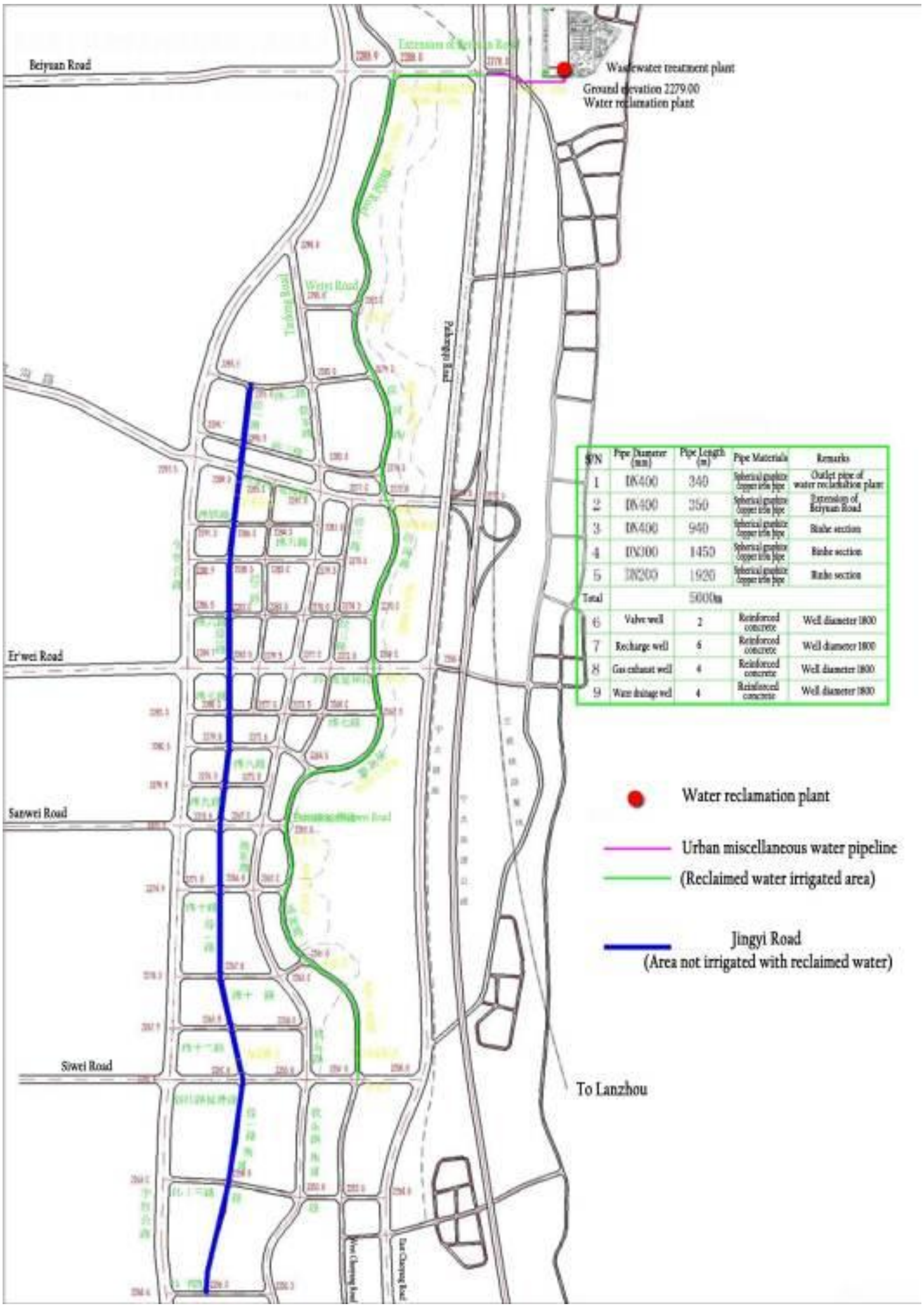


Fig. 2.6-3 Layout of Reclaimed Water Recycling Pipe Network

2.7 Low Impact Development and River Bank Environmental Improvement

2.7.1 Problems Existing with the River Banks to Be Improved

Based on field survey, it is found that the river banks to be improved have the following problems:

(1) Lack of basic infrastructure for waste water collection and sanitation along the river banks, and thus serious pollution along the river banks;

(2) Spoil can be seen everywhere along the river banks and, during rainstorms, flood may wash down the spoil into the river and cause serious pollution to water environment of Xining;

(3) River bank scouring occurs during rainy days and bare soil from river banks is washed into river, resulting in water and soil erosion;

(4) Poor visual effect without river bank improvement, incompliance with water environment development master plan of Xining.

2.7.2 Objectives of This Component

Through protecting and stabilizing river banks, controlling water pollution and purifying rainwater, this component aims at improving river bank environment of Beichuan River, solving the 'dirty and muddy water' problem existing with Beichuan River, so as to reduce water and soil erosion and improve river bank landscape and adjust microenvironment.

2.7.3 General Ideas on River Bank Improvement

This proposed project will tackle the environmental problems of the river banks mainly by: firstly, collecting rainwater in the area for treatment and reuse to reduce initial rainwater pollution to water bodies; secondly, cleaning and transferring the spoil currently piling up along the river banks to new development area closeby for use as filling soil in depression areas or foundations; thirdly, leveling the site based on earthwork balance design and backfilling with gravel and humus; fourthly, planting grass, bush, woody plants on the top to prevent soil and water erosion; fifthly, constructing small path, maintenance room, sanitation facilities and etc. to provide comfortable environmental for local residents.

2.7.4 Scale and Activities of Beichuan River Bank Environmental Improvement

Totally 600 thousand m^2 of the river bank area is planned to be improved with activities including LID rainwater treatment and reuse system, site leveling, greening and other ancillary facilities (for lighting, watering for greening areas, footpath, sanitation, maintenance rooms and etc.).

2.7.5 Design of LID Rainwater System

In initial rainfall there are lots of pollutants, which, if washed into river, may cause serious pollution to river water and higher peak flow. Therefore, it is planned to adopt LID rainwater system in core section of Beichuan River to control runoff and pollution caused by rainstorm at the source, so that runoff in that area can be more like that in a natural hydrological cycle.

Dispersed rainfall collection and treatment is planned for the LID rainfall system, including ecological rainfall collection system on road, biological retention ponds along the road, and infiltration depression.

(1) Ecological Rainfall Collection and Treatment System: By specific arrangement at road cross-sections, rainwater on the road can be drained into tree pits or greening areas along the road, so as to reuse the rainwater to irrigate greening area or replenish groundwater, thus turning rainwater as useful resources. By doing so, rainwater can be retained as much as possible for use by greening area along the road.

Figure 2.7-1 gives details of the rainwater collection and reuse and Figure 2.7-1 shows the steps to achieve the purpose.

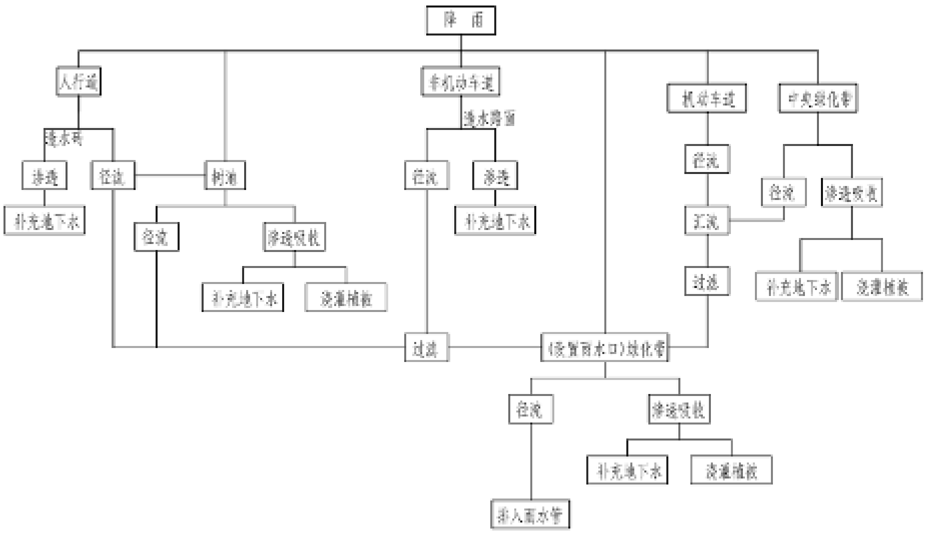


Figure 2.7-1 Rainfall Collection and Reuse System

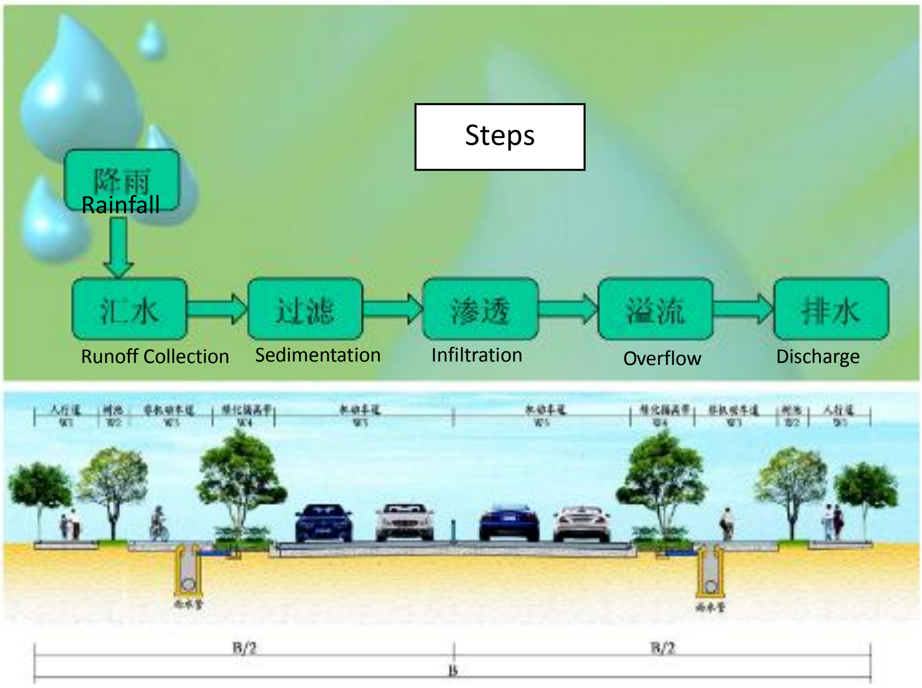


Figure 2.7-2 Steps of Rainwater Collection and Reuse

(2) Biological rainwater retention and infiltration depression technology: This technology is to imitate hydrological functions of forest environment by forming a spongy litter layer of fallen leaves and branches to absorb water and leak water little by little into soil layer. In the process of direct contact with rainwater, soil and roots of woody, bush and grass plants will take up or filter nutrients in rainwater and thus improve water quality of the rainwater. In such process, most rainwater will be used or retained or will infiltrate into deeper soil layer, rainwater runoff will be greatly reduced, thus possibility of peak flood reduced.

1）Figures 2.7-3 and 4 show details of biological retention pond.

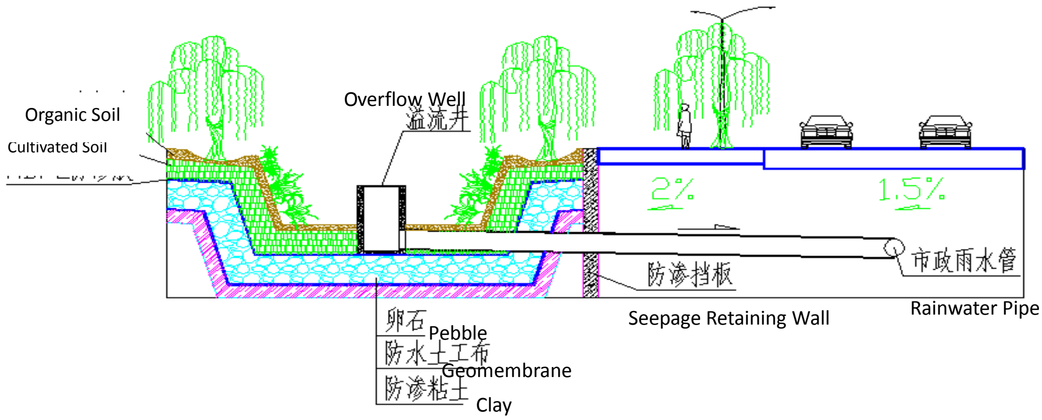


Figure 2.7-3 Sketch of Biological Retention Pond

2) Figures 2.7-5 and 6 show details of infiltration depression.

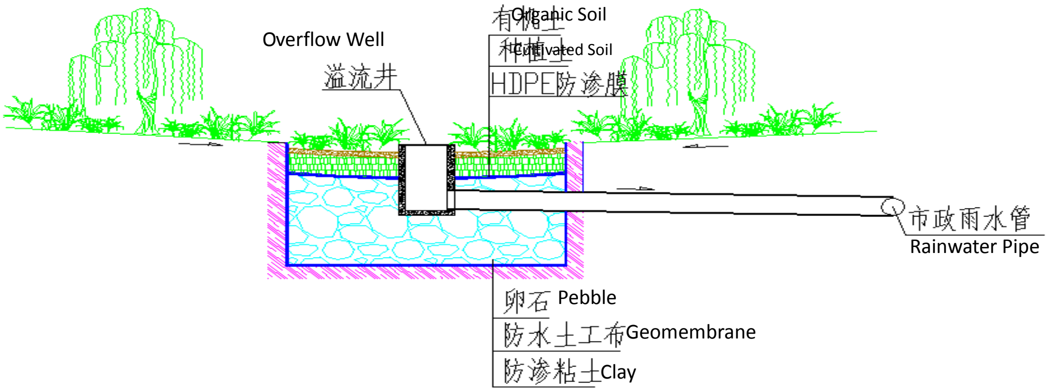


Figure 2.7-5 Sketch of Infiltration Pond

Figure 2.7-6 Typical Infiltration Depression

（3）General layout of LID rainwater collection and treatment is should in Figure 2.7-7.

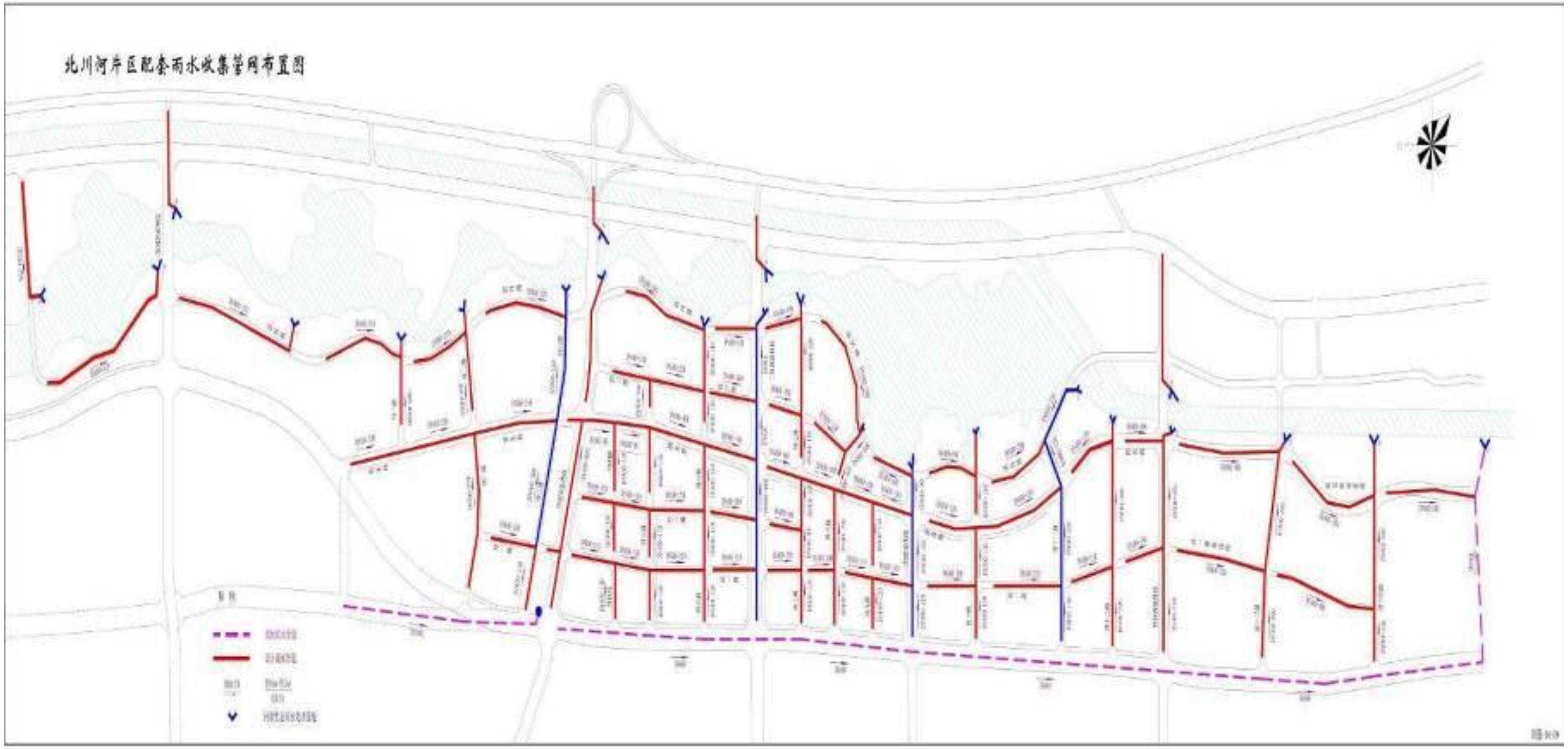


Figure 2.7-7 General Layout of LID Rainwater Collection and Treatment System

（4）Main Qualities of LID Rainwater Collection and Treatment System: See Tables 2.7-1 through 4 for details.

Table 2.7-1 Amounts of Materials for the System in Streets

Bush（No.）	30-80mm Pebble Infiltration Layer（m^3）	Seepage-proof Clay（m^3）	Seepage-proof Geomembrane（m^2）	Cultivated Soil（m^3）	HDPE Film（m^2）	Volume（m^3）	Organic Soil（m^3）	Concrete Retaining Wall（No.）	Overflow Well（No.）
40900	20450	1200	5950	5000	33100	40950	5110	336	227

Table 2.7-2　Amounts of Materials for the System along River Banks

30-80mm Pebble Infiltration Layer（m^3）	Seepage-proof Clay（m^3）	Seepage-proof Geomembrane（m^2）	Cultivated Soil（m^3）	HDPE Film（m^2）1.5mm	Volume（m^3）	Overflow Well（No.）
10921	3084	15419	1628	10855	19021	23

Table 2.7-3 Amount of Materials for Biological Retention Pond

	Volume m^3（1.2x1.2x1)	30-80mm Pebble Infiltration Layer（m^3）	Cultivated Soil（m^3）	Organic Soil（m^3）
Total	12524	5009	2505	2505

Table 2.7-4　Specific Materials

	Concrete Retaining Wall（m3）	0-80mm Pebble Infiltration Layer（m^3）
Total	97	479

2.7.6 Site Cleaning and Improvement along River Banks

2.7.6.1 Waste Soil Cleaning and Transport

Waste soil here refers to the dirt produced in daily lives of local people and spoil from construction and demolition of buildings, structures and pipes, as well as waste soil, material and other garbage produced in the process of house decoration by local people. The local people dump such waste soil in the river bank area, which has impacted on Beichuan River and the river bank environment, therefore, cleaning of such waste soil along the river bank is included in the project proposed. Based on field surveys, the area planned to be improved has about 2,300 m^3 of waste soil. The waste soil will be transported to landfill assigned by project owner. The quantities are shown in Table 2.5-7.

Table 2.7-5 Quantities of Waste Soil Cleaning

Activities	Quantities	Unit	Remarks

Waste Soil Cleaning	2300	m^3	Transport to Yinjiagou domestic solid waste landfill.
Site Leveling	28.1	10^4m^3	Source: Spoil from construction site in core area of Beichuan River

2.7.6.2 Site Land Leveling

According to elevation of roads in the surrounding area and topographic map provided by project owner and based on overall profile design, grid computing method is used to calculate earthwork quantities, and the grids are in right north-south direction , with a spacing of 20mx20m. The results from the calculation are: filling quantity is 373 thousand m^3, excavation quantity is 88 thousand m^3. If loose soil coefficient is taken as 5%, then the actual excavation quantity will be 92 thousand m^3. After filling-excavation balancing, there is 281 thousand m^3 more filling than excavation, as shown in Table 2.7-6. Source of material for filling is core area of Beichuan River.

Table 2.7-6 Earthwork Balancing Calculation

Activities	Earthwork（10^4m^3）		Remarks
	Filling（+）	Excavation（-）	
Land Leveling	37.3	8.8	
Loose Soil Quantity		0.4	Loose soil coefficient is taken as 5%
Total	37.3	9.2	
Filling-Excavation	28.1		

2.7.7 Design of Site Greening

Site greening is necessary for water and soil conservation and improvement of river bank eco-environment.

2.7.7.1 Greening for Water and Soil Conservation

Bare surface, loose soil and arbitrarily piled-up spoil along the river banks and on the river shoal are the reasons for serious water and soil erosion and river channel blockage. Therefore, appropriate mix of woody, bush and grass plants, including evergreen trees and deciduous trees, should be considered for greening to be supported by the project to suit the local conditions, based on ecological habits and seasonal changes of the species. Proper mix of the plants with woody, bush and grass species can help to make better use of the roots' capability to stabilize soil, so as to beautify environment while conserving soil and water.

2.7.7.2 Current Status of Vegetation at the Site

Xining City is located in high latitude area and characterized by plateau semi-arid climate, with longer winter and little precipitation, and deciduous broad-leaved plants is its dominant vegetation type.

Currently, land use along the river banks is mainly for farming, and singular species of agricultural crops form the local vegetation type.

2.7.7.3 Selection of Plant Species and Design of the Mix of Plants

The selection will consider both fast-growing and slow-growing species, and ensure woody trees mixed with bush and grass plants, as well as combination of evergreen trees with deciduous trees, so as to establish a greening environment with clear-cut seasonal features and the sense of layered appearance.

Native tree species are selected as the major tree species. The advantages of doing so include: first, highlighting the local characteristics; second, adaptability, strong ability against disease, and growing well; third, easiness of getting the seeds and seedlings, which can save the cost.

2.7.7.4 Design of Plant Layout for the Greening

The overall layout is based on the spatial pattern and line of sight of the two greening belts along both river banks, the small islets in the middle of the river and the water areas separated by the islets. In the design, the focus is on the 'waterscape' together with its corresponding plant landscape, so that a landscape featured by 'a sheet of water together with a stretch of green' can be formed. Meanwhile, the plant type selected should be helpful to remedy the disadvantage that the plateau city has no scenery in autumn and winter, suitable to the local natural conditions, capable of self-renewal, with lower cost for planting and maintenance, and reflect the local features of natural landscape. Emphasis should be put on showing the natural distribution characteristic and entire landscape effect of the flora, improving the local ecological environment which currently has vegetation of few species and sparse vegetation flora, and achieving the effect of purifying water in Beichuan River.

Figure 2.7-8 General Layout of Greening along Banks of Beichuan River

2.7.7.5 Plan of Plant Arrangement

According to local climatic, geologic and topographic conditions of Xining, proper plant mix including mainly native trees and consisting of woody, bush and grass species is determined to ensure healthy growth of the selected plants and beautiful seasonal aspects. Willow is selected as trees along the footpath, and flowers and grass, flower and bush, and quasi-woody trees will be arranged one belt after another to form gradually elevated layers of plants. The plants to be adopted are willow, Albizia julibrissin, Syzygium aromaticum, Cathay poplar, reed, peony, Berberis thunbergii, Lythraceae, Caryopteris clandonensis and etc.

Quantity of plants for greening is shown in Table 2.7-7 and the arrangement plan is illustrated in Figure 2.7-8.

Table 2.7-7 Quantities for Greening

Item	Quantity	Unit	Remark
Greening Area	60	$10^4 m^2$	

2.7.8 Other Ancillary Structures

2.7.8.1 Design of Footpaths

Footpaths along Beichuan River Bank can be divided into main path, branch path and tertiary path at 3 levels, with the main path being 5m in width to also allow for maintenance vehicle, branch path being 2m wide, and tertiary path being 1.2m wide to facilitate garden tour. Within the planning scope, design of traffic roads should be based on modern traffic concept and the public transit system should be connected with entrance and exit paths of the river bank greening area, so as to ensure people in the surrounding areas can have easier accesses by using public transit system, instead of private cars. By doing so, traffic pressure and the resulted pollution in the river bank area can be reduced.

Main path, 5m wide, to allow for maintenance vehicles to drive on;

Branch path, 2m wide, mainly for garden tour;

Tertiary path, 1.2 m wide, also for garden tour.

Total Area: 119775.19 m^2.

Water-permeable bricks plus pebble facing will be adopted for the footpaths. The quantity of footpaths is shown in Table 2.7-8, and Figure 2.7-9 illustrates the details of the design.

Table 2.7-8 Quantity of Footpaths

Item	Quantity	Unit	Remark
Area of Footpaths	11.9	10^4m^2	

2.7.8.2 Illumination Design

1) Illumination design includes two parts, footpath and greening area.

2) For lighting of footpaths, garden lamps and landscape lamps with 3.5 -5.5m high posts are selected, and the lamps will be 70W-150W metal halide lamps with a spacing of 15m-25m.

3) Lawn lamps of certain amount should be installed, with height range of 0.3 to 0.6m, fluorescent lamps with a spacing of 15m are suggested for this purpose.

4) Types of lamps should accord with the style or theme of the specific area.

5) Lighting control box should be installed in box-type substation. Intellectual timing control combined with manual control should be adopted and the selected control system should be simple, reliable and easier in operation. Electricity circuits need be arranged in various zones to meet specific controlling requirements.

2.7.8.3 Design of Water Supply for Greening

Reclaimed water plant within the existing No.5 WWTP will be the water source of the greening area. The water supply pressure is 0.40Mpa, capable of meeting the requirement for water use by the greening area. Two water diversion pipes of DN200 will be connected to the reclaimed water plant.

Sprinkler irrigation combined with water intaking valves will be applied for irrigating the greening area. For large area, sprinkler irrigation will be used with nozzle service range of 10.0m. Locations of nozzles can be adjusted to avoid roads, buildings, planted trees and flowers, where necessary. Height of the nozzle should ensure no blockage of spray by the objects for sprinkler irrigation. For irregular zones, soft tubes or intaking valves can be used for flexible irrigation to save water. PE pipes are adopted for water supply to the greening area and will be installed based on local topographic features, with a depth of 1.8 m for main pipeline and 0.7m at the end of the branch pipeline. Brick valve wells with a slope of 0.3% and discharge valves will be arranged to facilitate water discharge in winter. Foundation of the pipes will be prepared in line with Technical Norms for Installation of Underground PE Water Diversion Pipes (CJJ101-2004).

Table 2.7-9 shows details of materials needed for water supply to the greening area.

Table 2.7-9 Materials Needed for Water Supply to Greening Area

No.	Items	Quantities	Unit	Remarks
1	DN200	1500	m	PE pipe
2	DN100	1880	m	PE pipe
3	DN80	780	m	PE pipe
4	Nozzle	1930	个	Type 3500, 0.17l/s,0.3mpa

2.7.8.4 Design of Sanitation Facilities

(1) Resting Benches (70 sets)

Such benches should be suitable for the purpose, simple to install, durable, easier for cleaning, and can be installed in accordance with locations of trees, so as to provide better service to people.

(2) Dustbins (400 sets)

The dustbins should be located in places where people would stay for longer time for resting or with more passers-by, thus with more litters casted off by people. Locations of dustbins should be considered in accordance with layout of greening area and the ground for dustbins to stand on should be leveled and compacted.

(3) Direction Boards (30 in number)

Direction boards need to be designed to achieve the effects of introduction, notification and intention building, based on angle, direction and distance of the viewers, and full consideration of needs of the disabled. Systematic layout to suit specific space should be adopted.

(4) Toilets (10 in number)

Mobile toilets can be re-assembled and are light and handy, easier for transport, and thus are suitable to be used to suit condition of sites for installation. Size, color of the mobile toilets should be carefully selected for use in public places.

(5) Municipal Management Rooms (5 in number)

Such management rooms are for resting of management staff and storage of their working implements. Totally 5 such rooms are planned, each with a total space of $100m^2$.

(6) Main Quantities are shown in Table 2.7-10.

Table 2.7-10 Quantities of Ancillary Sanitation Facilities

Items	Quantities	Units	Remarks
Bench	70	set	
Direction Board	30	No.	
Dustbin	400	No.	
Mobile Toilet	10	No.	
Municipal Management Room	5	Site	100 ㎡/site

2.8 Integrated Gully Improvement

2.8.1 Selection of Gullies to Be Improved

Xining has the typical features as a city situated in intermontane river valley, and is surrounded by as many as over 60 scattered gullies (as shown in Figure 2.8-1). Over recent years, Xining has implemented successively a great number of water and soil conservation and improvement projects in the gully area, which has resulted in remarkable effectiveness with relatively stabilized vegetation communities formed in the improved gullies.

Based on field surveys, it is found that the two gullies Liujiagou, Shengou (see Figure 2.8-1 and Figure 2.8-2) only have their upstream sections improved under the previously implemented water and soil conservation projects, their gully mouth sections still have serious water and soil erosion problem caused by gravitational erosion process on both sides of the gullies, as illustrated by great amount of sediment deposition at the bottom of the gullies and massive loose earth bodies along both banks of the gully. It is also found that arbitrary household garbage dumping and direct waste water discharge are causing serious pollution to the gullies. Lacking engineering measures to stabilize both banks, the two gullies are prone to flood damage, mudflow caused by torrential flood is a great danger to lives and property of people living along the banks of the gullies. If washed into river by flood, sediment deposition and garbage in the gully may also cause increase of sediment content in river water and thus seriously impact on river water quality.

Changyangdianqu canal (see Figure 2.8-2 for its location) was built in 1963. It diverts water from Beichuan River and was meant to mainly serve the second level power station of Chaoyang Power Plant, as well as Zhongzhuangqu Irrigated Area, one of the major irrigation areas of over 10 thousand mu in Xining. After Chaoyang Power Plant stopped operation, Chaoyangdianqu has been used to mainly supply water to Zhongzhuangqu Irrigated Area and farmland along the canal. Its current water diversion capacity is smaller than the designed, and due to lack of proper management and adequate repair in the later stage after change of its main function, direct waste water discharge by residents living in the surrounding area and solid waste dumping have resulted in serious pollution and water quality deterioration in the canal, water flow in the canal is also found blocked by heaps of solid waste in the canal, so improvement of the canal has become an urgent task.

To solve the above mentioned problems with Liujiagou, Shengou gullies and Chaoyangdianqu canal and reduce pollution to water bodies and thus ensure ‘clean water flowing into the city’, integrated gully (canal) improvement activities are included in this proposed project.

Figure 2.8-1 Location of Liujiagou Gully

Figure 2.8-2 Location of Shengou Gully

Figure 2.8-3 Location of Chaoyangdianqu Section

2.8.2 Improvement of Liujiagou and Shengou Gullies

(1) Scale

Liujiagou starts at Xining-Datong Highway and ends at Beichuan River. Gully cross section improvement, gully channel earth backfill and greening are planned for Liujiagou. The section to be improved has a total length of 0.9km, as detailed in Table 2.8-1;

Shengou starts at the flood drainage culvert intersecting with Chaoyangdianqu, and ends at the Beichuan River. The improvement works mainly cover improvement of cross section, slopes and greening along both banks of the gully. The section to be improved is 0.9km in length, as detailed in Table 2.8-1.

Table 2.8-1 Gully Improvement Scale

Gully Location	Gully Name	River Basin	Stake Range	Length of the section to Be Improved (m)	Structure Type
Ershilipu Town, Beichuan Area, Xining Municipality	Liujiagou	Beichuan River	0+000-0+900	900	Open canal + slope protection
	Shengou		0+000-0+900	900	

(2) Activities to Be Conducted for the Improvement

Table 2.8-2 Activities to Be Conducted for Gully Improvement

	Liujiagou	Shengou
Design Parameters	Flood standard: one in 30 years, design flood flow $Q=26.0m^3/s$	Flood standard: one in 30 years, design flood flow Q=23.0m3/s
Section to Be Improved	Xining-Datong Highway to river mouth of Beichuan River	Flood drainage culvert of Chaoyangdianqu to river mouth of Beichuan River
Length of Improvement	0.9km	0.9km
Scheme	Flood discharge canal + slope protection, as shown in Figure 2.8-3	
Longitudinal Section	As described in Table 2.8-3	
Cross-section	Gabion cushion lining structure, as shown in Table 2.8-4	
Slope Protection	Reinforced Mike mat fixed with U-shaped nails will be used for slope protection, and anchoring trench will be used on the top of the slope; at the toe of the slope, gabion protection will be added to protect against scouring, with PET geotextile used for filter. The slope ratio is 1:2. One meter wide berms are provided at an interval of 5m. Trapezoidal cross-section drainage ditch of C15 plain concrete with a bottom width of 20cm is provided at the the slope bottom. The cross section dimensions of the drainage ditsch are 0.4×0.3m.	

	See Figure 2.8-4 for details.	
Landscape greening	See Table 2.8-5 for details, effect picture shown in Figure 2.8-5	
Sanitation Facilities	Garbage bins are to be provided close to the walkway by the gully at an interval of 100m	
	9	18
Wastewater Pipe	As shown in Table 2.8-6	

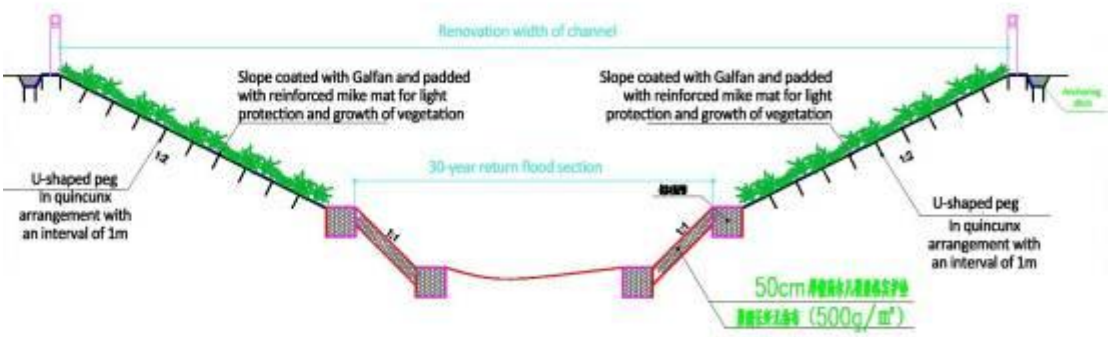


Figure 2.8-3 Sketch of Design

Table 2.8-3 Design of Gully Longitudinal Section

Gully Description	Section Description and Stake No. (from upper to lower)	Segmental Length (m)	Designed Longitudinal Slope (%)
Liujiagou	Xining-Datong Highway Bridge -Railway Bridge	443.624	2.25
	(0+000-0+443.624)		
	Railway bridge – Confluence into the Beichuan River	506.435	1.38
	(0+465.948-0+900.000)		
Shengou	Chaoyangdianqu flood drainage culvert ~Xining-Datong Highway bridge	264.721	1.63
	(0+000.000-0+264.721)		
	Xining-Datong Highway bridge ~ confluence into the Beichuan River	595.000	1.00
	(0+300.000-0+895.000)		

Table 2.8-4 Design of Cross Sections for Gully Improvement

Gully Name	Section and Stake No.	Dimensions of Cross Section (m)		
		Bottom Depth	Canal Depth	Slope Ratio
Liujiagou	Xining-Datong Highway bridge -railway bridge (0+000-0+443.624)	6.0	1.8	1：1
	railway bridge –confluence into the Beichuan River (0+465.948-0+900.000)	7.0	1.8	1：1
Shengou	Chaoyangdianqu flood drainage culvert ~Xining-Datong Highway bridge (0+000.000-0+264.721)	6.0	1.6	1：1
	Xining-Datong Highway bridge ~ confluence into the Beichuan River (0+300.000-0+895.000)	6.5	1.6	1：1

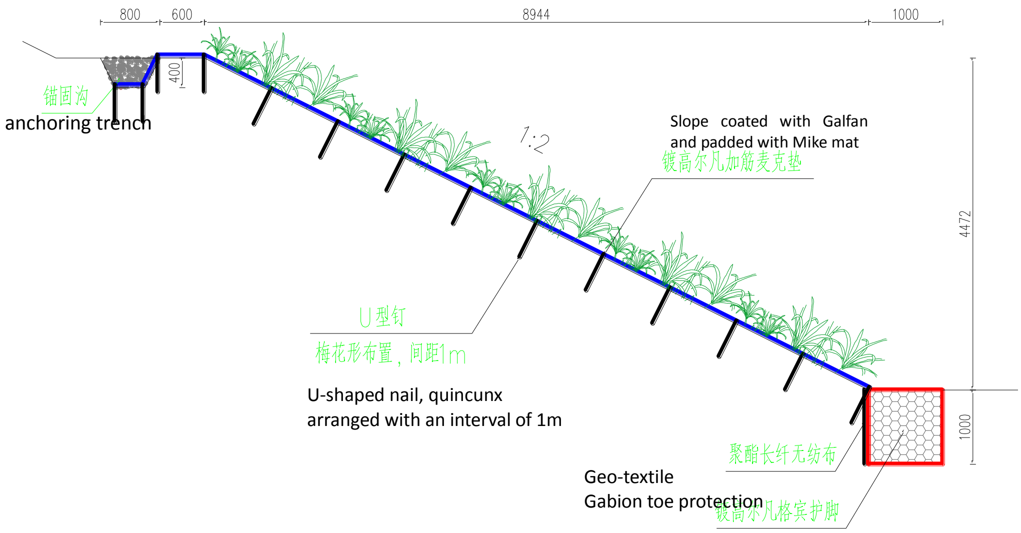


Figure 2.8-4 Typical Cross-section of Slope Protection

Table 2.8-5 Plan of Landscape Greening

Types of Greening	Location	Arrangement
Greening area on slope of canal/gully	On both slopes of canal/gully	acacia false (Robinia psendon cacia L.), Amygdalus davidiana, Armeniaca vulgaris Lam. var. ansu (Maxim.), Amorpha fruticosa., Sabina vulgaris, Rosa xanthina, lilac, forsythia, Lycium chinense Miller, Zizyphus jujuba mill, Polygonum aubertii L.Henry, Lonicera tragophylla, Clematis, Coronilla varia, Iris lactea var. chinensis,

		Hemerocallis fulva, Rudbeckia hirta, Nephrolepis auriculata etc
Greening Area of Road	Located along road next to canal/gully	not only the shading requirement of the street trees should be considered but also the requirements of the bank shore landscape. Therefore, willow, popular in Xining region with good shape, is taken as the main street tree. And meanwhile, such main landscape trees in Xining region as poplar and birch are interplanted. Such interplantation will not only mitigate the visual fatigue of people during driving and walking but also can effectively avoid diseases due to large area singular plantation of plants
recreational green land	Broad greening area close to canal/gully	take the evergreen high trees as the shading trees, take the landscape plants as the main associated landscape trees, plant various bushed with flowers or leaves of various colors underneath the trees, adopt locally bright-colored bushes which will be cut to smooth lively outline, so as to form various circles and spaces, plant seasonal flowers and turf at the lower space, so as to form well-distributed, bright-colored flora with distinct levels by means of combination of trees, bushes, flowers and herbs

Fig. 2.8-5 Intentioned Gully Landscape Green Land Design

Table 2.8-6 Design of Wastewater Interception Pipes

	Liujiagou	**Shengou**
Scope of Wastewater Collection	From railway bridge to confluence into the Beichuan River	From Beichuan River to Chaoyangdianqu, with total service area of 43.22ha
Scale	Not included in this design since it has already been	Construction of 1.8km of main pipe and 0.2km of branch pipe for waste water collection, and the collected waste water will be about 224m^3/d and sent to No.3 WWTP for treatment

Construction Activities	included in wastewater collection pipeline component of Beichuan Area	Separate collection of rain water and waste water will be adopted. However, in accordance with gully improvement scheme, the two sides of the gully will be mainly of green land zones, most of the rainfall will seep into the ground. It's hard to form the surface runoff. Therefore, placement of rain water pipe network is not considered in the gully improvement. In order to collect the waste water on two sides of the gully, waste water interception pipes are placed on two sides of the gully to help gully improvement.
Layout of Pipes		with consideration of the gully improvement scheme, the drainage plan and the existing drainage pipe network in the area, waste water collection pipes are to be placed in a direction from east to west underneath the green land zone on both sides of Shengou, for collecting the waste water on two sides of the gully and transporting the waste water of Chaoyangdianqu into the existing DN600 waste water Interception pipe on the east bank of the Beichuan River. The collected waste water will finally enter into No.3 WWTP.
Quantities		The main materials and shafts/chambers of Shengou are shown in Table 2.8-7.
		120º plain concrete will be used for reinforced concrete pipe, foundation uses C35 concrete. See Table 2.8-8 and Figure 2.8-6 for details.

Table 2.8-7 Summary of Main Materials and Shafts/Chambers of Shengou

No.	Description	Specification	Material	Unit	Quantity	Remarks
1	Reinforced concrete drainage pipe	DN600	Reinforced concrete	m	900	
2	Reinforced concrete drainage pipe	DN400	Reinforced concrete	m	900	
3	Reinforced concrete drainage pipe	DN300	Reinforced concrete	m	200	Branch pipe
4	Maintenance shaft	Φ1000	brick	No.	60	

Table 2.8-8 Dimension of Plain Concrete Foundation

DN	Thickness of Pipe Wall	Dimension of Foundation				Slope
		a	B	C1	C2	
300	40	80	540	80	95	1:0.75
400	47	100	694	100	123	1:0.75
600	60	100	920	100	180	1:0.75

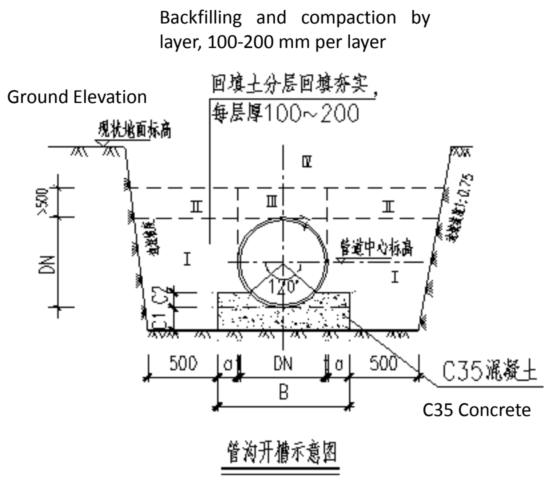


Figure 2.8 -6 Illustration of Foundation of Pipeline

2.8.3 Improvement of Chaoyangdianqu Canal

The Chaoyangdianqu diversion power plant does not generate power anymore. Chaoyangdianqu after integrated improvement will have double functions of water diversion and landscape improvement.

The water of the canal is from the Beichuan River, of which suspended sediment is the major load of sediment. Water from the river needs pre-treatment before entering into the canal. Therefore, a settlement tanks is provided at the outlet section of the diversion sluice of the canal, for the purpose of settling the harmful or surplus sediment in the water flow, improving the water quality, mitigating sedimentation in the downstream canal, so as to meet the requirements for diversion. The settlement tank is 100m long, 3.0m in average depth, about 20-50m wide, with a water surface area of 3500 ㎡, and a volumes of about 10500m³.

The axis for canal improvement is controlled on the basis of the centerline of the existing canal. The existing canal will be backfilled to the design elevation of the bottom of new canal and then construction will be done in accordance with the design cross section of the new canal. There will two types of new canal cross sections: trapezoidal cross-section and plate-covered culvert underground canal cross section. The first type is of reinforced concrete structure with a bottom width of 1.5m, lateral slopes of 1.25 and canal height of 1.6mcanal cross section, where the canal invert will be of 30cm thick reinforced concrete, the lateral walls will of reinforced concrete which is 20cm wide on the top and 30cm wide at the bottom. The second type is of reinforced concrete of a rectangular cross section which has a net width of 2.0m and a net height of 1.5m. The culvert has a depth of 25cm and the cover plate will be of 10cm-thick reinforced concrete.

In order to divert water to the downstream irrigated area, all the diversion intakes of the Zhongzhuang Canal need be rebuilt. The 770m canal after the water intake will be renovated to increase the current passing flow of only 0.78m3/s at maximum to $1.1m^3/s$ as the design service flow and $1.38m^3/s$ as the enlarged service flow, so as to satisfy the demand of irrigation of the downstream irrigation area.

All the existing irrigation water intakes along the canal will be renovated, while all the water intake structures will be rebuilt, all the water intake gates will be replaced, and all the existing flood drainage aqueduct along the alignment will be rebuilt as culvert box, which will pass water underground, for the purpose of not damaging the landscape. In accordance with the existing conditions, flood drainage passages are to be added for the culvert box at locations where it is necessary; the existing culverts will be renovated or rebuilt, all the inlets and outlets of the culverts are re- designed; all the existing traffic bridges or walk bridges of the canal will be renovated or newly-built in accordance with the new requirements for passage; and in accordance with the Employer’s requirements on canal green lands, corresponding artificial measures for landscape are added so as to ensure the improved canal can harmoniously join in the natural, realizing the final objective of the improvement.

The final design effect is shown in Fig. 2.8-7.

Fig. 2.8-7 Design Effect of Chaoyangdianqu

(1) Design of Longitudinal Slope

In accordance with the functional requirements of the canal after improvement, Chaoyangdianqu is to supply water for irrigation and landscape greening along the canal, and also improve living and leisure environment for people in the surrounding area, therefore, water depth in the canal should not be too deep and the flow should not be too speedy. Based on such requirement and the existing slope of the canal, longitudinal slope design is done for improvement of the canal and the results are shown in Table 2.8-9:

Table 2.8-9 Summary of Designed Longitudinal Slopes

Location	Stake No. (m)	Longitudinal Slope	Elevation of Bottom Plate
Water intake~Jiujiawan escape gate	K0+000~K4+954.81	0.3‰	2776.6～2775.11
Jiujiawan escape gate ~Step I power plant escape canal	K4+954.81~K8+670.32	0.25‰	2775.11～2274.18
Step I power plant escape canal	K8+670.32~K8+715.48	26.0%	2274.18～2239.50
End of the stilling basin of Step I power plant escape canal ~Confluence with the river at the end of Step I tailwater	AK0+000~ AK0+255.3	2.6‰	2241.0（Dissipation Pond ridge 1.5m high）～2240.5
Confluence with the river at the end of Step I tailwater ~Zhongzhuang Canal Water Intake	AK0+255.3~ AK1+429.0	0.43‰	2240.5～2240.0
Zhongzhuang Canal water intake~Step II power plant escape gate	AK1+429.0~ AK1+523.28	1.27%	2240.0～2238.8
Step II power plant escape gate ~end of the stilling basin of Step II escape canal	AK1+523.28~ AK2+180.2	36.2%	2238.8～2211.2

(2) Design of Cross Section

The following two types of cross-section are recommended:

1) Except for canal sections in densely populated villages, the cross section of the canal is to be of trapezoidal reinforced concrete cross-section, with a bottom width of 1.5m, a slope of 1.25 and a canal height of 1.6m. The bottom plate of the canal will be of 30cm thick reinforced concrete and the side wall will be cast-in-situ reinforced concrete which is 10cm at the top and 30cm at the bottom, as shown in Fig. 2.8-10.

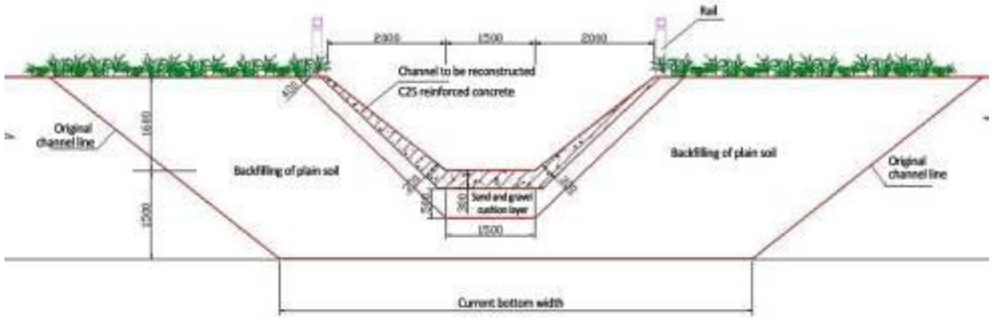


Figure 2.8-10 Designed Typical Canal Section

2) For canal sections in densely populated areas, such as canal sections in Shuangsubao Village, Guojiata Village and Qijiacheng Village, covered culvert cross-section will be adopted. The cross-section will be of rectangular reinforced concrete structure, with a net width of 2.0m, a net height of 1.5m, a culvert wall thickness of 25cm, and the cover will be 10cm reinforce concrete plate. The details are shown in Fig. 2.8-11.

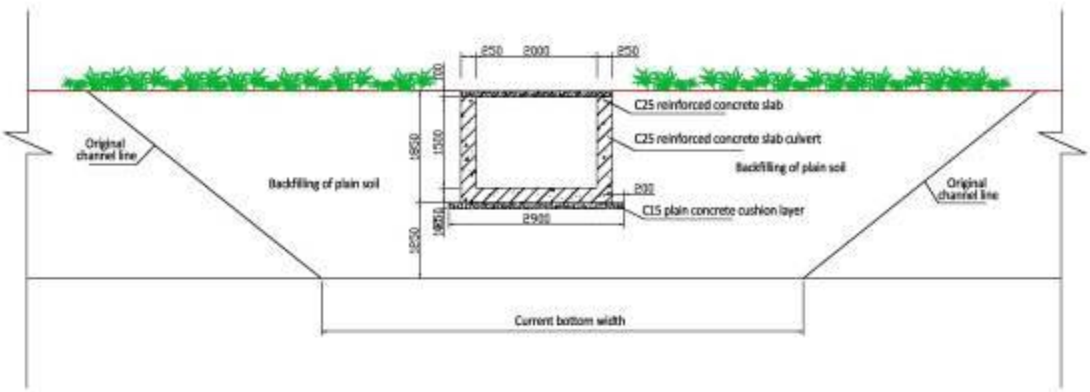


Figure 2.8-11 Typical Cross-Section of Covered Culvert

(3) Design of Canal Appurtenance

The canal appurtenance mainly includes the irrigation water intakes, flood drainage culverts, flood drainage aqueducts, traffic bridges, Jiujiawan escape canal, Step I power plant trashrack gate chamber, Step I power plant escape canal, check sluice and escape canal of Step II power plant, Zhongzhuang Canal inlet sluice etc.

Since the power plant is not in use anymore and the canal is mainly for irrigation water supply along the line, in the meantime of the canal improvement all the mentioned canal appurtenant structures need to be renovated so as to realize entire improvement. See Table 2.8-10 for details.

Table 2.8-10 Renovation of Canal Appurtenances

Items	Quantities	Planned Activities for Renovation
Irrigation Water Intakes	12	Elevation of the bottom of the water intakes after improvement shall all be of the same elevation of the invert of the canal at the corresponding location. Gate chamber uses C25F150 reinforced concrete, aliform structure for connection of the intake and slope of canal, dimension of openings for the intakes is 50cm×50cm (width x height), rectangular structure, with hand-operated plane steel gate. Identical elevation for chamber crest and canal top height to facilitate operation. Gate installed with waterstop to prevent seepage. DN50cm precast concrete pipe crossing at the rear of the chamber through canal dyke and

		connecting with original canal at the downstream
Flood Drainage Culvert	3	Four existing flood drainage culverts, namely, 1#, 2#, 4# and 5#. The 3# flood drainage culvert was plugged after construction of the canal. The 5# flood drainage culvert is the pressurized flood release and sand flushing channel for the forebay of Step I power plant. Its design joins renovation of the escape canal of Step I power plant. Therefore, 1#, 2# and 4# culverts needed to be renovated or rebuilt without changing original dimensions.
Flood Drainage Aqueducts	7	All the existing flood drainage aqueducts will be changed into culvert boxes or embedded culvert pipes passing underneath the canal, while broad-crested weirs will be provided at the inlet of the culvert box (culvert pipe) to regulate the water flow pattern entering into the culvert and simple energy dissipation device provided at the outlet if necessary, connecting the existing downstream flood drainage gully.
Bridges	15	Refer to the section on design of road on top of canal for details.
Jiujiawan Escape Canal	1	The canal is designed to be provided with non-pressure escape sluice with flat broad-crested weir which is controlled by plane steel gate. The sluice opening will have a net width of 1.0m, a maximal height of 1.0m and a water head above the weir of 1m, and the rear part of the sluice will be connected with 2.0m equally-wide chute. The chute is 40m long and 2.0m wide, with 1.5m~1.2m-high side walls, a slope of 1:1.2.A dissipation basin is provided at the end of the chute, with a length of 8.0m, a width of 2.0m, a sill height of 0.5m.
Step I Power Plant escape canal design	1	The improved escape canal will be provided with 4.0m-wide broad-crested weir, where the weir crest will have an elevation equal to the bottom of the water conveyance canal at the same location and the rear part of the weir will be connected with the steep chute with an equal width of 4.0m. The discharge chute has 30~40cm thick side walls and a chute height of 1.5~0.8m. The chute will connect with the dissipation basin at the end. The basin is 12m long, 4.0m wide, with a 0.8m high sill, connected at its end with the downstream canal.
Check Sluice and Escape Canal of Step II power plant	1	The check sluice will be a structure of flat-bottom broad-crested weir with a bottom width of 3m. A plate steel gate will be provided in the gate chamber, while the opening dimensions are 3×2m (W×H). The rear part of the weir will connect with the 75m long gentle sloped regulation canal, and the canal is connected with a discharge chute. The chute, with a 3.0m equally-wide rectangular cross section and a wall height of 1.5~1.0m, connects with existing reinforced concrete culvert and discharges water into Huangshui River.
Inlet sluice and canal in Zhongzhuang Canal	1	The inlet sluice will be provided with flat-bottom broad-crested weir, and controlled by a steel plate gate, with rectangular cross section of opening dimensions as 1.5×1.5m(W×H). The 770m long canal at the rear of the weir will remain a rectangular cross section, but the canal will be expanded with dimensions as 1.5×1.5m (W×H).

(4) Design of Landscaping Greening for the Canal

This design includes three parts identical to that for integrated gully improvement. For details see Table 2.8-5.

(5) Design for Improvement of Road on Top of Road

This design is for improvement of existing works. All the road alignments are arranged on the basis of the original alignment, while proper adjustment will be done only at the locations where there are turnings or sections exceeding standard because of canal improvement.

After completion of road improvement, the road will be mainly for daily travel of villagers in the surrounding areas. Bridges and culverts, sanitation facilities, sewage pipes will be constructed along with the road improvement, and the details are shown in Table 2.8-11.

Table 2.8-11 Summary of Activities and Quantities for Road Improvement on Top of the Canal

Activities	Existing road improvement from the water intake of Chaoyang Canal to the forebay of Chaoyang Step I power plant. As the connection section between Step I power plant escape canal and the powerhouse tailwater channel is of steep slope, it is impossible to arrange a road. This road will pass through the village for detour. However, walkway will be arranged along the escape canal to facilitate maintenance and repair.	
Road Layout	This road is to be divided into two partss: the first part (K0+000-K8+715.48) is 8715.48m long and the Second part (AK0+000-AK2+180.2) 2180.2m long. The total length for road improvement is 10895.68m	
Technical Standard	Class-4 Road	
Designed Speed	20km/h	
Width of Subgrade and Pavement	K2+150-K2+400 K4+760-K4+920	Subgrade: 4.0m;pavement:3.5m
	Other	Subgrade:5.5m; pavement:5.0m
Pavement Structure	4cm fine-grain asphalt concrete (AC-13)+6cm medium-grain asphalt concrete (AC-16)+20cm cement-(5%) stabilized sand/gravel +15cm natural gravel	
Bridges and Culverts	19 in total	Details are shown in Table 2.8-12
Sanitation Facilities	Garbage Bins	1 garbage bin for every 100m on average, arranged along sidewalk on west of the canal, totally 104 garbage bins will be needed.
	Solid Waste Collection Sites	One collection site at each of the villages including Shuangsubao, Guojiata, Jiujiawan, Weijiazhuang, Qijiacheng, one garbage chamber will be constructed with an area of 20 ㎡ and 10 garbage cans of 240l at each of the sites.
Waste water Interception Pipes	Scope of Collection	About 1km downstream of the water Intake Chaoyangdianqu~the start point of Zhongzhuang Canal, with a service area of 84.8ha.
	Scale	20.0km Interception Main pipe and 1.2km Branch pipe
	Construction Activities	In principle, separate collection of rainwater and sewage will be adopted. Sewage interception pipes will be installed along both banks of the canal as included in the gully improvement component. Rainwater will be collected using openings along the road and discharge into greening area for reuse. The rest of rainwater will flow through the greening area and then enter the canal by overflow after deposition and filtration.
	Layout of Pipes	For the section from the start point at the connection with Beichuan River (0+000) to about 1+000, as the inlet pipe of No.5 WWTP passes this area, no additional collection pipes are planned, and wastewater along both banks will be directly discharge into the inlet pipe of No.5 WWTP.
		For the section of 1+000~4+950 (at the intersection with Shengou), wastewater interception pipe will be arranged along both banks of the canal to collect and discharge wastewater into the Shengou interception pipe, via the pipe wastewater will be transmitted into the existing DN600 waste water Interception pipe on the east bank of the Beichuan River and the collected waste water will finally enter into No.2 WWTP.

		For the section of 4+950 (at the intersection with Shengou)-Zhongzhuangqu canal, wastewater interception pipes will be arranged along both banks of the canal to collect the wastewater, and the collected wastewater will enter into the downstream DN800 waste water interception pipe on the north bank of the Huangshui River and the waste water will finally enter into No.3 WWTP.
	Quantities	Summary of quantities of waste water collection pipe network are detailed in Table 2.8-11

Table 2.8-12 Summary of Bridges and Culverts

No.	Stake No.	Span (m)	Angle	Bridge name	Structure Type		Designed load	Bridge length (m)	Bridge pavement width (m)
					Superstructure	Substructure			
						Bridge abutment			
1	K0+116.528	1-6m	90°	No. 1 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.20	5.5 (4.5 in net +2×0.5)
2	K0+923.204	1-6m	90°	No. 2 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.20	5.5 (4.5 in net +2×0.5)
3	K1+211.201	1-6m	90°	No. 3 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.20	5.5 (4.5 in net +2×0.5)
4	K1+620.268	1-6m	90°	No. 4 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.20	5.5 (4.5 in net +2×0.5)
5	K2+546.967	1-6m	90°	No. 5 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.20	5.5 (4.5 in net +2×0.5)
6	K3+361.683	1-8m	90°	No. 6 bridge	Precast reinforced concrete hollow plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	10.20	5.5 (4.5 in net +2×0.5)
7	K4+642.798	1-8m	90°	No. 7 bridge	Precast reinforced concrete hollow	Head wall bridge abutment, open-cut	Road-Class II	10.20	5.5 (4.5 in net +2×0.5)

No.	Stake No.	Span (m)	Angle	Bridge name	Structure Type: Superstructure	Structure Type: Substructure: Bridge abutment	Designed load	Bridge length (m)	Bridge pavement width (m)
					plate girder	expanded foundation			
8	K5+208.165	1-8m	90°	No. 7 bridge	Precast reinforced concrete hollow plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	10.20	5.5 (4.5 in net +2×0.5)
9	K6+231.245	1-8m	90°	No. 7 bridge	Precast reinforced concrete hollow plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	10.20	5.5 (4.5 in net +2×0.5)
10	K6+607.106	1-6m	90°	No. 10 bridge	Reinforced concrete arch bridge	Solid bridge abutment, open-cut expanded foundation	Road-Class II	11.0	5.5 (4.5 in net +2×0.5)
11	K7+308.009	1-6m	90°	No. 11 bridge	Reinforced concrete arch bridge	Solid bridge abutment, open-cut expanded foundation	Road-Class II	11.0	5.5 (4.5 in net +2×0.5)
12	K7+728.748	1-6m	30°	No. 11 bridge	Reinforced concrete arch bridge	Solid bridge abutment, open-cut expanded foundation	Road-Class II	11.0	5.5 (4.5 in net +2×0.5)
13	K8+098.201	1-6m	90°	No. 11 bridge	Reinforced concrete arch bridge	Solid bridge abutment, open-cut expanded foundation	Road-Class II	11.0	5.5 (4.5 in net +2×0.5)
14	AK0+913.85	1-6m	90°	No. 12 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.2	5.5 (4.5 in net +2×0.5)
15	AK1+010.56	1-6m	90°	No. 13 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.2	5.5 (4.5 in net +2×0.5)
16	AK1+213.24	1-6m	90°	No. 14 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded	Road-Class II	8.2	5.5 (4.5 in net +2×0.5)

No.	Stake No.	Span (m)	Angle	Bridge name	Structure Type		Designed load	Bridge length (m)	Bridge pavement width (m)
					Superstructure	Substructure			
						Bridge abutment foundation			
17	AK1+461.24	1-6m	90°	No. 15 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.2	5.5 (4.5 in net +2×0.5)
18	AK1+872.14	1-6m	90°	No. 15 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.2	5.5 (4.5 in net +2×0.5)
19	AK2+180.22	1-6m	90°	No. 15 bridge	Reinforced concrete rectangular plate girder	Head wall bridge abutment, open-cut expanded foundation	Road-Class II	8.2	5.5 (4.5 in net +2×0.5)
Note: Stake No. in this table is the centerline stake number of the canal at the location of the bridge described.									

Table 2.8-13 Sumamry of Quantities of Chaoyangdianqu Waste Water Collection Pipe Network

No.	Description	Specification	Material	Unit	Quantity	Remarks
1	HDPE double-wall corrugated pipe	DN400	HDPE	m	20000	
2	HDPE double-wall corrugated pipe	DN300	HDPE	m	1200	Branch pipe
3	Maintenance shaft	Φ1000	brick	No.	630	

2.9 Land Acquisition and Resettlement

2.9.1 Standard for Compensation of Land Acquisition and Resettlement

(1) State-Owned Land

Policies and standards for acquisition compensation of state-owned land: in accordance with the standards for acquisition compensation of state-owned land as stipulated in *Notice of General Office of Xining Municipal People’s Government on*

Compensation Arrangement for Land Acquisition and Resettlement of Railway Station Renovation and Related Works (Ningzhengban No. [2011]179).

The alloted state-owned land is compensated on the basis of 60% of the benchmark land price; the contract-transferred land on the basis of the benchmark land price less the average price in the trial use period; and the land obtained by means of bidding, auction and listing on the basis of the obtained land price less the average price in the trial use period.

(2) Collective-Owned Land

Policies and standards for compensation to acquisition of collective-owned land: On the basis of the stipulations in *Notice of Qinghai Provincial People's Government on Issuing Unified Standards of Annual Product Value for Land Acquisition and Compound Land Prices of Land Areas*, corresponding compound land prices for the areas in Xining Municipality will be adopted and the compensation standards for land acquisition will be determined based on the location of the land. The standards for compensation of the land acquisition of affected villages are detailed in Table 2.9-1.

Table 2.9-1 Compensation Standard for Land Acquisition

Type	Compound Land Price (10^3 Yuan/ mu)	Land Scope	
I	97.2	Chengbei Area	Taojiazhai Village, Sanqi Village
II	90.0	Chengbei Area	Taojiazhai Village, Taoxinzhuang Village, Beixinyuan Village, Ershilipu Village (part), Shuangsubao Village
III	27.0	Chengbei Area	Taojiazhai Village (hilly land), Taoxinzhuang Village (hilly land), Sanqi Village (hilly land), Shitoulei Village, Ershilipu Village (hilly land), Shuangsubao Village

(3) Temporarily-Occupied Land

Compensation of the temporarily-occupied rural collective-owned land involved in the Project will be made on the basis of the land use and loss. The compensation cost for the temporarily-occupied land will include the compensation for the green crops and that for the ground-attachments. Meanwhile, the Employer of the Project shall pay the land reclamation fee for reclamation of the temporarily-occupied land.

- The temporarily-occupied land will be compensated on the basis of the principle of one year compensation for one year occupation and one season compensation for one season occupation, with the standards executed on the basis of the annual product values of the land. Compensation of non-farmland will be made with reference to the farmland; the compensation standards will be executed in accordance with the actual use of the land and the compensation for the wood land will be made with reference to the farmland.

- The period for temporary occupation of the land shall not exceed 2 years.

- In order to minimize impacts of land acquisition on green crops, the Project will, generally, be implemented after harvest of the crops or before plantation of new crops, as necessary for the actual conditions and the impacted farmers shall be informed one month in advance.

- No compensation will be considered for temporarily-occupied state-owned land. However, compensation will be made to the dismantled ground attachments on a basis of replacement price or that the Employer of the Project shall rehabilitate such ground attachments on the basis of the existing standard and scale, with cost for such rehabilitation included in the Cost of the Project.

(4) House Demolition and Relocation

Policies and standards for compensation of relocated houses: Compensation standards for relocation as determined in accordance with *Notice of Xining Municipal People's Government on Issuing Compensation Standards and Price Evaluation Rules for House Relocation and Resettlement* (Ningzheng No. [2004]30), *Notice of General Office of Xining Municipal People's Government on Compensation Arrangement for Land Acquisition and Resettlement of Railway Station Renovation and Related Works* (Ningzhengban No. [2011]179) will be executed.

2.9.2 Activities to Be Implement for Land Acquisition and Resettlement

In accordance with the Resettlement Action Plan prepared by the task team of Hoihai University, this project will need to acquire land of 406.035 mu in total, including 2.4 mu of permanent land acquisition of rural collectively owned land; 403.635 mu of temporarily-occupied land, of which 74.85 mu is state-owned land and 258.9 mu rural collectively owned land. Table 2.9-2 shows the details.

Table 2.9-2 Summary of Land Acquisition and Resettlement under the Project

Project Components	Permanent Land Occupation (mu)		House Demolition and Relocation（10^4 ㎡）		Temporary Land Occupation（mu）		Amount of People Affected (No.)				Remarks
	State-Owned	Collectively Owned	Residential	Non-residential	State-Owned	Collectively Owned	Permanent Land Acquisition		Temporary Land Acquisition		
							HH	Persons	HH	Persons	
Urban Waste Water Collection Pipe Network	/	2.4	/	/	68.37	328.815	35	128	91	414	
LID and River Bank Environmental Improvement	/	/	/	/	/	/	/	/	/	/	Use land in core area of Beichuan River
Reuse of Reclaimed Water	/	/	/	/	/	/	/	/	/	/	Use land in No. 5 WWTP
Integrated Gully Improvement	/	/	/	/	6.45	/	/	/	/	/	
Total	0	2.4	0	0	74.82	328.815	35	128	91	414	

(1) Urban Waste Water Collection Pipe Network

In accordance with the construction conditions defined in feasibility study and the field investigations, permanent land acquisition of 2.4 mu of rural collectively owned land is needed for construction of manholes and valve wells; for access roads and installation of pipes, 68.37 mu of state-owned land (roads) and 328.815 mu of rural collectively owned land needs to be temporarily acquired, including 303.93 mu of irrigated farmland and 24.885 mu of forestry land and involving 22,120 trees. The permanent land acquisition will affect 128 people of 35 households in 7 villages, such as Xiaozhai, Chengdong and Weijiazhuang in Duoba Town of Huangzhong county, and Hetan, Wangjiazhuang, Daijiazhuang and Shuangmiao in Changning Town of Datong county. Temporarily-occupied land will affect 414 people of 91 households in 7 villages, such as Xiaozhai, Chengdong and Weijiazhuang in Duoba Town of Huangzhong county, and Hetan, Wangjiazhuang, Daijiazhuang and Shuangmiao in Changning Town of Datong county.

More specifically:

1）For Xichuan River waste water collection pipes: construction of manholes and valve wells will involve permanent land acquisition of 0.7 mu of rural collectively own land, all being irrigated farmland; temporary land acquisition for access roads totals 28.245 mu of rural collectively owned land, all being irrigated farmland; temporary land acquisition for pipe installation involves 20.04 mu of state-owned land (roads) and 71 mu of rural collectively owned land, including 60.2 mu of irrigated farmland and 10.8 mu of forest land with 9,600 trees.

2）For Beichuan River waste water collection pipes: construction of manholes and valve wells will involve permanent land acquisition of 1.7 mu of rural collectively own land, all being irrigated farmland; temporary land acquisition for access roads totals 65.985 mu of rural collectively owned land, all being irrigated farmland; temporary land acquisition for pipe installation involves 48.33 mu of state-owned land (roads) and 163.585 mu of rural collectively owned land, including 149.5 mu of irrigated farmland and 14.085 mu of forest land with 12,520 trees.

3）For Beichuan Area sewage collection pipes, ancillary roads, rainwater collection pipes and municipal facilities, land allocated for Beichuan River (core section) Comprehensive Improvement Project can be used, therefore no newly added land acquisition and resettlement is needed.

(2) LID and River Bank Environmental Improvement

Based on feasibility study and field investigations, for implementation of this component, the land allocated for Beichuan River (core section) Comprehensive Improvement Project can be used, therefore no newly added land acquisition and resettlement is needed.

(3) Reuse of Reclaimed Water (Reclaimed Water Plant in No. 5 WWTP of Xining)

Based on feasibility study and field investigations, reclaimed water plant in No.5 WWTP will cover an area of 11.7 mu, all within the land use scope of the No.5 WWTP, thus no land acquisition and resettlement is needed. Since installation of ancillary pipes will be included as part of new road construction in Beichuan development area, no land acquisition and resettlement will be involved.

(4) Integrated Gully Improvement

In accordance with the feasibility study and the field investigation, this component will not involve land acquisition and resettlement. During construction of the works, 6.45 mu of state-owned unused land will be temporarily occupied for the offices, staff dormitory, storage etc., including 4.5 mu for Chaoyangdianqu canal improvement, 1.2 mu for Liujiagou Gully improvement, and 0.75 mu for Shengou Gully improvement.

The land acquisition and resettlement for the proposed project are detailed in Table 2.9-3, temporarily-occupied land detailed in Table 2.9-4. The arrangement of the construction camps are detailed in Table 2.9-5.

Table 2.9-3 Summary of Land Acquisition and Resettlement for Proposed Project

Unit: mu

Project Components	Permanently-occupied Land	Temporarily-occupied Land				Total
	Cultivated Land	Irrigated Land	Unused Land	Forest Land	Road	
Urban Waste Water Collection Pipe Network	2.4	303.915	-	24.9	68.37	399.585
Integrated Gully Improvement	-	-	6.45	-	-	6.45
Total	2.4	403.635				406.03

Table 2.9-4 Breakdown of Land to be Temporarily Occupied by Proposed Project

Component Description	Length (km)	Pipe Ditch (mu)	Temporary Earth Disposal (mu)	Temporary Access Road (mu)	Construction camp (mu)	Total
Xichuan River Main Interception Pipe Works (south bank)	13.52	40.56	63.64	20.28	4*0.75=3	127.48
Beichuan River Main Interception Pipe Works (east bank)	13.94	41.82	65.62	20.91	4*0.75=3	131.35
Beichuan River Main Interception Pipe Works (west bank)	14.88	44.64	70.04	22.32	5*0.75=3.75	140.75
Integrated Gully Improvement Works	-	-	-	-	6.45	6.45
Total	42.34	127.02	199.3	63.51	16.2	406.03

Table 2.9-5 Arrangement of Construction Camps

Project Components	Arrangement of Construction Camp
Urban Waste Water Collection Pipe Network	Construction camps will be arranged at an interval of about 3km along the pipelines for Xichuan and Beichuan rivers
	For construction of sewage collection pipe and rainwater collection pipes in Beichuan Area, the construction camp will be located in construction area, not occupying extra land
LID and River Bank Environmental Improvement	The construction camp will be located in the construction area, not occupying extra land
Reuse of Reclaimed Water	The construction camp will be located in the construction area, not occupying extra land
Integrated Gully Improvement	A general camp will be provided close to Liujiagou

2.10 Balance of Earth-Rock Quantities

The proposed project has a total earthwork excavation quantity of 973,000 m^3, a total fill quantity of 3,056,000 m^3, a borrow quantity of 2,083,000 m^3, and a reused quantity of 181,000 m^3, as detailed in Table 2.10-1. The workflow is detailed in Fig. 2.10-1. All the earth-rock quantities of the project will be arranged for reuse in the project, no spoil is produce and thus spoil disposal area is needed. On the basis of earthwork calculation, the proposed project needs to borrow 2,083,000 m^3 of earth, and thus borrowing area will be arranged. However, the location of the borrow area is not yet determined. Therefore, the environment impact assessment puts forward relevant requirements on site selection of earth borrow area for the purpose of environmental conservation and protection.

Table 2.10-1 Summary of Earthwork Quantities
Unit: m^3

Description	Excavation Quantity	Fill Quantity	Borrowing Quantity	Reused Quantity
Xichuan River Waste Water Interception Pipe Network	63000	48618	0	-14384
Beichuan River Waste Water Interception Pipe Network	133875	103305	0	-30566
River Bank Environmental Improvement	92000	373000	99838	+181162
Beichuan Road Nework	547867	1697931	1150064	
Chaoyangdianqu Integrated improvement	83460	556400	556400	-83460
Liujiagou Gully Improvement	48000	220667	220667	-48000
Shengou Gully Improvement	4752	56128	56128	-4752
Total	972954	3056049	2083097	0

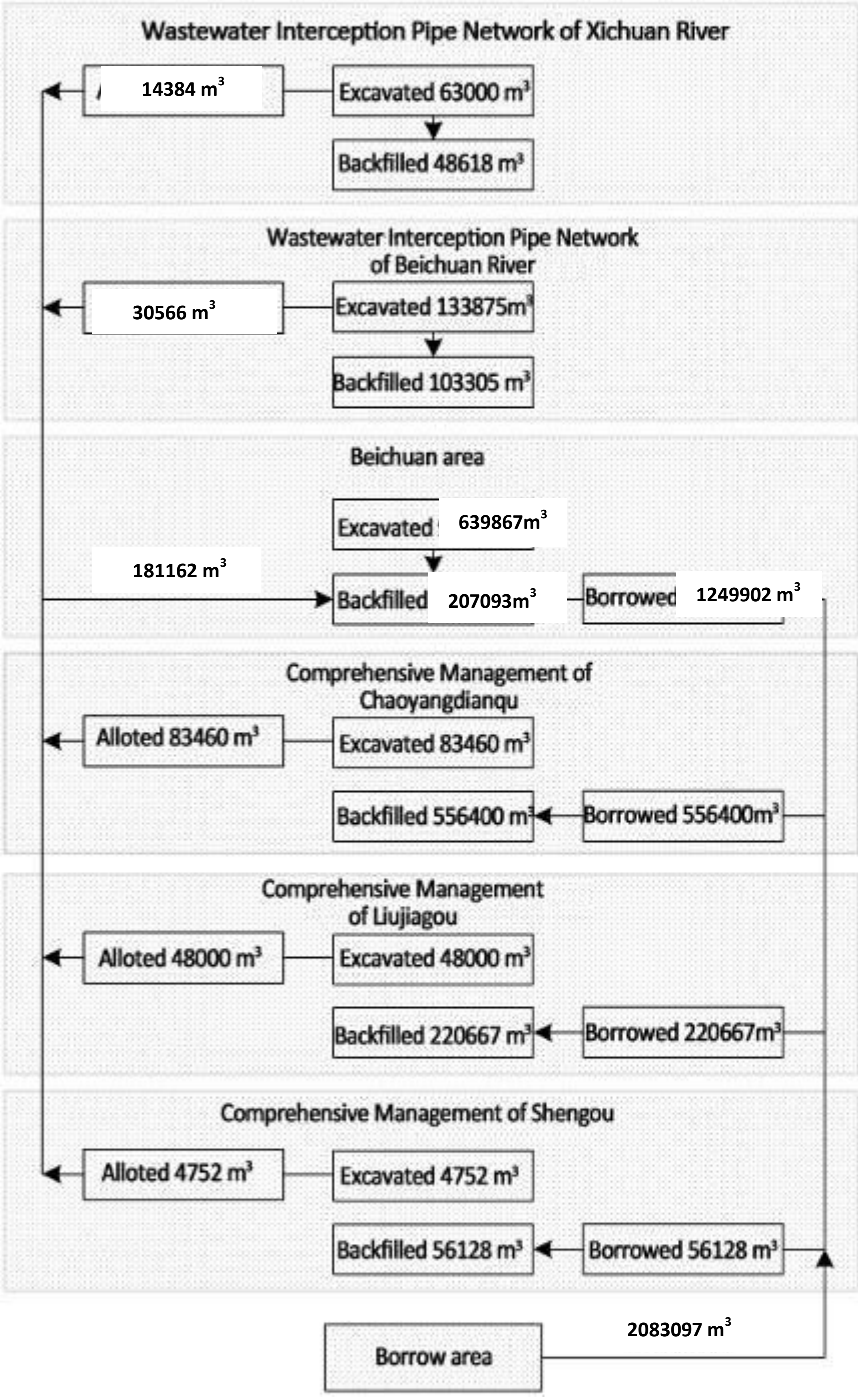


Figure 2.10-1 Flow Chart of Earthwork Quantities

2.11 Project Cost Estimates and Fund Raising

(1) Cost Estimates

Total cost of the project: 1524.1771 million yuan.

Base cost of the project is 1152.0802 milllion yuan, including 754.2902 million yuan for the urban waste water collection pipe network, 229.9734 million yuan for low impact development and river bank environmental improvement, 9.6253 million yuan for reuse of reclaimed water, and 158.1913 million yuan for integrated gully improvement.

Other costs of the project: 162.8831 million yuan.

Cost for institutional development and capacity building: 7.4 million yuan;

Contingencies: 131.2212 million yuan;

Interest during construction period and front-end fee: 70.2867 million RMB Yuan;

Initial working capital: 30.8 thousand yuan.

Total investment of project is 1524.1771 million yuan, including the World Bank loan of 150.00 million US dollars, an equivalent of 915.00 million yuan and accounting for 60% of the total investment; and counterpart fund of 609.1771 million yuan, accounting for 40% of the total investment.

(2) Repayment of Loan

The Xining municipal government will assume responsibilities for loan repayment and counterpart fund raising. The loan period is 30 years, including 5 years of grace period, during which only loan interest will be repaid, and after the grace period the principal will be repaid in 25 years on the basis of level repayment of principal and interest.

The project will be implemented in five years, with annual investment amounting to 34.96%, 13.17%, 19.35%, 19.35% and 13.17%, respectively, of the total cost.

2.12 Project Schedule

In 2012 this project was listed as the World Bank loan pipeline project for FY2013-2015. Preparation and appraisal of the project is planned to be completed at end of 2013 or in early 2014. Project implementation is planned to take 5 years from 2014 to 2018.

3 Environmental Overview and Current Status

3.1 Overview of Natural Environment

3.1.1 Topography and Morphology

Located on an alluvial plain and surrounded by mountains and hills, in principle, Xining's topography is high in the south and west, and low in the east and north. The city is ribbon-shaped, long and narrow in the west-east direction. The distance between hills on the south and north is 5km at most and only 2km at least. The alluvial plain in the middle is relatively flat and open, and can be divided into four types of terrace according to its differing features: flood plain, Grade I terrace, Grade II terrace and Grade III terrace. The Huangshui River improvement project is located in the Lanzhou-Minhe Basin. The Huangshui River runs through along the middle of the basin from the west to the east. The Huangshui River Basin is like a long and narrow ribbon with irregular shapes along NWW-SEE direction: 230km long, 50-100km wide, wide in the west and narrow in the east, high in the west and north and low in the east and south, and with mountains and hills on its south, west and north. Specifically, Daban Mountain is on the north; Tuanbao Mountain and Riyue Mountain are on the west; and Laji Mountain is on the south. The peak ridges of these mountains are often 4,000m above sea level. In particular, Yeniu Mountain and Nanshan Mountain of the west section of Laji Mountain are the highest, reaching 4,898.3m above sea level; and the Huangshui Valley where Gansu and Qinghai border with each other is the lowest, only about 1,650m above sea level. The elevation difference between the two is as large as 3,350m, as shown in the attached Figure 2. The topography and geomorphy of the catchment are very complex, including: high and medium-high mountains and hills made of ancient metamorphic rocks and igneous rocks, plateau basins filled with Mesozoic and Cenozoic rocks, and low mountains and hills and valley plains covered with loess.

The proposed project areas are mainly along the Xichuan River and Beichuan River, and the major topography is valley and plain. Overall, the land is high in the north and west, and low in the south and east. Its microreliefs are Grade I and II river terraces. The river bank section of Grade I river terrace is V-shaped, and Grade I terrace has developed along the two sides; the elevation of the river bed ranges from 2,265.5m to 2,266.5m above sea level, and the elevation of the terrace along the banks ranges from 2,266.2m to 2,268.4m above sea level. The elevation difference between the two ranges from 1.1-1.9m. The river bank section of Grade II river terrace is V-shaped, and Grade II terrace has developed along the two sides; the elevation of the river bed ranges from 2,267.4m to 2,325.5m above sea level, and the elevation of the terrace along river bank ranges from 2,274.2m to 2,349.8m. The difference in elevation between the two varies between 5.0 and 24.3m, and the longitudinal riverbed gradient is 2‰.

3.1.2 Palegeography and Strata

According to geologic explorations and relevant information, , the exposure strata in the project areas include, from old to new, pre-sinian system, sinian system, Cambrian system (upper and middle), Ordovician system, Silurian System (lower), Permian system, Triassic system (upper), Jurassic System, Cretaceous system, Tertiary system, Quaternary system, and the intrusive rocks from the late Proterozoic, Caledonian and Variscan stages. The strata are undeveloped, with many lancunas. Due to the geotectonic conditions, the spatial distribution of the strata is not balanced:

(1) Pre-sinian system: rare and distributed exclusively near Riyue Mountain;

(2) Sinian system: widespread on the edge of the catchment and the mountainous areas in the west and northeast; the major layer of the base of the basin;

(3) Lower Paleozoic sediments: mainly distributed at Daban Mountain and Laoye Mountain;

(4) Upper Paleozoic sediments: mainly distributed to the south of Laji Mountain and Riyue Mountain;

(5) Trassic system of Mesozoic-Paleozoic sediments: mainly distributed to the south of Laji Mountain and Riyue Mountain; Jurassic system and Cretaceous system: dispersed across the basin.

(6) Tertiary system: can be divided into Paleogene system and Neogene system, according to its sedimentary and lithological features. Xining-group of Paleogene system (E) is widespread in the lower part of the Xining-Minhe basin. The rocks are: red or brownish red mud rock, silitite, thin gypsum rock interbedded with mirabilite, mud rocks containing gypsum, and alternating layers of sandrock, gravel and conglomerate. The contacts between Paleogene system and Cretaceous system are either conformable or overlapping.

Guide-group of Neogene system (N) is in the upper part of the northeast edge of Xining-Minhe basin. This group can be divided into two sub-groups according to their lithological characters. The top consists of mud rocks, and the alternating layers of silitite and mud rock containing gypsum. The bottom consists of grayish brown and brownish red mud rock, silitite and the alternating layers of river rock, stone rock and rock; it is the result of river sedimentation and the contact between it and the underlying Xining-Group is continuous and conformable.

(7) Quaternary system: widespread in project areas. Due to the sedimentary environment and geological conditions, the genetic types of this system are very complex and the lithological characters and

thickness of rocks vary significantly.

- Pliocene system (Q1): mainly consists of aeolian soil that covers hills and mountains above the high valley terrace like a cloak. Its' thickness ranges between 10cm and 30cm. It is collapsible to some degree and a little permeable.

- Holocene alluvial system (Q4al): mainly found in river bed, flood plain, low-grade terrace and large gullies. It is often a layer consisting of boulders and stone rocks, void-structured, loose/a little compact, permeable (the permeability coefficient is often between 20-80m/d), and 0.6-2.5cm thick.

- Holocene proluvium sediments (Q4pl): mainly found in gullies and the mouths of gullies of tributaries, often in the form of proluvium fan, consisting proluvium stone rock and gravel soil. Its mineral composition includes: the sediments contain granite, sandstone, amphibolite, basite and ultrabasite. The fillings are mainly incompact mud and sand. The permeability is good. The thickness often ranges between 0.5-2.5m.

- Holocene diluvium sediments (Q4dl): mainly spread at the frontier of Grade II and Grade III terraces and talus slope. It is a layer of diluvium gravel soil. The grain size and thickness vary greatly. The composition is mainly determined by the composition of rocks on the upstream. It consists of gravel and soil. It is void-structured and permeable. The thickness differs greatly.

- Gravity deposits: primarily the deposits as a result of landslide and collapse along the two sides of gullies and slopes, containing yellow earth or a mixture of yellow earth and clay. The thickness varies greatly with the size of the deposits. The deposits are incompact and loose, and they are the major matter source of a debris flow.

(8) Intrusive rocks

The distribution of intrusive rocks is determined by geotectonic conditions. In [project] areas, the exposed intrusive rocks include the rocks from the late Proterozoic, Caledonian, Variscan stages and pre-Xingkai period (前兴凯期).

- Rocks from the late Proterozoic: gneissic granite, migmatitic granite, and diorite-like dikes and suite.

- Rocks from Caledonian stage: diorite, quartz diorite, granodiorite, granite, euphotide, picrite-porphyrite, peridotite and ultrabasite.

- Rocks from Variscan stage: mainly granite.

- Rocks from the pre-Xingkai period: mainly granite.

Intrusive rocks mainly develop in the areas near fold axes and fractures. The extension direction of the rocks is similar to the direction of the tectonic line of the region. In the catchment, rocks from Caledonian stage are the most developed and widespread, compared with the others. Intrusive rocks from Variscan stage are mainly found near Laji Mountain (west section) and Riyue Mountain.

Tectonically, the Huangshui River catchment is located in the south of the uplift belt (dome) of the middle of Qilian Mountain Fold System. Geotectonically, [the catchment] lies in the uplift belts of Daban Mountain, Riyue Mountain and Lajishan which are at the fore-arc and west wing of the ‘multi-characters shaped’ Qilvhelan fold system, and the depression belts (or troughs) of Haiyan, Huangyuan, Riyue, Datong, Xining and Minhe basins. The tectonic line is mainly in the NWW direction. Affected by the geologic conditions, the depression belts from the mid-Cenozoic era are also in the direction of NWW (as shown in the attached Figure 3: the geological structure of Huangshui River Catchment). During the Yan(燕) movement period, fractures and depression occurred in this region, thus many intermountain basins took shape and a thick layer of Neogene red clay accumulated there. After gentle folds and fractures occurred to Tertiary system due to the Himalayan movement, with the long-term erosion and denudation, a thick layer of yellow earth piled up during the Quaternary period.

The overall fold of Xining-Minhe Basin is a large a synclinal basin, composed of Tertiary system, with a 10-200 dip angle and undulation.

3.1.3 Hydrogeological Conditions

The old and hard metamorphic rocks and carbonate rocks around the Huangshui River catchment, and the middle-high mountains and low hills in the catchment, the unique crevasses and caves and the crushed zone formed due to fractures, crevasses and pores of clasolite rocks in the basin, and porous grails, pebbles, yellow earth and yellow soil together create spatial conditions for groundwater to flow and to be stored. Furthermore, rainfalls – especially the abundant rainfalls in the middle-high mountainous areas – are the major groundwater recharge source. Some rainwater evaporates from the ground, but the majority falls downward along the mountain slopes into gullies and creeks, and thus is recharged into surface runoff. Some water permeates into the ground and is stored up in the strata formed during different stages and composed of different rocks, and the pores in rocks. An aquifer thus forms.

Due to its geological structure and the control of the hydrographic net, the high and steep-sloped mountains and hills are fragmented, therefore the surface runoff and groundwater exhibit the following features: the runoffs are short and water cycle is fast and active; the water is fresh water; the distribution of groundwater is sophisticated; and the water-bearing capacity of rocks is low and varies greatly.

At some karst sections where carbonate rocks spread, the water-bearing capacity of rocks is high, the flows of karst springs and fissure karst springs are often large, and the water quality is excellent.

In mountainous areas, groundwater above the base level of erosion (pass) is often stored in the crevasses of the weathering belt of bed rocks. The flow is short; water cycle is fast and active, often takes less than a year; the water often flows out in the form of a gravity spring, entering into creeks and recharging into surface runoff. Groundwater below the base level of erosion often permeates through the ground surface in the form of a hypogene spring through fault zones, reaching river or moving to the piedmont or the lower part of the basin in the form of under flow and being stored up.

Based on the factors such as the aquifers with comparable water-bearing capacity, lithologic structure, the conditions for rocks to yield groundwater and hydraulic features, the groundwater in Huangshui River catchment can be divided into 4 groups: 1) loose rock pore phreatic water; 2) loose rock pore fissured water; 3) fissure cavern water in carbonate and clastic rocks; and 4) Mesozoic-Paleozoic bedrock fissured karst water.

(1) Loose rock pore phreatic water. It is the major type of groundwater in the plain. Shallow water is one of the most abundant groundwater resources in the catchment, mainly distributed in low-grade terraces (Grade I and II), the recently-formed alluvial layer of sandstones and pebbles on the flood plain, the grail layer and ice water deposits formed in the mid- and upper-epochs, and the layer of sandstones and clay. In many cases, there is a single aquifer closely connected to rivers. The aquifer is often inlaid into the narrow and long valley belt between the yellow earth low hills and mountains that are confined by the red sandstone layer of Tertiary System, argillaceous sandstone and mud rocks. Above the aquifer is a layer of yellow earth (clayed soil, sandy clay, etc.) whose thickness varies from a few meters to dozens of meters. In general, the shallow water table depth is: (1) less than 10m below the land surface in the flood plain, and Grade I and II terraces; (2) between 10-30m in Grade III terraces; and (3) above 30m in Grade IV and above terraces and the valley edges affected by alluvial fan. The river valley aquifer is mainly composed of loose sandstones and pebbles, mixed with argillaceous sand on the bottom. The topographical and spatial differences result in the differences in the concentration and composition of argillaceous sand, which in turn affect the aquifer's permeability to some extent. In flood plain and Grade I terrace, the aquifer's permeability is the highest (often 50-200m/day), and that in Grade II and above terraces comes second.

(2) Loose rock pore fissured water: The aquifer contains: Mesozoic-Paleozoic (including Tertiary, Cretaceous, Jurassic and Triassic periods before Quaternary period) clastic sedimentary rock strata that contains conglomerate, sandy

conglomerate, sand rock, shale and mud rocks. Such groundwater is mainly distributed in all basins in the catchment. Its' recharge is mainly from rainwater. The water quality is poor.

(3) Fissure cavern water in carbonate and clastic rocks: mainly distributed along the north piedmont of Laji Mountain, from Laoye Mountain in Datong to the middle-high mountains in Nanmenxia and the north of Ledu. The aquifer contains the Huashishan group of sinian system and Cambrian system (middle). The rocks are mainly crystalline limestone, dolomite, phylite and schist. The development level of crevasse and karst varies.

(4) Mesozoic-Paleozoic bedrock fissured karst water: mainly distributed in sand rocks and slates of Triassic system and intrusive rocks formed during different periods in the low-middle high mountains on the edge of the catchment. In the north of Xiaoxia, Daxia and Ledu in the basin, the groundwater is covered by a layer of yellow earth with changing thickness. In this area, the geologic structure is complicated. The development of folds and fractures provide the spatial conditions for groundwater to be stored up. The groundwater is distributed in the rocks like a water net or a water belt. The quantity of groundwater is affected by the topography. The major source of recharge is rainfalls. The water quality is good and does not cause erosion to reinforced concrete.

3.1.4 River System

The river system of Xining's downtown is mainly composed of Xichuan River, Nanchuan River and Beichuan River, which converge in the middle of the downtown from the west, south and north, respectively, then run eastward and leave Xining at Xiaoxiakou. As a result, the river valley is '十'-shaped: valleys are in the east, south, west and north directions and mountain ridges are in the northeast, northwest, southwest and southeast directions. The Huangshui River runs for more than 50km throughout Xining's downtown and divides it into the southern and northern parts and four areas. As a result, Xining's topography is cross-shaped, with three rivers cross it and two mountains facing each other.

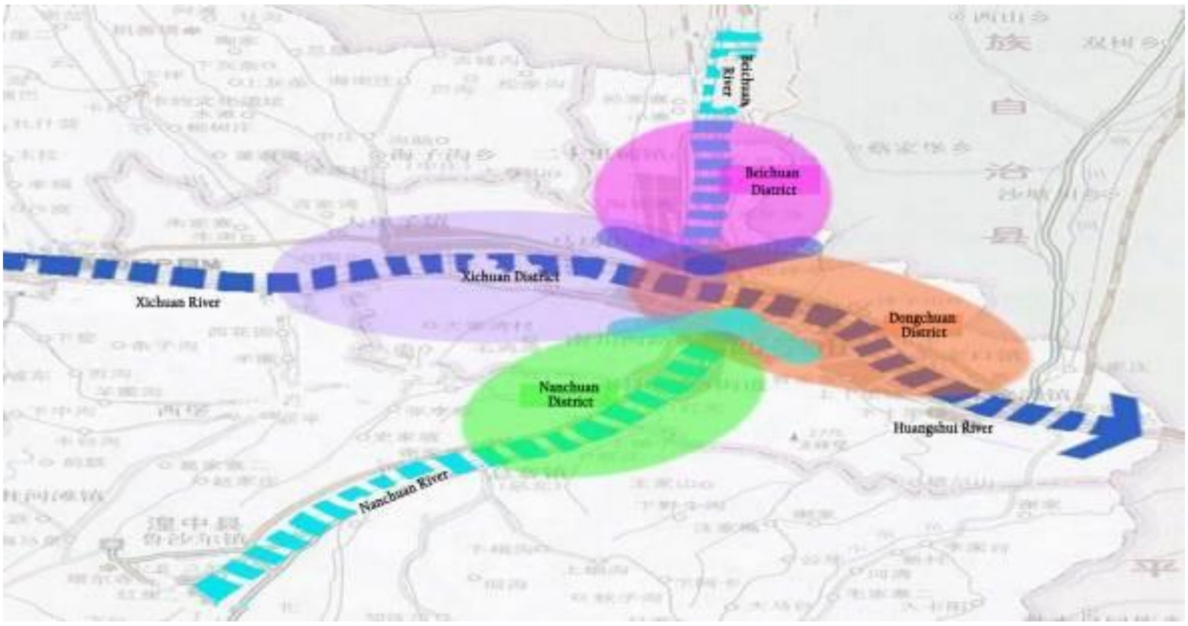


Figure 3.1-1 Overview of Huangshui River

The Huangshui River flows for 374km in total, and the area of the catchment is 17,733km^2. Specifically, in Qinghai province, the river runs 336km, and the catchment area is 16,120km^2.

From Tuoluotu, the Huangshui River flows from the west to the east and arrives at Huangyuan County, Xining. It then runs through Huangzhong County and the downtown. Finally it leaves Xining at Xiaoxiakou. In Xining, the Huangshui River flows for 95.9km, accounting for 25.5% of the length of the river. The area of the catchment in Xining is 7,335km^2, and the catchment above Xiaoxiakou is 11,220km^2, accounting for 45.7% and 69.9%, respectively, of the total area of the Huangshui River catchment in Qinghai. The Huangshui River discharges at an annual average rate of 39. 6m^3/s (Xining Station). This section is the upstream and midstream parts of the Huangshui River catchment with a dense network of rivers, mainly including the mainstream of Huangshui River and its tributaries, i.e., Beichuan River and Nanchuan River, as well as many other rivers and lacks.

Much runoff of the Huangshui River is attributable to the precipitation and melting snow and ice in Nao Mountain area. The distribution of runoff varies greatly throughout the year, corresponding to the distribution of precipitation throughout the year, and mostly likely during the rainy season from July to September. Throughout the year, the runoff changes as below: (1) during May-June, as temperature rises, melting snow and ice on mountains on the upstream flows into rivers, and the runoff gradually increases as a result, making up 16.7% of the annual runoff; (2) between July and September, the rainy season, the runoff accounts for 46.7%. All large floods took place during this period; (3) between October and November, as the precipitation declines, rivers become dry, and the runoff accounts for 17.1% of the annual runoff; and (4) between December and April of the next year, the dry season in winter, the runoff is mainly recharged by the groundwater.

Because rivers have frozen over, a considerable amount of water is stored up in the form of the ice in gutters, which will melt and be released into runoff in the next spring. The runoff during this period makes up 19.5% of the annual runoff.

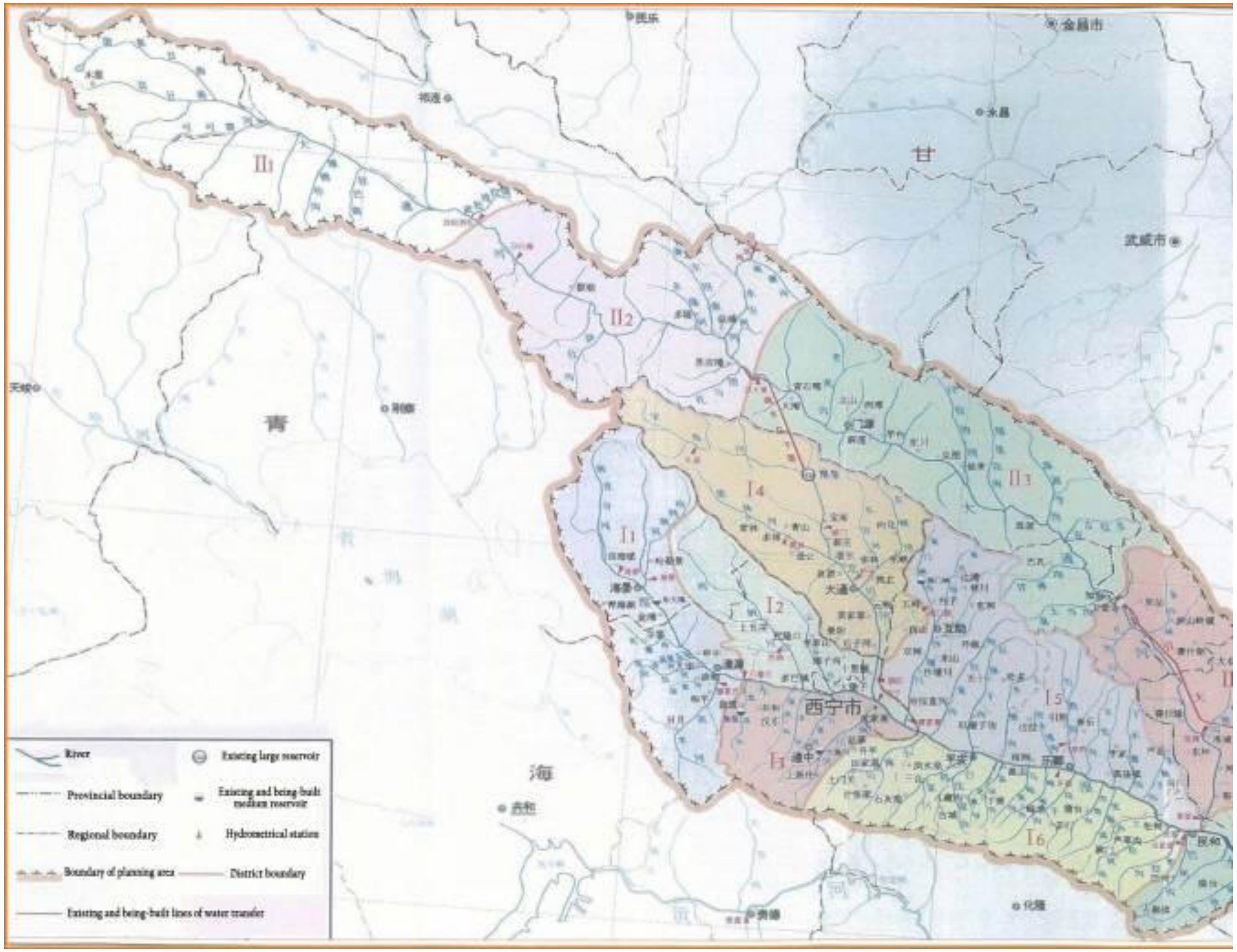


Figure 3.1-2 River System in the Project Area

3.1.5 Climatic Conditions

Lying in the arid plateau continental climate zone, due to its high altitude and low air pressure, Xining's climate is characterized by low precipitation, high evaporation, long freezing period, short frost-free period, large temperature differences between day and night and strong UV radiation.

- Temperature

The recorded highest and lowest daily temperatures are 33.9°C and -26.6°C, respectively; and the respective monthly averages are 26.1°C and -19.5°C.

- Precipitation

In Xining, the average annual precipitation is 368.2mm; the recorded maximum/minimum annual precipitation is 541.2mm/196.4mm; the maximum daily precipitation is 62.2mm. The distribution of precipitation varies greatly throughout the year: most likely occurring in July, August and September; in the next 5 months (from November to March of the next year), the total precipitation only makes up 3% of the annual precipitation. In addition, the geologic characteristics also result in the uneven spatial distribution of the precipitation: storms and torrential rains may pour down in some particular locations in the downtown.

- Evaporation

The maximum/minimum annual evaporation is 2,095.8mm/1,535.9mm, respectively. The maximum/minimum monthly evaporation is 323.7mm/28.5mm.

- Directions and Velocity of Winds and air pressure

In Xining, wind mainly comes from the southeast; the average wind velocity is 1.97m/s and the maximum velocity is 27m/s; the wind direction frequency is 23.1%. The average air pressure is 73.3KPa.

3.1.6 Soil

In the project area, soil parent material is mostly loess parent material, as well as residual deposit parent material and tertiary red soil parent material. Main soil type in the area is chestnut soil and sierozem, and thickness of the soil layer is about 0.3 - 0.8m.

3.2 Social Environment

3.2.1 Administration Division and Population

(1) Qinghai Province

Located in the northwest of the Tibetan Plateau (31°39'-39°12' N, 89°24'-103°04' E), Qinghai is an important province on the Tibetan Plateau. It has a territory of 722,300km2, stretching out for more than 1200km in the east-west direction and more than 800km in the south-east direction. 6 prefectures, 2 cities and 51 county-level administrative units are under its jurisdiction. The province is bordered by Gansu, Sichuan, Xizang and Xinjiang. Its eastern part has been long known for its beautiful landscapes.

(2) Xining

Under Xining's jurisdiction, there are four districts and three counties (i.e., Chengdong District, Chengzhong District (entrusted to administer Chengnanxin District), Chengbei District, Chengxi District, national economic development zone, high-tech development zone, Haihuxin District, Datong County, Huangzhong County and Huangyuan County), 50 townships, 12 offices administering issues related to agriculture, 931 village committees, 4,580 cooperatives/associations, 250,000 rural households and an agricultural population of 1.03 million. The total area of cultivated land is 1,841,112mu, of which, 460,680mu (25%) are irrigated land, 605,481mu (33%) are Qianshandi (nearby mountains), 621,451mu are Naoshandi (tope mountains), and 153,500mu are temporary cultivated land (the area of the latter two types of cultivated land makes up 42% of the total cultivated land).

In 2011, Xining had a population of 2.228 million, increasing by 0.87% from the previous year. In 2008, the population of elderly people (60 or above) reached 268,400, 52.76% higher than that in 2000. The elderly population grows much faster than the population: the former's growth rate is 34% and the latter's is 8%. In Xining, there are about 5.06 million mu of natural pastures, of which, 4.74 million mu are usable, 0.982 million mu are fenced, 1.3 million square meters are animal sheds and more than 1,500mu are aquaculture areas. There are about 135,500 agricultural machineries, the total power of which is 1.1145 million kW and the agricultural mechanization index is 67%.

(3) Chengbei District

Chengbei District is located in northwest of Xining Municipality, and the total area is 137.7 km^2. Dabaozi Town, Nianlipu Town, and Xiaoqiao, Chaoyang and Mafang subdistrict offices, 38 administrative villages, 23 community residents committees are under its jurisdiction. It is the biggest new municipal district and a transportation junction in Xining Municipality.

(4) Duoba Town (Huangzhong County)

Duoba Town is located 25 km in the north of Lushaer Town of Huangzhong County, 25km away from the Xining Municipality in the east, and the total area is 148.76 km^2. Duoba Town is a organic town in Huangzhong County. There are 44 village committees, 225 co-operative societies and 1 neighborhood committee. It is a main trading and service town in Huangzhong County.

(5) Changning Town (Datong County)

Changning Town is located in the south of Datong County, between 36°50' - 36°47' north and 101°42' - 101°48' east. It is next to Hutou Mountain to the east, borders with Dadunling Mountain and Huzhu County, next to Jingyang Town to the west, and adjacent to Huangjiazhai Town to the north. And the total area is 96.65 km^2. When Changning Town is established by merger of villages in October, 2001, it was merged with 15 village committees in Houzihe Township, 7 village committees in Changning Township, 4 village committees in Yuanshuo Township. And 26 village committees and 49 natural villages are under its jurisdiction.

See Table 3.2-1 for detailed administrative division of above regions.

Table 3.2-1 Area Affected by the Project (2011)

Area	Area (Km^2)	Township Sub-district Office				Village Committee	Community Committee	Cooperative
		Total	Town	Village	Sub-district Office			
Qinghai Province	722300	/	133	232	/	4164	/	/
Xining Municipality	7649	72	27	23	22	931	143	/
Chengbei District	137.7	5	2		3	38	23	/
Duoba Town	148.76	/	/	/	/	44	1	235
Changning Town	96.65	/	/	/	/	26	/	/

Data source: Statistics Year Book for Xining 2012, Project Office.

3.2.2 Social and Economic Situations

(1) Qinghai Province

In 2012, Qinghai's GDP amounted to RMB188.454 billion, 12.3% higher than that in the previous year. Qinghai is at the low-to-middle development level in China. Specifically, the primary industry yielded a value added of RMB17.681 billion, 5.2% over the previous year; the secondary industry yielded a value added of RMB109.198 billion, 14.1% over the previous year; and the tertiary industry yielded a value added of RMB61.575 billion, 11.1% higher relative to the previous year. The industrial structure ratio of the primary, secondary and tertiary industries was changed from 9.3:58.4:32.3 in 2011 to 9.4:57.9:32.7 in 2012. The per capita disposable income of urban residents was RMB17,566.28, 12.6% higher than that in the previous year; and the per capita net income of farmers and herders was RMB5,364.38, 16.4% higher. The Engle coefficients for urban and rural households were 37.8% and 38.87%, respectively.

(2) Xining

In 2012, Xining's GDP amounted to RMB85.109 billion, increasing by 15.0%. Specifically, the primary industry yielded a value added of RMB3.117 billion, 5.3% higher than that in 2012; the secondary industry yielded a value added of RMB43.952 billion, 18.3% higher; and the tertiary industry yielded a value added of

RMB38.04 billion, 11.8% higher. The industrial structure ratio of the primary, secondary and tertiary industries was changed from 3.56:53.36:43.08 in 2011 to 3.66:51.64:44.70 [in 2012]. The per capita GDP was RMB38,034 per year, increasing by 14.0%. The per capita disposable income of urban residents was RMB17,633.51, increasing by 11.3%; and the per capita net income of farmers were RMB7,801.54, increasing by 17.6%.

(3) Chengbei District

In 2011, the total GDP of Chengbei District, Xining, amounted to RMB15.907 billion, 22.1% higher than that in 2010. Specifically, the primary industry yielded a value added of RMB153 million, declining by 5.45% from 2010; the secondary industry yielded a value added of RMB11.487 billion, increasing by 26.06%; and the tertiary industry yielded a value added of RMB4.267 billion, increasing by 13.69%. The industrial structure ratio of the primary, secondary and tertiary industries was changed from 1.24:69.94:28.81 in 2010 to 0.96:72.21:26.82. The per capita GDP was RMB35,747, increasing by 18.72%. The per capita disposable income of urban residents was RMB14,623, 12.54% higher; and the per capita net income of farmers was RMB10,412, 15.18% higher.

(4) Duoba Town (Huangzhong County)

In 2011, the total GDP of Duoba Town amounted to RMB602.734 million, of which, the contribution of the primary industry was RMB186.054 million, accounting for 30.8% of the total GDP; the contribution of the secondary industry was RMB263.28 million, accounting for 43.6%; and the contribution of the tertiary industry was RMB153.40 million, accounting for 25.4%. Farmers' per capita net income was RMB5,236, of which: RMB1,123 (21%) were from agricultural activities, RMB677 (13%) were from agricultural and livestock production activities and RMB3,436 (66%) were from non-agricultural (the secondary and tertiary industries) activities.

(5) Changning Town (Datong County)

In 2011, Changning Town's GDPs of the primary and secondary industries were RMB32.731 million and RMB20.357 million, respectively. Its industrial structure ratio of the primary, secondary and tertiary industries was 35.2:47.6:17.2. Farmers' per capita net income was RMB3,712.83.

The social-economic situations of the above areas are summarized in Table 3.2-2.

Table 3.2-2 Summary of Social-economic Situation

Area	Total GDP (RMB100 million)	The Industrial ratio of the primary, secondary and tertiary industries	The per capita disposable income of urban residents (RMB)	The per capita net income of rural residents (RMB)
Qinghai	1884.54	9.4：57.9：32.7	17566.28	5364.38
Xining	851.09	3.66：51.64：44.70	17633.51	7801.54
Chengbei District	159.07	0.96：72.21：26.82	14623	10412
Duoba Town	6.03	30.8：43.6：25.4	3436	5236
Changning Town	/	35.2:47.6:17.2	/	3712.83

3.2.3 Natural Resources

Endowed with abundant natural resources and benefitted from the province's comparative advantages in natural resources, Xining is facing unique favorable development opportunities.

Water resources: Qinghai Province is crisscrossed by a number of rivers. It is also where the Yellow River, the Yangtz River and the Lancang River originate. Moreover, rivers in Qinghai exhibit the features of steep-sloped riverbeds, narrow valleys, large elevation differences and rich hydraulic resources – especially concentrated along the Yellow River and the Yangtze River. Thus, the development potentials are enormous. According to the exploration results, there are 108 rivers in Qinghai with a reserve over 10,000 kW each, and the total reserve is 23.3746 million kW, accounting for 3.3% of the total reserve of the nation and 27.8% of the total reserve of the northwest region of the nation. The total installed capacity of large and medium hydropower stations that can be developed/constructed reaches 20.99 million kW, of which, 17 stations with an installed capacity over 250,000kW each and 51 stations with an installed capacity between 25,000kW and 250,000kW each. Xining has rich surface water and groundwater resources. The Huangshui River runs throughout its downtown with an annual runoff of 1.894 billion cubic meters. The surface water resources produced internally reaches 701 million cubic meters, the groundwater resources amounted 698 million cubic meters, and the total water resources are 1.399 billion cubic meters.

Plants: Lying in the cool temperate zone, Qinghai has a rich diversity of flora. Specifically, it has 75 families, 331 generas and 947 species of economic plants. About one third of these plants are seed-bearing. There are around 680 species of medicinal plants, including 50 species of famous Chinese herbs that are very popular at home and abroad, such as Xining rhubarb, Chinese caterpillar fungus, saussurea, fritillaria thun-bergli, liquorice, Tibetan capillaries, astragalus mongholicus, Chinese ephedra and Chinese wolfberry. In addition, there are also hundreds of fiber plants, oil and perfume plants, edible and ornamental plants, in particular, bracken, potentill anserine and hippophae are the most famous ones. The vast majority of the plants are yet to be exploited and developed.

Animals: In Qinghai, there are 103 species of wild animals and 294 species of birds, accounting for 1/3 and ¼ of the respective numbers of the nation. At present, more than 250 species of animals have been identified as with an economic value. Qinghai has 10 national protected animal species, including: wild camel, wild yaks, wild ass, argali, white-lipped deer, snow leopard, black-necked crane, serow and ciconia nigra. It also has 20 national secondary protected animal species and 9 national tertiary protected animal species. In rivers, lakes and swamps, there are 37 species of fishes, of which, 15 species have economic values, and the majority of them are yet to be developed and utilized.

Animal husbandry: Qinghai is one of the five major pastoral areas of the nation and an important livestock production base. The total area of pastures is 36.4494 million Ha, accounting for 53.6% of the territory of the province. The carrying capacity is 2.300 million heads of animals. It produces 130,000 tons of mutton and beef and more than 4 million pieces of cowhide and sheepskin each year. Specifically, it has more than 5 million heads of yaks that are called as 'the ship of snow mountains' -- more than a half of the total number of yaks in China, and more than 14 million heads of sheep. 'Xining wool' is famous at home and abroad for its long fiber and strong staple strength.

Mineral resources: At present, 123 minerals have been discovered in the province, and the reserves of 97 minerals have been confirmed. Moreover, the reserves of 51 minerals in Qinghai rank in the top 10 nationwide, including 11 rank first. Over 70 minerals have been put on the national reserve list, and the potential value of the retained reserves amounts to RMB8,120 billion. Qinghai has remarkable comparative advantages in:

Salt lake resources: There are 33 salt lakes in Qaidam Basin, nicknamed as the treasure bowl. In particular, the lithium mining area at the Dongtai Jinaier Lake (the only one in the nation) and the potassium magnesium salt mining area at the Chaerhan Salt Lake (the largest one in the nation) are the most valuable ones. The preliminary estimates show that Qinghai has reserved: 326.3 billion tons of sodium chloride, 4.4 tons of potassium chloride, 4.82 billion tons of magnesium salt, 139.2 billion tons of lithium chloride, 159.2 billion tons of strontium and 6.86 billion tons of glauber salt. Moreover, the reserves of magnesium salt, potassium chloride and lithium chloride make up more than 90% of the corresponding total national reserves that have been proven. In addition, Qinghai's salt lake resources are characterized by high quality/grade, diverse mineral deposits, concentrated distribution, good mineral combinations and favorable exploration conditions.

Petroleum and natural gas: Currently, 16 oilfields and 6 gas fields have been discovered. Qinghai's petroleum resources amount to over 1.2 billion tons, and the proven reserve is 208 million tons. Its natural gas resources amount to 293.7 billion cubic meters, and the proven reserve is 66.329 billion cubic meters.

Metals and gold: Qinghai has a rich diversity of metal and gold resources. They are of high quality/grade and they are distributed widely across the province. Nonferrous metals include: copper (1.8 million tons), lead (1.10 million tons), zinc (1.53 million tons), nickel, cobalt, stibium and mercury. Ferrous metals include: Iron, manganese, chromium, titanium and vanadium. Precious metals include: gold, silver and platinum. Rare-earth metals and dispersed elements include: germanium, gallium, Gu, cadmium, beryllium, strontium, etc., and the retained reserves are about 63% of the total national reserves.

36 nonmetallic minerals have been discovered in Qinghai, including 5 rank first in the nation. They mainly include: asbestos, graphite, gypsum, solvent quartz, limestone, dolomite, refractory quartzite, silica, refractory clay, etc. The development potentials are huge.

Tourism resources: Lying on the plateau, Xining has a history of over 2100 years. In the ancient days, it was called Xipingting. In the Han Dynasty, General Zhao Chongguo stationed his troops here. It then became the capital city of Nanliang Kingdom. It was the commercial hub on the corridor and the Southern Silk Road, the gateway to the Tibetan Plateau. It is one of the important birthplaces of Hehuang Culture. Xining has been a shinning 'pearl' ever since the ancient time. The 'misty drizzles at Bei Mountain' is the best preserved attraction of the famous ancient 'eight best sights of Xining'. The natural landscape will deeply attract you.

3.2.4 Science and Technology and Education

(1) Science and Technology

Xining now has 33 independent research institutes and 2 dependent research institutes, of which, 2 are under the Chinese Academy of Sciences (CAS), namely: Qinghai Institute of Salt Lakes of CAS and Northwest Institute of Plateau Biology of CAS. It has 88 associations for science and technology with 43,500 members. And it has 21,885 science and technology professionals, of whom, 593 have the senior professional titles and 6,524 have intermediate professional titles.

(2) Education

Xining currently has 8 universities and colleges (of which, 5 are ordinary universities and colleges), with 32,753 registered students, 110 majors (diploma and degree) and 18 master programs. Xining has 2 colleges of continuing education, with 9,907 students.

Xining has 13 vocational schools with 3,331 students, offering training programs of various vocational skills (in particular, finance, business, cooking and hairdressing skills) at different levels. They have effectively contributed to the province's social and economic development.

3.2.5 Historic Heritage

There is now 1 provincial organization for management of cultural relics, 1 provincial museum, 3 city- and county-level organizations for management of cultural relics and 3 city- and county-level museums as well as 28 professional personnel involved in cultural relics exposition. There are more than 4,300 sites of cultural relics discovered in Qinghai (with 705 sites in Xining), which include 6 key cultural relic sites under state protection (Ta'er Lamasery and Rongwo Monastery [6], Qutan Temple, Machangyuan Historical Site, Xihaijun Ancient City and Reshui Cemetery), 224 provincial cultural relic protection organizations (with 64 organizations in Xining) and 319 county-level cultural relic protection organizations (with 77 organizations in Xining). The number of cultural relics collected in the museum is more than 160,000 including 205 pieces of first-class cultural relics (with 14 pieces in Xining). The pottery basin painted with dancing figures unearthed in Shangsunjia Village, Datong county, Xining, is confirmed to be the earliest pottery basin painted with dancing figures discovered in China.

Through field surveys and meeting with relevant organizations, it is confirmed that there is no cultural relic protection site within the project area.

3.2.6 Road Transport

Located in the east of Qinghai Province at the upper reaches of Huangshui River, the branch of Yellow River, Xining is surrounded by mountains or hills on all sides and has three rivers converging within its territory, and is called the eastern portal of Qinghai-Tibet Plateau, therefore being geographically important. Just as the saying goes, "roads lead to prosperity of all trades", as the political, economic, scientific and technological, cultural and transportation center of the province, transportation development of Xining plays a crucial role in overall development of city. Over 3 years, investment in urban road and transport facilities of Xining has reached RMB 2 billion, as a result, the total length of roads constructed in the established area of Xining has reached 422km, with road area totaling 11.165 million m^2 and road density reaching 4.94km/ km^2; the percentage of land occupied for construction of road is 14.9%; the per capita road area is 14.4m^2/person; the current density of main road is 2.63km/ km^2 and the average space between main roads is 761m. By December 23, 2010, vehicle amount of Xining had reached 219,436, an increase by 43,825 or 18.8% year on year, and 90% of the vehicles were privately owned. According to conservative estimation based on vehicle increase ratio in recent years, the vehicle amount of Xining will have exceeded 350,000 by 2015.

The road condition within Beichuan River area (core area) is relatively poor, with mainly tractor roads and temporary access roads. Moreover, the internal traffic facilities in the area are mainly for north-south transportation and only a few are for east-west transportation. In terms of the current traffic situation in Beichuan River area (core area), there are mainly two highways (north-south direction) and two railways (north-south direction). The highways are Xining-Datong Highway (at east side) and Xining-Zhangye Highway (at west side) and the railways are Lanzhou-Xinjiang Railway (at east side) and Xining-Datong Railway (at the center).The traffic function of highway mainly exists in passenger and freight transport. For railways, Lanzhou-Xinjiang Railway is mainly for passenger transport and Xining-Datong Railway is mainly for industrial transportation and mineral product transportation.

3.3 Current Environment Quality

The proposed project mainly contains the construction of the rainwater and wastewater collection system, reuse of reclaimed water in the existing wastewater treatment plant, low impact development (LID) and river bank improvement, and integrated gully and canal management and improvement.

Based on project components, with the assistance of Huangshui River (Xining section) Management Committee, this EIA team conducted investigation to review the performance of relevant construction projects in implementing EIA requirements. The results of the review indicate that EIAs of No.4 and No.5 WWTPs, the two WWTPs that are now under construction and relate to this proposed project, have been prepared and gone through technical review and approval; the existing No.1 and No.3 WWTPs are now functioning normally, and No.1 WWTP is now making efforts to upgrade its treatment standards. Thanks to the close proximity and environmental comparability between the above mentioned projects and this proposed project, when investigating the current situations of the environment quality, this EIA can refer to and quote some EIA conclusions for the former, and conduct complementary monitoring activities to collect necessary relevant data that are not available. Xining Environment Monitoring Station was commissioned by Huangshui River (Xining section) Management Committee to undertake monitoring of current environmental quality for the purpose of this EIA.

3.3.1 Overview and Evaluation of Current Situation of Acoustic Environment

(1) Overview of the Quality of Acoustic Environment of Xining

According to the *Xining Environment Quality Bulletin* (2011):

Noise of regional environment: In 2011, the noise of regional environment was at a relatively good level in terms of the acoustic environment of the whole city. The average equivalent sound level of noise of regional environment of Xining was 53.6db, an increase by 0.4db than that in 2010. In terms of the composition of noise source, domestic noise accounted for 52.7% and caused the biggest impact, other noises accounted for 26.8%, traffic noise 14.3%, and construction and industrial noises accounted for 4.9% and 1.3%, respectively. Compared with that of 2010, construction noise increased by 4.4%, and industrial noise dropped by 3.6%.

Road traffic noise: In 2011, the equivalent sound level of the traffic noise of 35 main roads of Xining was in the range of 64.2—72.1db and the average equivalent sound level of traffic noise of Xining urban areas was 69.7db, an increase by 0.2db than the previous year and presenting relatively good urban traffic environment quality. The length of road of which the traffic noise exceeds 70db is 47.5km with over limit rate of 55.4%. Compared with last year, the over limit rate increased by 5.1 %.

(2) Monitoring of Quality of Acoustic Environment of Project Area

Data in *EIA for No.4 WWTP* (based on monitoring conducted in 2011), *EIA for No.5 WWTP* (based on monitoring conducted in 2012) and *EIA for Beichuan River Plan* (based on monitoring in 2012) were refered to during this EIA. The referenced data are all results of monitoring conducted in 2011 and 2012, within the time interval for reference purpose. Moreover, these data are from sites that are largely overlapping with the project construction sites, and are thus capable of representing status of acoustic environment in the WWTPs and of the sewage collection pipes. The monitoring scheme and results are as follows:

Monitoring point: See table 3.3-1 and Figure 3.3-1 for arrangement of monitoring points.

Monitoring factor: Equivalent sound level L_{Aeq} (synchronously recording the weather condition at the monitoring site)

Monitoring time and frequency: Time of monitoring at No. 4 WWTP is March 3, 2011 during 8:00-22:00 and 22:00-8:00. Time of monitoring at No. 5 WWTP is September 2012 during 8:00-12:00 and 14:00-18:00 in daytime and at 22:00 at night. Monitoring for EIA of Beichuan River Plan was conducted during the period from October 30 to 31, 2012, lasting two days and in two phases, i.e. daytime and nighttime phases.

Monitoring method: Monitoring of acoustic environment was conducted according to relevant requirements in *Environmental Quality Standard for Noise* (GB3096—2008) and *Emission Standard for Industrial Enterprises Noise at Boundary* (GB 12348-2008)

Table 3.3-1A Arrangement of Monitoring Points for Quality of Noise Environment and Monitoring Results

Location	Time of Monitoring	Monitoring Point	Description	Results	
				Daytime	Nighttime
Reference Data					
No.4 WWTP	March 3, 2011	In Plant	Xichaun sewage collection pipes collect and convey sewage to No.4 WWTP; Beichuan sewage collection pipes collect and convey sewage to No.5 WWTP. These sewage pipes are planned to be installed in rural area, mainly with domestic noise and a small amount of traffic noise.	50.5	36.0
		East Side of Plant		58.8	43.1
		South Side of Plant		56.9	34.0
		West Side of Plant		52.6	45.2
		North Side of Plant		49.2	44.8
		Residential Area of Grain and Oil Reserve Warehouse		58.9	47.7
		Residential Area of		59.2	48.3

		Flour Mill	Monitoring was conducted before commencement of construction of the two WWTPs, so the ambient noise includes mainly domestic noise and a small amount of traffic noise, such results are representative.		
No.5 WWTP	September,2012	East Side of Plant		47.5	41.2
		South Side of Plant		52.3	46.5
		West Side of Plant		48.9	42.8
		North Side of Plant		47.1	41.6
		Shuangsubao Village at South-east Side of Plant		50.1	44.3
Class-II Standards in 《Quality Standard for Acoustic Environment》（GB3096—2008）				60	50
Supplementary Monitoring Data					
No.3 WWTP	August 12, 2013	East Side of Plant	For monitoring of noise on boundary of No.3 WWTP	54.9	48.3
		South Side of Plant		52.6	47.3
		West Side of Plant		51.8	47.3
		North Side of Plant		52.8	49.5
	August 13, 2013	East Side of Plant		55.8	50.4
		South Side of Plant		53.0	45.6
		West Side of Plant		52.1	56.3
		North Side of Plant		52.6	48.6
Class-II Standards in 《Standard for Noise Emission on Boundary of Industrial Enterprises》（GB 12348-2008）				60	50

Table 3.3-1 B Monitoring Results of Current Status of Noise in Beichuan Area

No.& Name of Monitoring Site	Leq[dB（A）]			
	Oct.30, 2012		Oct.31, 2012	
	Daytime	Nighttime	Daytime	Nighttime
1# Qijiacheng	52.4	42.2	53.3	41.7
2# Xinshiji Garden	55.6	44.1	54.1	45.5
3# Taoxin Village	51.7	40.9	52.2	43.2
4# Huaming Leisure Park	51.0	39.6	54.4	40.2
5# Jingya Primary School	52.4	37.5	51.8	39.7
6# Beihai Park	46.6	36.7	47.0	37.8
7# Xining No.25 Middle School	57.0	40.6	55.6	41.4
8#Ershilipu Village（West）	51.4	41.1	52.7	40.2
9# Kangjiaqiao	48.6	42.7	48.8	37.8
10# Ershilipu Village（East）	53.5	41.5	53.9	40.5
11# Provincial Drug Testing Institute	51.2	42.5	55.1	39.7
12# Zihengdijing Garden Residential Area	55.7	42.0	53.4	41.5

Monitoring results and evaluation: The results indicate that the level of noise monitored meets the requirements of class 2 standards of *Environmental Quality Standard for Noise* (GB3096-2008).

Located in a rural environment, the proposed wastewater interception main pipes connect Duoba town with No. 4 WWTP, along the pipeline quality of acoustic environment is better than where the No. 4 WWTP is located. Therefore, acoustic environment along Xichuan River wastewater interception main pipes is good.

Since Beichuan River wastewater interception main pipes from Datong wastewater treatment plant to toll station of Xining-Datong Highway are to be installed in rural environment, where quality of acoustic environment is better than that of No. 5 WWTP, so acoustic environment along the Beichuan River wastewater interception main pipes is good.

Based on monitoring data of current acoustic environment in Beichuan Area, noise at all sites monitoring is ranging from 46.6 to 57.0 dB(a) during daytime, and from 36.7 to 44.1 dB(A) during nighttime, Leq (dB(A)) monitoring values of both daytime and nighttime periods meet the requirements of Class II standard as defined in the Environmental Quality Standard for Noise (GB3096-2008), indicating good quality of current acoustic environment in Beichuan Area.

The land area where the rainwater and wastewater collection pipe network, low-impact development and river bank environmental improvement project components in Beichuan area are planned to be constructed has been acquired. The No. 5 WWTP is located at the northeast corner of the area where the project is to be constructed and close to Shuangsubao Village. The monitoring results of this plant can represent the current quality of acoustic environment of the area. The results indicate that the current quality of acoustic environment of Beichuan area and Shuangsubao Village is good and satisfies the requirements of class 2 standards of *Environmental Quality Standard for Noise* (GB3096-2008).

A, B, C, D, residential area of cereals and oils store and residential building of flour mill are noise monitoring points and E is noise and air monitoring point.

Figure 3.3.-1A Monitoring Point for Current Environment of No. 4 WWTP

A, B, C, D, and Shuangsubao are noise monitoring points and E is noise and air monitoring point.

Figure 3.3.-1B Monitoring Point for Current Environment of No. 5 WWTP

Figure 3.3-1C Noise Monitoring Points in Beichuan Area

3.3.2 Overview and Evaluation of Ambient Air

(1) Overview of Quality of Ambient Air of Xining

According to the *Xining Environment Quality Bulletin* (2011), there are now four ambient air automatic monitoring stations under national control in Xining to continuously carry out automatic monitoring of ambient air of the whole city. They include four monitoring points, i.e. city-level monitoring station, provincial medicine warehouse, Silu hospital and No. 5 Water Plant (control point of cleanliness).

The monitoring results indicate that the daily mean concentration of NO_2 in urban area of Xining in 2011 was 0.026mg/m^3 reaching the first-level standard (0.040mg/m^3) in *Ambient Air Quality Standard* (GB3095-1996); that the daily mean concentration of SO_2 is 0.043 mg/m^3 reaching the national first-level standard (0.050mg/m^3) for ambient quality. Compared with 2010, the concentration of oxynitride drops slightly and that of sulfur dioxide rises slightly; the daily mean concentration of inhalable particles (PM10) is 0.105 mg/m^3, which drops slightly compared with 2010 and reaches the national third-level standard for ambient air quality (0.150mg/m^3). In 2011, the total number of days monitored for ambient air quality of Xining was 365 days including 316 days with good ambient air quality. The rate of good air quality is 86.6%, up 1.4 percentage points compared with last year. The primary pollutant that impacts the ambient air quality is still particles. In 2011, no acid rainfall occurred in Xining, and the annual average amount of dust fall of the whole city was 19.41t/km^2 • month, which dropped slightly compared with 2010.

(2) On-line Monitoring Data of Xining Released by the Ministry of Environmental Protection

According to the real-time data for air quality of cities across China released by the website of the Ministry of Environmental Protection, four publishing points for monitoring data are set in Xining including provincial medicine warehouse, No. 5 water plant, city-level environment monitoring station and Silu hospital. The monitoring point of provincial medicine warehouse is located in the Chengbei District of Xining city. Fig 3.3-2-5 shows the data for SO_2, NO_2, PM_{10} and $PM_{2.5}$ in one month continuously from September 25 to October 24. According to the data, the ambient air quality of Chengbei District is relatively good in general.

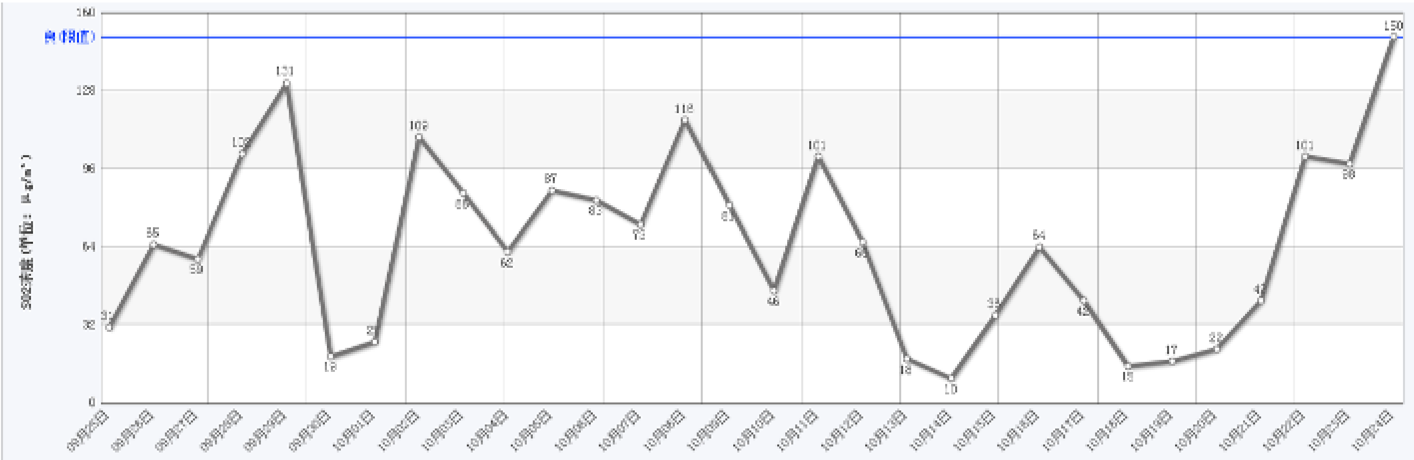


Figure 3.3-2 Daily Average Values of SO_2 from September 25 to October 24

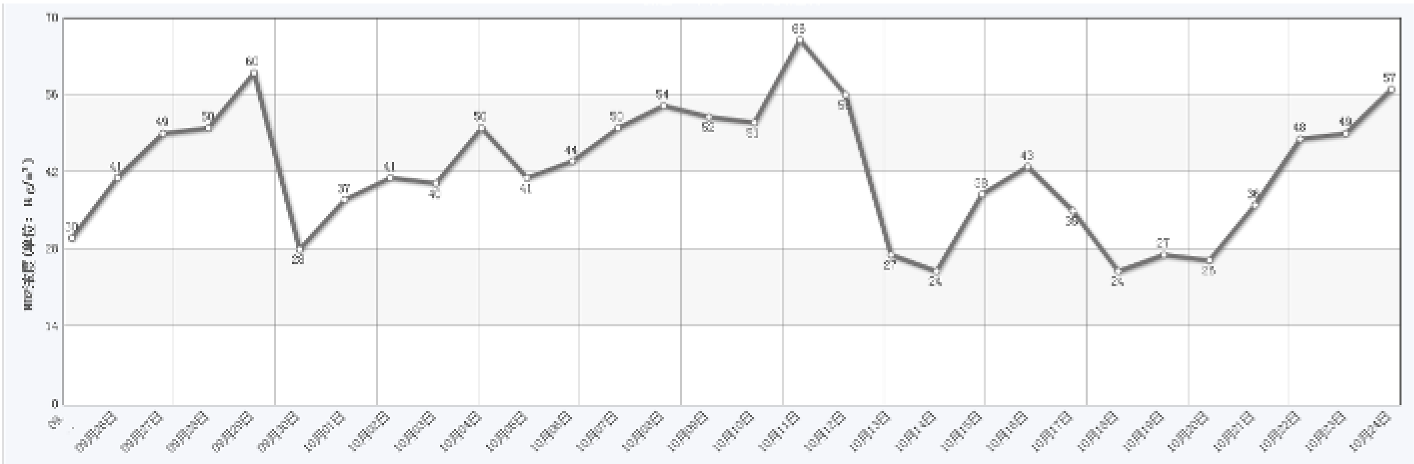


Figure 3.3-3 Daily Average Values of NO_2 from September 25 to October 24

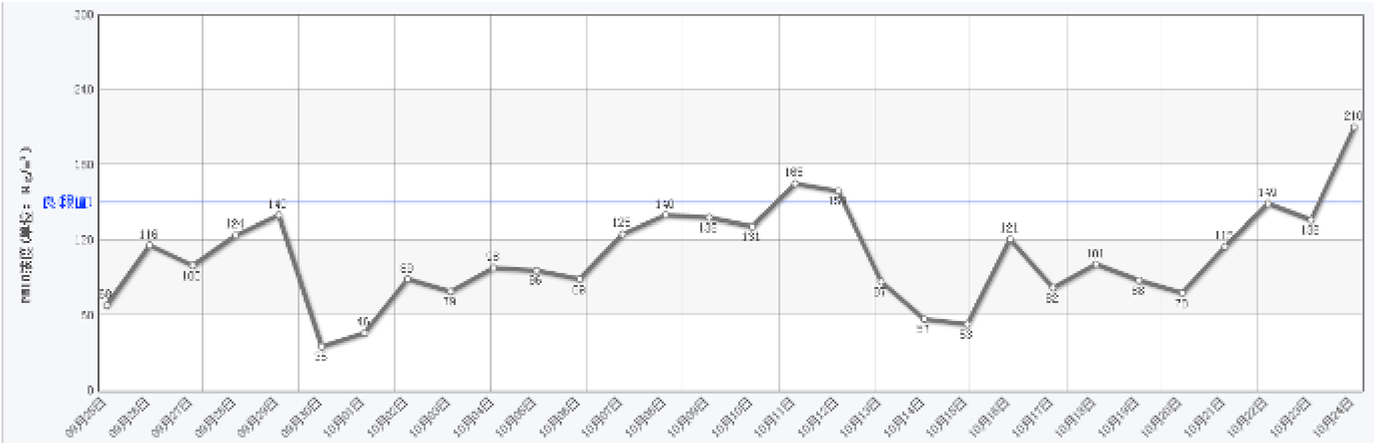


Figure 3.3-4 Daily Average Values of PM10 from September 25 to October 24

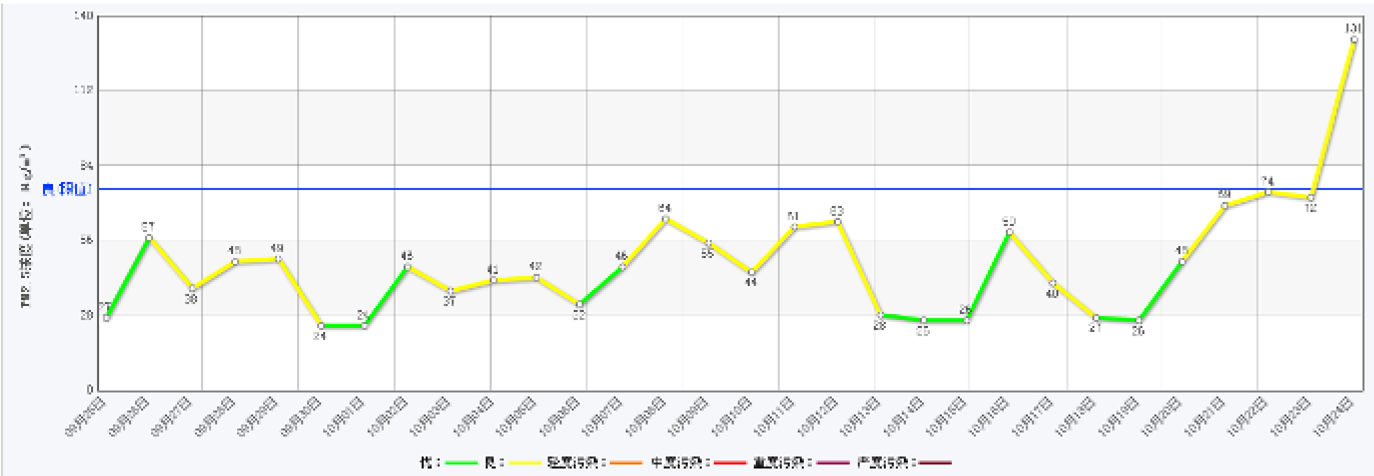


Figure 3.3-5　Daily Average Values of PM2.5 from September 25 to October 24

(3) Monitoring of Atmospheric Environment of Project Construction Area

This environmental impact assessment covers monitoring of the atmospheric environment of project construction area and is mainly aimed at understanding the current quality of atmospheric environment of project construction area in Beichuan area and along the bank of Xichuan River. The monitoring scheme and results are as follows:

Monitoring point: See table 3.3-2 and Figure 3.3-1 for arrangement of monitoring points.

Monitoring factor: nitrogen dioxide, sulfur dioxide, TSP, ammonia and hydrogen sulfide.

Monitoring date and frequency: Monitoring is carried out at each sampling point synchronously with sampling and continuously for 7 days from August 8 to August 15, 2013.

For the daily average concentration of SO_2 and NO_2, continuous sampling time shall not be less than 18 hours;

For the daily average concentration of TSP, continuous sampling time every day shall not be less than 12 hours;

For hydrogen sulfide and ammonia, 4 times of monitoring are required at an interval of 2 hours, the maximal value is taken as the measurement result.

Table 3.3-2 Arrangement of Monitoring Points for Current Ambient Air Quality and Monitoring Results

Location	Monitoring Point	Monitoring Date	Monitoring Results				
			SO_2	NO_2	TSP	Ammonia	Hydrogen Sulfide
No.4 WWTP	Inside 4-G Constructi on csite	August 8	0.024	0.038	0.546	-	-
		August 9	0.057	0.035	0.316	0.199	0.008
		August 10	0.03	0.026	0.5	0.175	0.009
		August 11	0.037	0.027	0.36	0.151	0.005
		August 12	0.044	0.028	0.341	0.168	0.008
		August 13	0.04	0.031	0.19	0.192	0.009
		August 14	0.033	0.04	0.213	0.176	0.008
		August 15	-	-	-	0.169	0.008
No.5 WWTP	Inside 5-G1 Constructi on site	August 8	0.098	0.041	0.2947	-	-
		August 9	0.074	0.033	0.059	0.148	0.007
		August 10	0.053	0.029	0.101	0.159	0.008
		August 11	0.072	0.034	0.367	0.148	0.006
		August 12	0.079	0.036	0.345	0.187	0.009
		August 13	0.069	0.039	0.227	0.189	0.008
		August 14	0.098	0.051	0.203	0.164	0.008
		August 15	-	-	-	0.177	0.009
No.3 WWTP	On 3-G1 Boundary of Plant	August 8	0.032	0.042	0.445	-	-
		August 9	0.015	0.042	0.697	0.489	0.077
		August 10	0.021	0.04	0.536	0.144	0.003

		August 11	0.018	0.033	0.524	0.185	0.009
		August 12	0.023	0.052	0.404	0.459	0.006
		August 13	0.022	0.047	0.302	0.467	0.003
		August 14	0.012	0.047	0.523	0.238	0.009
		August 15	-	-	-	0.431	0.007
	On 2-G2 Boundary of Plant	August 8	0.038	0.035	0.297	-	-
		August 9	0.015	0.025	0.301	0.484	0.004
		August 10	0.017	0.03	0.194	0.14	0.008
		August 11	0.022	0.028	0.265	0.234	0.009
		August 12	0.034	0.034	0.349	0.492	0.01
		August 13	0.013	0.032	0.305	0.444	0.002
		August 14	0.012	0.034	0.323	0.21	0.01
		August 15	-	-	-	0.545	0.009
	On 3-G3 Boundary of Plant	August 8	0.028	0.039	0.344	-	-
		August 9	0.006	0.03	0.39	0.52	0.006
		August 10	0.008	0.028	0.195	0.395	0.005
		August 11	0.03	0.029	0.288	0.43	0.008
		August 12	0.027	0.038	0.286	0.444	0.007
		August 13	0.032	0.039	0.309	0.456	0.006
		August 14	0.02	0.031	0.266	0.429	0.011
		August 15	-	-	-	0.472	0.007
	On 3-G4 Boundary of Plant	August 8	0.029	0.036	0.289	-	-
		August 9	0.006	0.028	0.428	0.399	0.013
		August 10	0.038	0.025	0.426	0.296	0.013
		August 11	0.008	0.029	0.358	0.316	0.011
		August 12	0.03	0.039	0.361	0.435	0.01
		August 13	0.02	0.034	0.265	0.488	0.011
		August 14	0.013	0.039	0.205	0.259	0.012
		August 15	-	-	-	0.524	0.01
Class-II Standards for *Quality Standard for Ambient Air Environment*（GB3095—2012）			0.15	0.08	0.3	-	-
One-time Concentration limit of Sanitary Standard for Design of Industrial Enterprises (Tj36-79)			-	-	-	0.2	0.01

Monitoring result and evaluation: The results indicate that the concentration of SO_2, NO_X and TSP in the ambient air of No. 4 and No. 5 WWTPs meets the limit value of Class-2 standard of *Ambient Air Quality Standard* (GB3095—2012), and that of H_2S and NH_3 meets the one-time limit value for concentration of *Sanitary Standard for the Design of Industrial Enterprise* (TJ36-79), which mean that the ambient air quality is good.

Xichuan wastewater interception main pipes connecting Duoba town with No. 4 WWTP is located in rural area, along the pipeline quality of acoustic environment is better than where the No. 4 WWTP is located. Therefore, acoustic environment along Xichuan River wastewater interception main pipes is good.

Since Beichuan River wastewater interception main pipes from Datong wastewater treatment plant to toll station of Xining-Datong Highway are to be installed in rural environment, the quality of acoustic environment is better than where the No. 5 wastewater treatment plant is located, thus acoustic environment along the Beichuan River wastewater interception main pipes is good.

(4) Investigation on Air Environmental Quality in Beichuan Area

To understand air environmental quality in Beichuan Area, data in EIA for Beichuan River Plan were referenced and the monitoring was conducted by Xining Environmental Monitoring Station in 2012, within the time inverval for data reference purpose.

Monitoring sites: 4 sites in total, located in Ershilipu Village, Shitoulei Village, Biological Industry Zone and Qijiacheng, respectively.

Monitoring frequency: Monitoring was conducted for 7 consecutive days from Oct.24 to Oct.30, 2012, with daily value (at least sampling for 18 hrs a day), 1 hr average value (at least sampling for 45min.) of SO_2, NO_2 monitored at 6:00, 9:00, 14:00 and 18:00; daily average value of TSP (at least sampling for 12 hrs).

The monitoring results obtained are shown in the following table (Table 3.3-3). Sites selected for the monitoring are shown in Figure 3.3-C.

Table 3.3-3 Monitoring Results of Ambient Air Quality (unit: mg/m^3)

Items		Locations	1# Ershilipu Village	2# Shitoulei Village	3# Biological Industrial Zone	4# Qijiacheng
SO_2	Daily Average	Concentration	0.020～0.085	0.006～0.096	0.004～0.109	0.015～0.094
		Exceedance Ratio %	0	0	0	0
		Maximal Times of Exceedance	0	0	0	0
	Hourly Average	Concentration	0.027～0.494	0.014～0.509	0.013～0.435	0.014～0.402
		Exceedance Ratio %	0	7.14%	0	0
		Maximal Times of Exceedance	0	0.02	0	0
NO_2	Daily Average	Concentration	0.030～0.049	0.027～0.047	0.023～0.052	0.019～0.049
		Exceedance Ratio %	0	0	0	0
		Maximal Times of Exceedance	0	0	0	0
	Hourly Average	Concentration	0.024～0.113	0.029～0.107	0.019～0.082	0.022～0.098
		Exceedance Ratio %	0	0	0	0
		Maximal Times of Exceedance	0	0	0	0
TSP	Daily Average	Concentration	0.302～1.301	0.378～1.214	0.203～0.327	0.367～1.049
		Exceedance Ratio %	100%	100%	28.6%	100%
		Maximal Times of Exceedance	3.34	3.05	0.09	2.5
PM10	Daily	Concentration	0.235～0.713	0.182～0.432	0.096～0.291	0.265～0.784

	Average	Exceedance Ratio %	100%	100%	85.7%	100%
		Maximal Times of Exceedance	3.75	1.88	0.94	4.23

From the above table, it is clear that:

For SO_2, its daily value of ranges from 0.004 to 0.096 mg/m^3，hourly value ranges from 0.013 to 0.509 mg/m3，no exceedance of daily concentration was observed at all sites, except hourly concentration exceeding the standard at some individual site.

For NO2, daily value of ranges from0.010 to 0.029 mg/m^3，hourly value ranges from0.013 to 0.509 mg/m3，no exceedance of daily or hourly concentration was found at all sites.

For TSP, daily concentration ranges from 0.203 to 1.301mg/m^3，exceedance of daily concentration was observed at all sites, including 100% of exceedance ratio at Ershilipu Village, Shitoulei Village and Qijiacheng, 85% of exceedance ratio at Biological Industrial Zone, and the maximal times of exceedance reach 3.34.

For PM10, daily concentration ranges from 0.096 to 784mg/m3，exceedance of daily concentration was observed at all sites, and the exceedance ratio ranges from 85.7% to 100%, with maximal times of exceedance being 4.23 (at Site 4#).

Analysis of such monitoring results indicates that, since SO_2 and NO_2 in the assessment area are all within the standard scope, pollution by SO_2 and NO_2 is slight in the assessment area. TSP and inhalvable particulate matter exceeds the standard at all monitoring sites, while such exceedances are largely due to the geological location of the assessment area, because the project area is located in the northwest China, arid with little precipitation, and is prone to dust raised from the barren and dry cultivated land by winds.

3.3.3 Overview and Evaluation of Surface Water Environment

(1) Overview of Water Environment Quality of Xining

According to the *Xining Environment Quality Bulletin* (2011), the quality of water in main rivers of the city kept improving. As a main river running through Xining, Huangshui collects the water from three branches at the Xining section, i.e. Beichuan River, Nanchuan River and Shatangchuan Rivera total of 11 monitoring sections are set for trunk and branch streams of Huangshui River (Xining section) including 5 sections for trunk streams of Huangshui River. The sections for Zhamalong, Xigang bridge, Xinning bridge, Baoshe bridge and Xiaoxiakou (Zhamalong and Xiaoxiakou are sections under national control) are sections at the national boundary and also sections for quantitative evaluation on comprehensive improvement of the urban environment. As can be seen from the monitoring results of 2011, functional zoning targets of water environment were achieved in 7 of the 11 monitoring sections and the rate of sections reaching the standard is 63.6%.There were 4 sections with water quality of class I-III and 3 sections with poor water quality of class V. In general, the water of Huangshui River Basin was slightly polluted. The water quality in normal and high water reasons was improved compared with 2010, but the water quality in low water season was relatively poor. Organic pollutants prevailed in water with ammonia nitrogen, total phosphorus and five-day biochemical oxygen demand ranking in top three. The water of trunk streams of Huangshui River was slightly polluted while that of branch streams was heavily polluted. The water quality of the Xigang bridge section of trunk stream had been obviously improved while that of Qiyi bridge section was relatively poor. The water quality of Xiaoxiakou section at the national boundary had been improved and the proportion of water with quality better than that of class IV reached 75% for the whole year.

(2) Monitoring of the Quality of Water Environment

Monitoring point: Runze Bridge and Chaoyang Bridge are selected as monitoring points for the current situation of reclaimed water plant of the No. 5 wastewater treatment plant. The data from January to October of 2011 environmental impact assessment for the construction project of No. 5 wastewater treatment plant is adopted for Chaoyang bridge whereas the current situation of Runze Bridge is monitored. For the current situation of reclaimed water plant of the No. 4 wastewater treatment plant, the three provincial control sections, i. e. Zhamalong at the upstream and Xigang bridge and Xinning Bridge at the downstream of the project are selected as monitoring points. The continuously monitored data for the current situation from January to October of 2012 environmental impact assessment for the construction project of No. 4 WWTP is adopted and the monitoring points are shown in Figure 3.3-6.

Figure 3.3-6 Monitoring Points for Surface Water

Monitoring factor:

① Chaoyang Bridge: five-day biochemical oxygen demand, chemical oxygen demand, ammonia nitrogen and total phosphorus;

② Runze bridge: water temperature, PH, DO, chemical oxygen demand, five-day biochemical oxygen demand, ammonia nitrogen, total phosphorus, copper, zinc, selenium, arsenic, mercury, cadmium, chromium (six valence), lead, cyanide, volatile phenol, petroleum, anionic surfactant, sulfide and fecal coliform, etc.

③ Zhamalong, Xigang Bridge and Xining bridge: five-day biochemical oxygen demand, chemical oxygen demand, ammonia nitrogen and total phosphorus;

Monitoring time and frequency:

② Chaoyang Bridge: once every month from January to October of 2011.

② Runze Bridge, Xiaoxiakou: Routine monitoring data for surface water quality at the monitored cross-sections are used, once a month routine monitoring in April, May and June of 2013 was conducted.

③ Zhamalong, Xingang Bridge and Xinning Bridge: once every month from January to October of 2012.

Monitoring result and evaluation: See Table 3.3-3 for the monitoring results of the cross-sections of Chaoyang Bridge and Runze Bridge.

Table 3.3-3A Routine Monitoring Data of Chaoyang Bridge Section

Monitoring Cross-Section	Monitoring Time (YY-MM-DD)	BOD_5	COD	Ammonia Nitrogen	TP
Chaoyang bridge over Beichuan River	2012.01.05	5	19	2.91	0.362
	2012.02.01	7	14	1.46	0.252
	2012.03.01	15	27	2.42	0.344
	2012.04.01	1	20	1.83	0.304
	2012.05.02	19	2	2.49	0.249
	2012.06.03	4	15	1.2	0.180
	2012.07.02	4	22	3.78	0.381
	2012.08.03	6	14	1.4	0.404
	2012.09.01	2	15	1.28	0.238
	2012.10.08	2	14	1.11	0.140
	Average value	6.5	16.2	1.988	0.284
	Standard value of class IV	6	30	1.5	0.3
	Rate of reaching the standard	70%	100%	50%	50%

As can be seen from Table 3.3-3, the rates of reaching the standard for COD and BOD of the Chaoyang bridge section are relatively high, being above 70% whereas the rates of reaching the standard for ammonia nitrogen and total phosphorus are relatively low, being only 50%. The standard for water quality is class IV.

At Chaoyangqiao cross-section, maximal values of COD, ammonia nitrogen and TP are 3.2, 2.52 and 1.35 times of the standard values, respectively.

Table 3.3-3B Routine Monitoring Data of Runze Bridge Section

Monitoring Section	Monitoring Time (YY-MM)	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand (BOD)	Ammonia Nitrogen	Petroleum	Volatile Phenol	Mercury	Lead	Chemical Oxygen Demand (COD)	Hexavalent Chromium
		^{0}C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2013.04	6	14	1.46	0.252	2.16	0.03	0.0024	0.00005	0.002	21.0	0.004L
	Standard Value of Class III		6~9	5	4	1.0	0.05	0.005	0.0001	0.05	20	0.05
	Monitoring Time (YY-MM)	Selenium	Total Phosphorus	Copper	Zinc	Arsenic	Cadmium	Anionic Surfactant	Sulfide	Fecal Coliform	Cyanide	
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Nr./L	mg/L	
	2013.04	0.0005	0.38	0.05L	0.02L	0.0072	0.0002L	0.16	0.0005L	28000	0.004L	
	Standard Value of Class III	0.01	0.2	1.0	1.0	0.05	0.005	0.2	0.2	10000	0.005	
	Monitoring Time (YY-MM)	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand (BOD)	Ammonia Nitrogen	Petroleum	Volatile Phenol	Mercury	Lead	Chemical Oxygen Demand (COD)	Hexavalent Chromium
		^{0}C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2013.05	10	8.72	7.8	3	1.43	0.01	0.0021	0.00003	0.004	19.0	0.004L
	Standard Value of Class III		6~9	5	4	1.0	0.05	0.005	0.0001	0.05	20	0.05
	Monitoring Time (YY-MM)	Selenium	Total Phosphorus	Copper	Zinc	Arsenic	Cadmium	Anionic Surfactant	Sulfide	Fecal Coliform	Cyanide	
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Nr./L	mg/L	
	2013.05	0.0006	0.362	0.05L	0.02L	0.0053	0.0002L	0.156	0.0005L	160000	0.004L	
	Standard	0.01	0.2	1.0	1.0	0.05	0.005	0.2	0.2	10000	0.005	

	Value of Class III											
	Monitoring Time (YY-MM)	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand (BOD)	Ammonia Nitrogen	Petroleum	Volatile Phenol	Mercury	Lead	Chemical Oxygen Demand (COD)	Hexavalent Chromium
		^0C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2013.06	10	8.48	7.6	4	2.97	0.02	0.0028	0.00003	0.001L	15.0	0.004L
	Standard Value of Class III		6~9	5	4	1.0	0.05	0.005	0.0001	0.05	20	0.05
	Monitoring Time (YY-MM)	Selenium	Total Phosphorus	Copper	Zinc	Arsenic	Cadmium	Anionic Surfactant	Sulfide	Fecal Coliform	Cyanide	
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Nr./L	mg/L	
	2013.06	0.0005L	0.330	0.05L	0.02L	0.0051	0.0001L	0.095	0.005L	24000	0.004L	
	Standard Value of Class III	0.01	0.2	1.0	1.0	0.05	0.005	0.2	0.2	10000	0.005	

Table 3.3-3C Routine Monitoring Data of Xiaoxiakou Cross-section

Monitoring Section	Monitoring Time (YY-MM)	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand (BOD)	Ammonia Nitrogen	Petroleum	Volatile Phenol	Mercury	Lead	Chemical Oxygen Demand (COD)	Hexavalent Chromium
		^{0}C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2013.04	9	8.84	6.4	3	1.45	0.06	0.0033	0.00002	0.001L	16.0	0.013
	Standard Value of Class IV		6～9	3	6	1.5	0.5	0.01	0.001	0.05	30	0.05
	Monitoring Time (YY-MM)	Selenium	Total Phosphorus	Copper	Zinc	Arsenic	Cadmium	Anionic Surfactant	Sulfide	Fecal Coliform	Cyanide	
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Nr./L	mg/L	
	2013.04	0.0005L	0.295	0.05L	0.02L	0.0044	0.0001L	0.118	0.0005L	**160000**	0.004L	
	Standard Value of Class IV	0.02	0.3	1.0	2.0	0.1	0.005	0.3	0.5	20000	0.01	
	Monitoring Time (YY-MM)	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand (BOD)	Ammonia Nitrogen	Petroleum	Volatile Phenol	Mercury	Lead	Chemical Oxygen Demand (COD)	Hexavalent Chromium
		^{0}C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2013.05	12	8.45	7.4	6	1.02	0.02	0.0029	0.00004	0.002	17.0	0.009
	Standard Value of Class IV		6～9	3	6	1.5	0.5	0.01	0.001	0.05	30	0.05
	Monitoring Time (YY-MM)	Selenium	Total Phosphorus	Copper	Zinc	Arsenic	Cadmium	Anionic Surfactant	Sulfide	Fecal Coliform	Cyanide	
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Nr./L	mg/L	
	2013.05	0.0005L	0.295	0.05L	0.03	0.0033	0.0001	0.297	0.005L	**160000**	0.004L	

	Standard Value of Class IV	0.02	0.3	1.0	2.0	0.1	0.005	0.3	0.5	20000	0.01	
	Monitoring Time (YY-MM)	Temperature	pH	Dissolved Oxygen	Biochemical Oxygen Demand (BOD)	Ammonia Nitrogen	Petroleum	Volatile Phenol	Mercury	Lead	Chemical Oxygen Demand (COD)	Hexavalent Chromium
		^{0}C		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	2013.06	12	8.31	7.6	6	1.40	0.02	0.0035	0.00003	0.001L	26.0	0.008
	Standard Value of Class IV		6～9	3	6	1.5	0.5	0.01	0.001	0.05	30	0.05
	Monitoring Time (YY-MM)	Selenium	Total Phosphorus	Copper	Zinc	Arsenic	Cadmium	Anionic Surfactant	Sulfide	Fecal Coliform	Cyanide	
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Nr./L	mg/L	
	2013.06	0.0005L	0.299	0.05L	0.02L	0.0018	0.0001L	0.297	0.005L	**160000**	0.004L	
	Standard Value of Class IV	0.02	0.3	1.0	2.0	0.1	0.005	0.3	0.5	20000	0.01	

As can be seen from Table 3.3-3B, the three-month continuously monitored data of ammonia nitrogen, total phosphorus and fecal coliform for Runze Bridge all exceeded the limit value. More specifically, maximal ammonia nitrogen was 2.97 times of the limit value, total phosphorus being 1.9 times and fecal coliform being 16 times, the most serious exceedance. The chemical oxygen demand only slightly exceeded the limit value in April. Other indicators can meet the standard of class III.

As shown in Table 3.3-3c, according to the three month monitoring at Xiaoxiaokou cross-section, only fecal coliform was 8 times exceeding standard, while other indicators all meet Class IV standards.

See Table 3.3-4 for the monitoring results of the sections of Zhamalong, Xingang Bridge and Xinning Bridge.

Table 3.3-4 Routine Monitoring Datasheet Unit: mg/l

Monitoring Cross-section	Monitoring Time (YY-MM-DD)	BOD_5	COD	Ammonia Nitrogen	TP
Zhamalong	2012.01	1	8	0.355	0.042
	2012.02	1	9	0.464	0.068
	2012.03	2	14	0.434	0.108
	2012.04	2	18	0.62	0.18
	2012.05	3	17	0.501	0.189
	2012.06	3	19	0.235	0.094
	2012.07	1	12	0.240	0.102
	2012.08	4	12	0.214	0.190
	2012.09	2	10	0.247	0.09
	2012.10	2	13	0.296	0.094
	Average value	2.1	13	0.361	0.116
	Standard value of class III	4	20	1.0	0.2
	Rate of reaching the standard	100%	100%	100%	100%
Xigang Bridge	2012.01.05	2	10	0.646	0.118
	2012.02.01	1	11	0.746	0.094
	2012.03.01	3	16	1.000	0.149
	2012.04.01	2	21	1.03	0.392
	2012.05.01	25	4	0.588	0.2
	2012.06.03	2	16	0.414	0.128
	2012.07.02	1	20	0.778	0.128
	2012.08.03	4	14	0.555	0.230
	2012.09.01	3	11	0.534	0.185
	2012.10.08	3	13	0.504	0.064
	Average value	4.6	14	0.680	0.169
	Standard value of class III	4	20	1.0	0.2
	Rate of reaching the standard	90%	90%	90%	90%
Xinning Bridge	2012.01.05	2	10	1.09	0.154
	2012.02.01	1	12	1.09	0.176
	2012.03.01	1	16	1.38	0.175
	2012.04.01	2	19	1.42	0.484

	2012.05.01	35	6	0.802	0.181
	2012.06.03	4	16	0.505	0.158
	2012.07.02	2	19	0.951	0.17
	2012.08.03	4	16	0.690	0.230
	2012.09.01	3	14	0.587	0.298
	2012.10.08	3	14	0.705	0.052
	Average value	5.7	14.2	0.922	0.208
	Standard value of class IV	6	30	1.5	0.3
	Rate of reaching the standard	90%	100%	100%	90%

As can be seen from Table 3.3-4, 80% of the indicators at each cross-section were within the limits stipulated in the standard. The water quality of Zhamalong and Xigang Bridge met the standard of class III and that of Xining Bridge met the standard of class IV.

At Xigang Bridge cross-section, maximal COD was 6.25 times exceeding the standard, BOD 1.05 times, ammonia nitrogen 1.03 times, and TP 1.15 times.

At Xining Bridge cross-section, maximal COD was 5.8 times exceeding the standard and TP 1.6 times.

From the above monitoring data it can be seen that COD, BOD, NH4-N, TP and feces coliform are the main pollutants along the river, mainly because of lack of complete sewage collection system in villages at the upper stream along the river and thus direct sewage discharge into the river. Besides, piled solid domestic waste form non-point pollution sources, resulting in overall deterioration of water environment in Xining.

3.3.4 Overview and Current Situation of Groundwater Environment

Groundwater in Xining Basin, shallow, abundant and of good quality, has relatively high degree of development and utilization based on higher degree of hydrogeological research. The amount of underground water resources is calculated based on its total replenishment, which includes rainfall infiltration, surface water replenishment, pedimont lateral recharge (mainly from undercurrent of river bed) and return flow of groundwater abstraction. Surface water replenishment comes from seepage from river channel, canal system and farmland. The phreatic water of river valley in Xining area mainly comes from leakage of surface water bodies and from lateral recharge of underground runoffs of ditches and valleys in bedrock mountain area and rainfall infiltration as well.

(1) Groundwater Environment in Beichuan Area

To understand quality of groundwater environment in Beichuan Area, data in *EIA for Beichuan River Plan* were referenced and the monitoring was conducted by Xining Environmental Monitoring Station in 2012, within the time inverval for data reference purpose.

Monitoring time and frequency: Groundwater monitoring was conducted by Xining Environmental Monitoring Station for 3 consecutive days from Oct.29 to Oct.31, 2012, with water samples collected once every day.

Monitoring parameters: Totally 10 parameters, incl. PH, TDS, NH4-N, Total Hardness, permanganate index, Zn, Fe, anionic surfactant, coliform and total bacteria.

Monitoring results: As shown in Table 3.3-5, the results include maximal value, average value, detection ratio, exceedance ratio, multples of average value exceeding the standard. Sites selected for the monitoring are shown in Figure 3.3-1C.

Table 3.3-5 Monitoring Results of Groundwater Environmental Quality

No.	Parameters	1# Beihai Park	2# Taoxin Village	Standard Value （mg/l， except for pH, coliform and bacteria）
1	pH	7.49~7.63	7.53~7.86	6.5~8.5
2	Total Hardness	**550~589**	**960~996**	450
3	TDS	152~198	106~128	1000
4	Fe	0.05~0.06	0.03~0.03	0.3
5	NH4-N	**0.237~0.263**	0.037~0.066	0.2
6	Anion Surfactant	0.05~0.056	0.058~0.081	0.3
7	Zn	0.02~0.04	0.04~0.04	1.0
8	Permanganate index	1.9~2.1	0.6~0.6	3.0
9	Total Coliform （No./L）	2/L	20~20	3.0/L
10	Total Bacteria （No./mL）	9000-13000	8000-10000	100/mL

From the above table, it is clear that among all 10 parameters monitored at No.1 monitoring well at Beihai Park and No.2 monitoring well at Taoxin Village, pH, permanaganate index, Zn, Fe, TDS, anionic surfactant are within limit of the standard, while NH4-N, total bacteria, total coliform and total hardness exceed the standard value, including 100% of exceedance ratio for both total hardness and total bacteria, and 100% of exceedance ratio for total coliform at No.3 monitoring well in Taoxin Village.

The above monitoring results indicate that groundwater in the assessment area has been polluted by pollutants such as total hardness, NH4-N, total coliform and total bacteria. The main reasons for the pollution are arbitrary dumping and pile-up of domestic solid waste and lack of effective sewage collection in the assessment area, and the solid and liquid domestic waste result in pollution through infiltration.

(2) Groundwater Monitoring at Upper Stream of Xichuan and Beichuan River

Considering that groundwater in Beichuan Area has parameters of NH4-N, total coliform and total bacteria exceeding the standard, investigations on quality of groundwater at the upper stream of Beichuan and Xichuan rivers were conducted during this EIA for data collection and hence better understanding of groundwater quality in the assessment area. Based on data collected from No.4 water plant and Duoba water plant in Xining for period of 2011 and 2012 (see Table 3.3-6 on the next page for details), in the upper stream of Beichuan and Xichuan River, groundwater quality has all parameters meeting Class-III standard as per Groundwater Quality Standard (GB/T 14848-93), indicating good quality of groundwater in the upper stream of rivers.

Table 3.3-6 Monitoring of Groundwater Quality of Project Area

Water Source	Sampling Time (YY-MM-DD)	PH	Total Hardness	Sulfate	Chloride	Iron	Manganese	Copper	Zinc	Volatile Phenol	Anionic Synthetic Detergent	Index of Permanganate	Nitrate Nitrogen	Nitrite
No.4 Water Plant	2011.02.09	7.67	171	8	8	0.05	0.01L	0.001L	0.02L	0.002L	0.05L	0.5	1.24	0.003L
	2011.06.01	7.70	194	31	10	0.17	0.01L	0.002	0.02L	0.002L	0.05L	0.5L	1.22	0.003L
	2011.08.01	7.72	162	30	52	0.03L	0.01L	0.013	0.02L	0.002L	0.05L	0.56	1.15	0.003L
	2012.02.01	7.71	162	34	10L	0.03L	0.01L	0.05L	0.02L	0.0005	0.05L	0.5L	1.3	0.003L
	2012.06.07	7.86	178	35	8	0.03L	0.01L	0.05L	0.02L	0.0009	0.05L	0.5L	0.931	0.003L
	2012.08.03	7.83	142	21	6	0.005	0.02	0.05L	0.02L	0.0010	0.05L	0.5L	0.98	0.003L
Duoba Water Plant	2011.02.09	7.45	313	103	50	0.03L	0.01L	0.001L	0.02L	0.002L	0.05L	0.6	3.08	0.003L
	2011.06.01	7.76	348	104	56	0.12	0.01	0.008	0.02L	0.002L	0.05L	0.64	4.74	0.003L
	2011.08.01	7.54	322	90	52	0.03L	0.01L	0.017	0.02L	0.002L	0.05L	0.56	4.67	0.003L
	2012.02.01	7.51	366	97	54	0.06	0.01L	0.05L	0.02L	0.0009	0.064	0.5L	3.55	0.003L
	2012.06.07	7.57	380	94	62	0.03L	0.01L	0.05L	0.02L	0.0009	0.05L	0.5L	0.931	0.003L
	2012.08.03	7.75	336	105	16	0.03L	0.02	0.05L	0.02L	0.0008	0.05L	0.5L	4.55	0.003L
Standard		6.5~8.5	450	250	250	0.3	0.1	1.0	1.0	0.002	0.3	3.0	20	0.02

Table 3.3-6 (Continued) Monitoring of Groundwater Quality of Project Area

Water Source	Sampling Time (YY-MM-DD)	Ammonia Nitrogen	Fluoride	Cyanide	Mercury	Arsenic	Selenium	Cadmium	Hexavalent Chromium	Lead	No. of Fecal Coliform Group (Nr./ L)	Total Dissolved Solid
No.4 Water Plant	2011.02.09	0.025L	0.36	0.004L	0.00001L	0.0017	0.0005L	0.0001L	0.004L	0.001L	1L	
	2011.06.01	0.025L	0.32	0.004L	0.00001L	0.0008	0.0005L	0.0001L	0.004L	0.001L	1L	
	2011.08.01	0.025L	0.33	0.004L	0.00001L	0.0006	0.0005L	0.0001L	0.004L	0.001L	1L	
	2012.02.01	0.025L	0.14	0.004L	0.00002	0.001	0.0005L	0.0001L	0.004L	0.001L	1L	
	2012.06.07	0.025L	0.09	0.004L	0.00001	0.0009	0.0005L	0.0001L	0.004L	0.001L	1L	162
	2012.08.03	0.025L	0.09	0.004L	0.00002	0.0016	0.0005L	0.0001L	0.004L	0.001L	1L	162
Duoba Water Plant	2011.02.09	0.025L	0.49	0.004L	0.00001L	0.001	0.0005L	0.0001L	0.004L	0.001L	1L	
	2011.06.01	0.025L	0.49	0.004L	0.00001L	0.0005	0.0005L	0.0001L	0.004L	0.001L	1L	
	2011.08.01	0.025L	0.52	0.004L	0.00001L	0.0016	0.0005L	0.0001L	0.004L	0.001L	1L	
	2012.02.01	0.025L	0.2	0.004L	0.00001	0.0005L	0.0005L	0.0001L	0.004L	0.001L	1L	
	2012.06.07	0.025L	0.09	0.004L	0.00001L	0.0005L	0.0005L	0.0001L	0.004L	0.001L	1L	188
	2012.08.03	0.025L	0.12	0.004L	0.00001L	0.001	0.0005L	0.0001L	0.004L	0.001L	1L	194
Standard		0.2	1.0	0.05	0.001	0.05	0.01	0.01	0.05	0.05	3	1000

3.4 Current Ecological Situation in Project Area

(1) Current Structure of Ecological System

At present, the inland ecological system of the area refers to the flood plain ecological system on both sides of Beichuan River and the urban ecological system on both banks. The ecological environment in the area generally shows the form of suburban agricultural environment. Artificial ecological system is the main form which mainly consists of human, crops and domestic animals, and relatively less other species of animals and plants. For this reason, food chain and food web formed are relatively simple and the ecological system is weak in resisting external interference.

(2) Current Types of Vegetation

At present, the vegetation species in the area are mainly crops cultivated artificially which include certain part of artificially cultivated or naturally growing forestlands. The original vegetation species are destroyed because villagers are building houses and reclaiming farmlands in such area. See figure 3.4-1 for the vegetation forms in the area.

(3) Current Types of Animals

Wild animals in the area are mainly small animals such as rats, rabbits and snakes. Besides wild animals, there are also poultry and livestock such as chicken, cattle and sheep that are artificially raised in the area.

(4) Current Situation of Agriculture

In the area, agriculture is the major industrial structure; the local villagers live basically by growing crops. Remote sensing data show that irrigated land is the main farmland in the area.

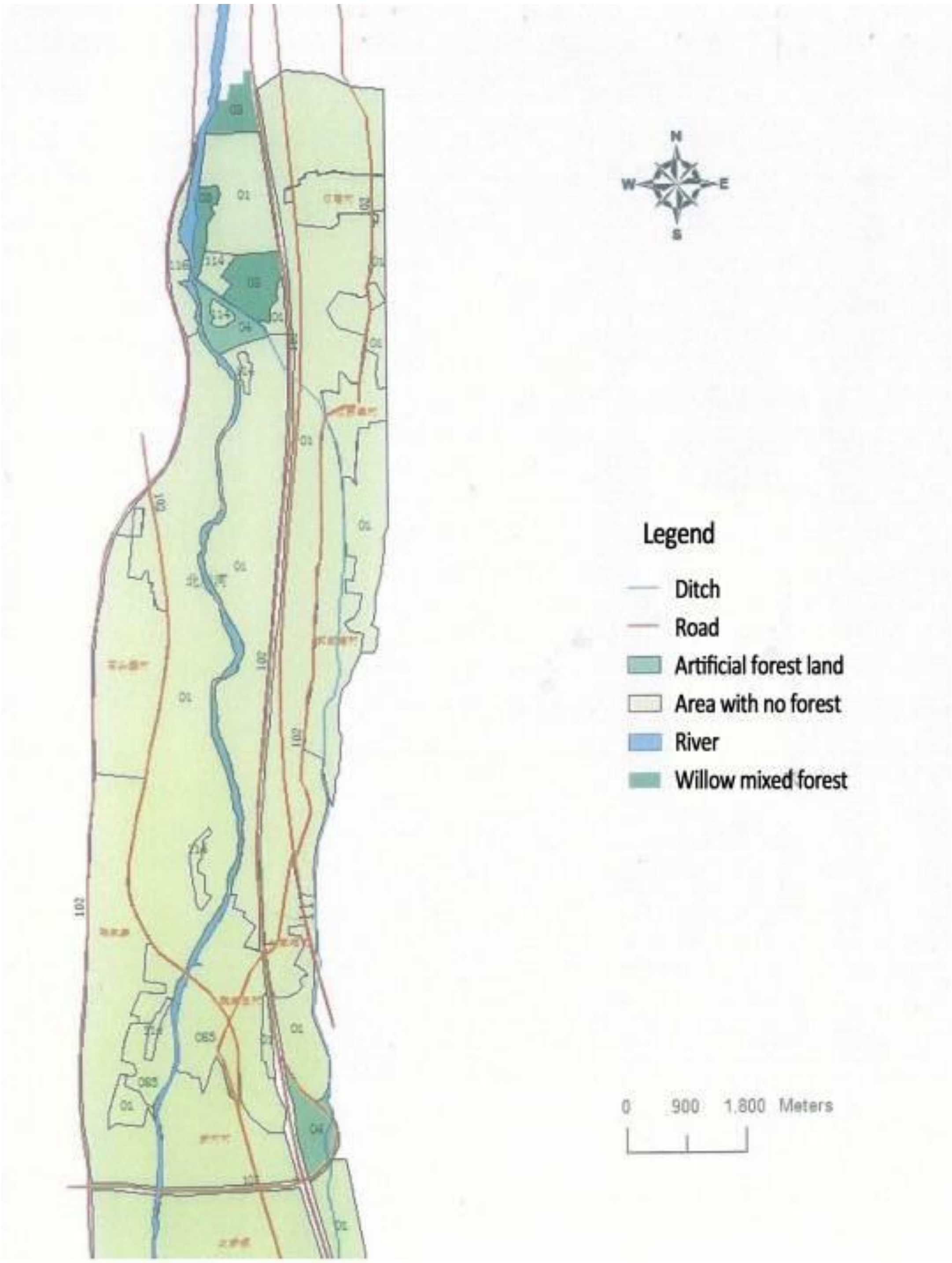


Figure 3.4-1 Current Distribution of Vegetation in Beichuan area

(5) Current Situation of Soil Erosion

Xining Municipality is located in the transition area between Loess Plateau and Qinghai-Tibetan Plateau with serious water and soil loss, and belongs to the fourth subregion of hilly and gully region in terms of the classification of areas with water and soil loss in Loess Plateau. According to *Notification on Zoning of Important Prevention Area for Water and Soil Loss* issued by People's Government of Qinghai Province and map of 3-area zoning for water and soil loss in Qinghai, it is determined that planning area is located in the important treatment area for water and soil loss in Qinghai, with main erosion type being water erosion. The soil erosion modulus is in the range of 1500~3000t/Km^2.a. See Figure 3.4-2 for the current situation of soil erosion in the area.

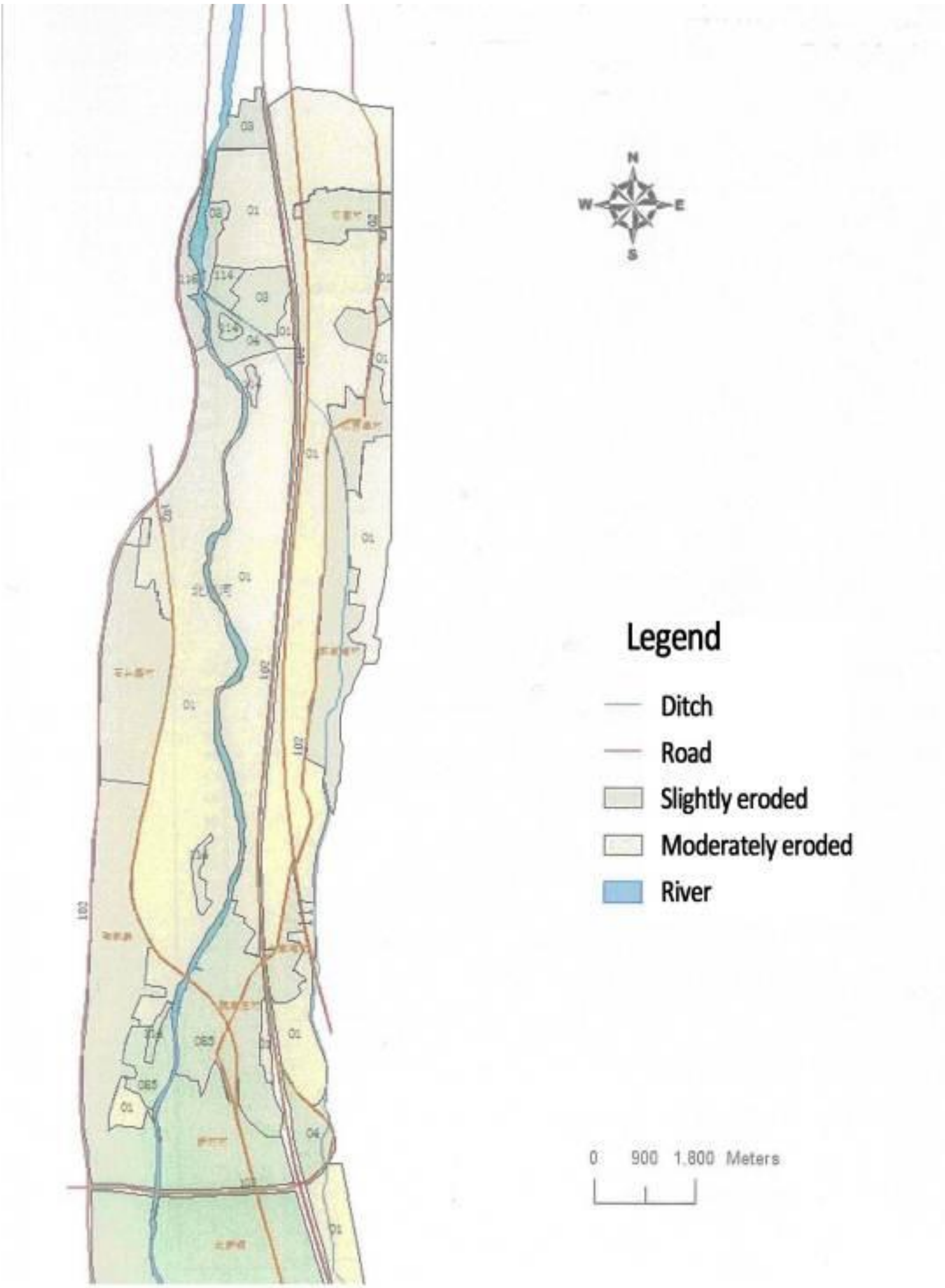


Figure 3.4-2 Current Situation of Soil Erosion in Beichuan area

3.5 Current Land Utilization in the Project Area

(1) Current Land Utilization in Beichuan Area

Lands in Beichuan area mainly are farmland, woodland and riverway, and some are land for villages, industrial lands, land for public and municipal facilities. At present, resettlement in this area has been accomplished and the land is now unused. The current environmental stutas of Beichuan area is shown in Figure 3.5-1, and current land utilization is shown in Figure 3.5-2.

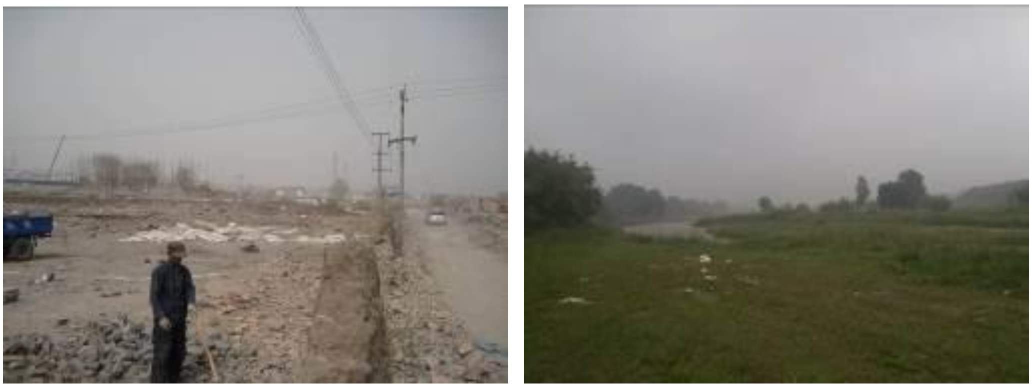


Figure 3.5-1 Current Environmental Status in Beichuan Area

(2) Current Status of the Land to Be Used for Construction of Reclaimed Water Plant within the WWTP

The reclaimed water plant is to be located within No. 5 WWTP, in a vacant space at its west side. Therefore, no additional land requisition and resettlement is involved. For construction of the reclaimed water plant, totally about 11.7mu of land is needed, current situation of the land is shown in Figure 3.5-3.

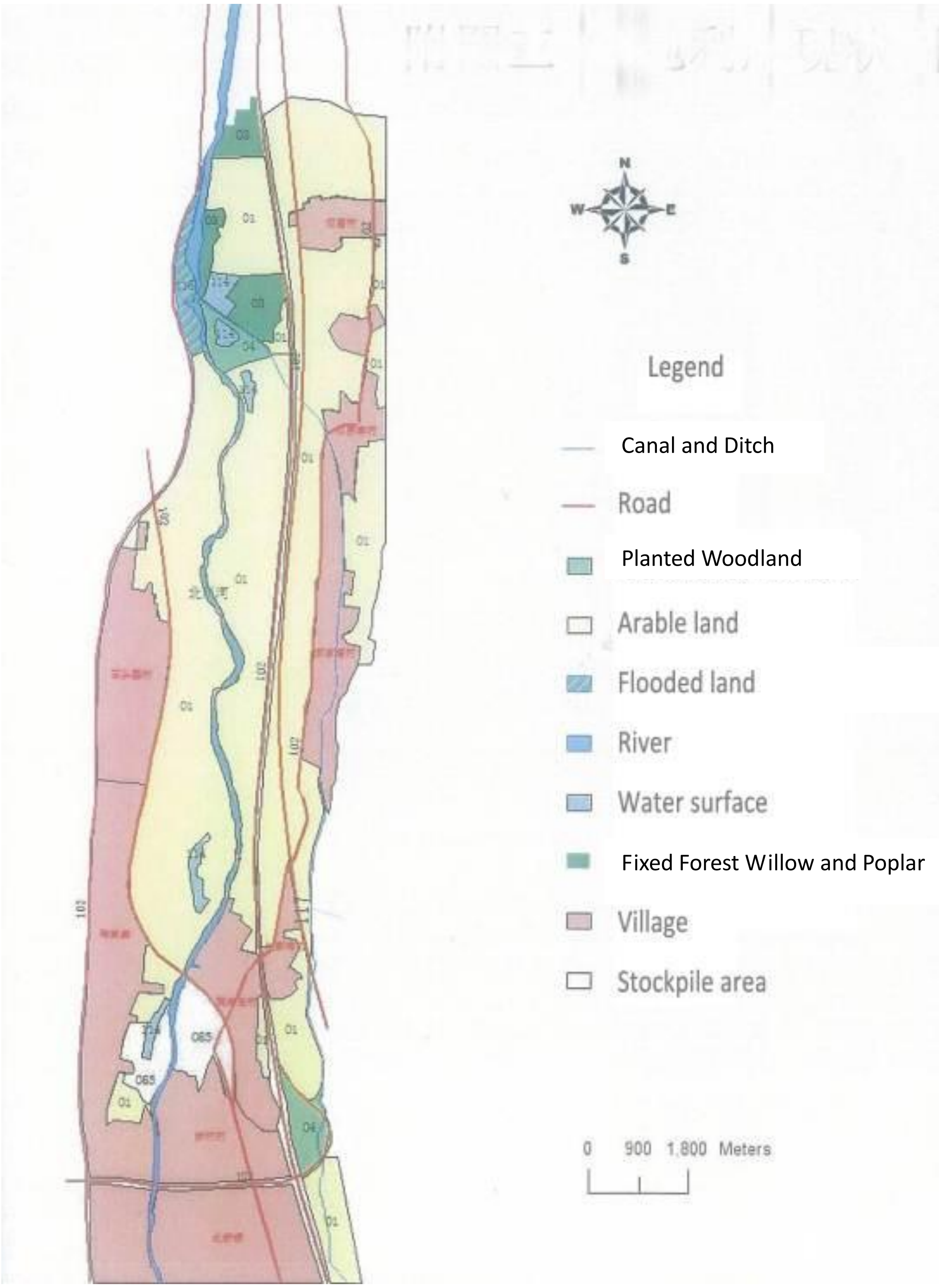


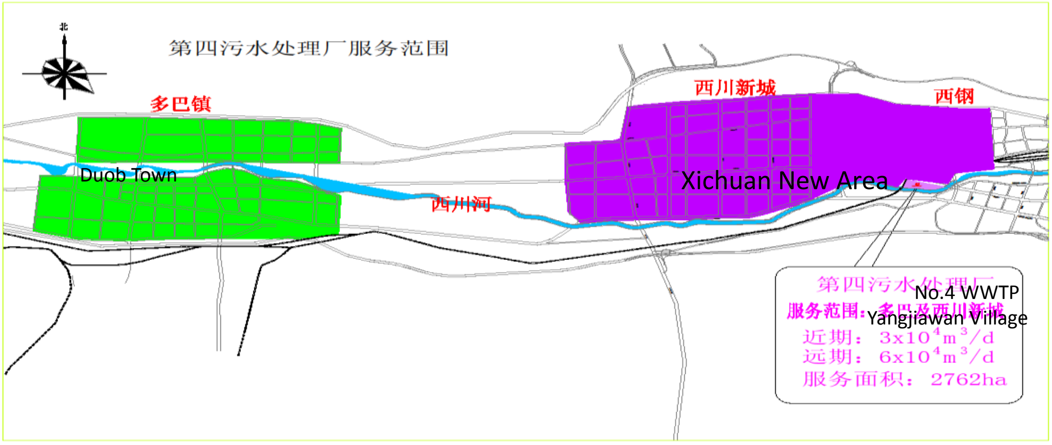
Figure 3.5-2 Current Land Utilization in Beichuan Area

Figure 3.5-3 Current Situation of the Location for Construction of Reclaimed Water Plant

(3) Current Land Utilization along Xichuan and Beichuan Wastewater Collection Main Pipelines

Through investigation, the proposed wastewater collection main pipelines are located mainly on the terraces along the banks of Beichuan River and Xichuan River. Such works are linearly distributed and go through lands such as irrigable land, open woodland, flood land and existing road pavement.

Figures 3.5-4 and 3.5-5 show the layout of the pipelines and current situation of the types of land the pipelines will go through.



Layout of Wastewater Collection Pipeline on South Bank of Xichuan River

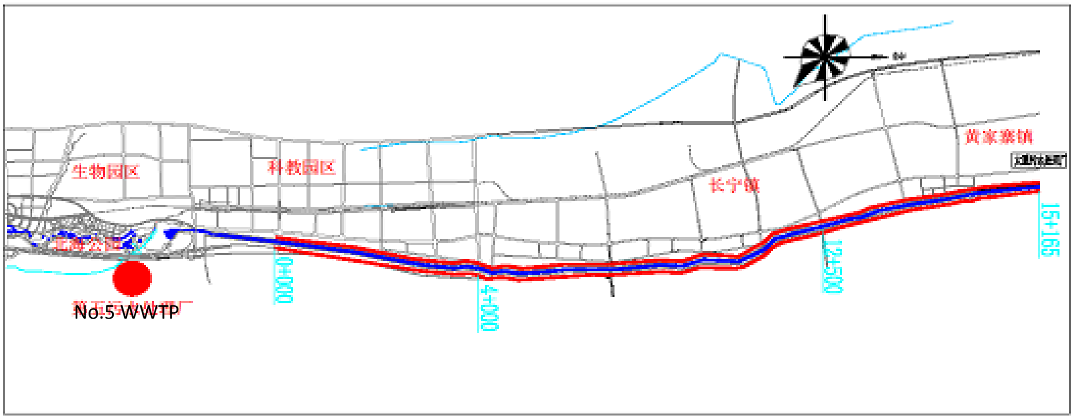
Irrigated Land

Flood Plain

Poplar Trees

Sand and Gravel Road

Figure 3.5-4 Construction Conditions for Wastewater Collection Pipeline on South Bank of Xichuan River



Layout of Wastewater Collection Pipelines on Both Banks of Beichuan River

Sand and Gravel Roads along West and East Banks of Beichuan River

Sand and Gravel Road on West Bank and Woodland on East Bank of Beichuan

Forestland on West and East Banks of Beichuan River

Irrigated land on West and East Banks of Beichuan River

Flood Plain on West Bank and Irrigated Land on East Bank

Flood Plain on East Bank and Irrigated Land on West Bank

Figure 3.5-5 Construction Conditions for Wastewater Collection Pipeline along

Both Banks of Beichuan River

4 Due Diligence on Linked Projects

4.1 Current Situation of Water Resources in Xining

4.1.1 Basic Situation of Water Resources

Xining is located in the upper middle reaches of Huangshui River Basin and the river system of the whole city is mainly composed of Huangshui trunk stream and such branches as Beichuan River, Nanchuan River, Shatangchuan River, Yaoshui River and Xinachuan River. The total amount of water resources of the whole city is 1.314 billion cubic meters. The total amount of surface water resources is 1.293 billion cubic meters; the total amount of underground water resources is 894 million cubic meters; and the repeated amount is 873 million cubic meters. The river system of the project area is shown in Figure 3.1-2.

The special terrain and landform as well as the social and economic development of Xining have resulted in the following characteristics of water resources:

First of all, imbalanced water availability and a severe water shortage in the city. The total amount of water resources in Xining accounts for 2.1% of that of the whole province. The per capita amount of water resources is about 600 cubic meters accounting for nearly 1/4 and 1/20 of those of the whole nation and the whole province respectively making it a resource-oriented city with serious shortage of water. Moreover, there is a relatively large gap in the distribution of water resources in each region of the city. Datongbaoku River and Dongxia River are important sources of water resources of Xining with water production moduluses being 284,000 and 229,000 cubic meters per square kilometer respectively. The two counties Huangzhong and Huangyuan as well as the Xining downtown, with water production moduluses being 175,600, 107,800 and 109,700 cubic meters per square kilometer respectively, are resource-oriented areas with serious shortage of water.

Second, uneven spatial and temporal distribution of water resources, making it difficult to utilize the water resources. The water resources of Xining mainly come from precipitation. The water vapor in the fishbone-shaped valleys of Xining forms special characteristics of precipitation, presented with three high value zones and one low zone . The zone with the highest precipitation of the three high value zones is located in the south foothill of Daban Mountain at an elevation of 4300 meters and with annual precipitation of 801.8 mm. The zone with low precipitation is located at the south section of Huangshui River Valley at an elevation of 2168 meters and with annual precipitation of 339.7 mother distribution of precipitation in a year is extremely uneven with that from June-September accounting for above 70% of the annual precipitation and that from November of this year to May of the next year accounting for 30% of the annual precipitation. The amount of water resources of Xining is recharged by precipitation. Affected by seasonal precipitation, the annual and interannual amounts of water resources change obviously. The amount of runoff from June-September during flood season accounts for 63% of the amount of surface water resources whereas that from November of this year to May of the next year accounts for only 37%.The interannual variation of water resources synchronizes with the interannual precipitation but with relatively larger amplitude of variation The areas with abundant underground water in Xining only includes Shijiazhuang and Ta'er area of Datong county in the valley plain, and Danma Temple, Duoba and Dujiazhuang of Huangzhong county. The exploitation amount of underground water accounts for above 60% of that of Xining city. The uneven spatial and temporal distribution of water resources results in obvious contradiction in seasonal shortage of water for industrial and agricultural production and living of urban residents as well as difficulties in exploitation and utilization of water resources. Engineering water shortage and resource-oriented water shortage coexist.

Third, pollution of water bodies aggravates, resulting in reduced amount of available water resources. With rapid economic and social development of the city, discharge of wastewater is increasing day by day, resulting in aggravated pollution of water bodies. Among the 17 water quality monitoring points for monitoring sections of Huangshui River Basin, the water quality of 9 of them is better than and just reach the standard of water of class III and the water quality of 8 of them is poorer than the standard of water of class III. The substances causing the pollution mainly include five-day biochemical oxygen demand, ammonia nitrogen and total phosphorus. The water functional zones of Xining that are seriously polluted include Xining industrial water consumption area and Xining sightseeing and entertainment water consumption area of Nanchuan. The functional zones of Huangshui River trunk stream and Beichuan are also seriously polluted after entering the Xining urban area. Pollution of water bodies has restricted the utilization of comprehensive benefits from limited water resources, destroyed the ecological environment of Xining and worse still caused water shortage due to poor quality of water in middle and lower reaches of Huangshui River.

4.1.2 Current Situation of Water Resources Development and Utilization

Water supply: The annual amount of water supplied by various water conservancy projects of the city in 2012 was 675 million cubic meters accounting for 51.4% of the total amount of water resources of the city. The amount of water supplied by surface water conservancy projects was 337 million cubic meters accounting for 49.9% of the total water supply and the amount of water supplied by underground water conservancy projects was 338 million cubic meters accounting for 50.1% of the total water supply.

Water use: The total water use of all national economy sectors of the city in 2012 was 675 million cubic meters, among which the water use for living of residents in urban and rural areas was 131 million (accounting for 19.4%), industrial water use was 208 million cubic meters (accounting for 30.8%), water use in ecological environment of urban area was 12 million cubic meters (accounting for 1.8%), water use in farmland irrigation was 265 million cubic meters (accounting for 39.2%) and water use in forestry, animal husbandry and fishery was 59 million cubic meters (accounting for 8.8%). The total water use of the city accounts for 51.4% of the total amount of water resources of the city.

4.1.3 Prediction of Water Supply and Demand

In 2005 (i.e. early stage of the 11th five-year plan), water use of national economy sectors in Xining Municipality was 590 million m^3. However, with seven years of rapid economic development, the water use in 2012 reached 675 million m^3, an increase by 85 million m^3 or an average increase rate of 2.0% per year.

As per *12th Five-year Plan Outline for National Economy and Social Development of Xining Municipality*, by 2015, gross value of production will be more than two times of that at the end of 11th five-year plan, and the gross value of production is expected to reach RMB 132 billion. It is predicted that the gross value of production of primary industry will increase by 5% (expected to reach RMB 2.8 billion), the gross value of production of secondary industry will increase by 16% (expected to reach. RMB 73 billion with industrial growth of 17% (expected to reach RMB 65 billion), and the gross value of production of tertiary industry will increase by 13% (expected to reach RMB 56.2 billion).

As per development planning of industries and national economy sectors, it is predicted that total water demand of Xining Municipality will reach 850 million m^3 by 2015 (when P=75% in relatively dry hydrological year), and by 2020, total water demand of Xining Municipality will reach 1.05 billion m^3. If no additional water supply works is added, by 2015, water shortage will be 150 million m^3 and 350 million m^3 by 2020. The water resources which can be developed in Xining Municipality are seriously insufficient, and the restriction of water resources on economic development in Xining Municipality becomes more serious.

4.1.4 Alternative Sources for Water Resources

Many water sources are used for urban miscellaneous water purposes, currently being tap water, surface water, groundwater and reclaimed water.

Based on comparison of multiple water resources (Table 4.1-1), reclaimed water is finally selected to be used as water source for miscellaneous water in Beichuan area.

Table 4.1-1 Table for Comparison of Alternative Water Sources for Urban Miscellaneous Water Uses

Water Source	Guaranteed Quantity of Water	Water Quality	Safety of Water Supply	Usage Cost	Urban Planning and Development Layout	Feasibility	Advantages and Disadvantages
Tap water	The current urban water supply is close to scale of water supplied by water plant	Domestic drinking water	Industrial water cannot be guaranteed at the peak of water use	RMB 2.20/t for household water-use, RMB 3.43/t for industrial use	Tap water is planned no longer to be used as water source for industrial water uses, and to be gradually stopped from being used as water source for greening	No surplus amount exists, thus not feasible to be used as water source	Expensive, good quality, limited amount
Surface water	Surface water diversion in Xining has exceeded worldwidely accepted safety limit of 40%	Class-IV Surface water	It is determined by seasons and the guaranteed degree of safety is not high	RMB 0.12/t for greening	It is planned to strictly control surface water diversion	It is too expensive to construct new headwork and long-distance water diversion and distribution pipes	Expensive, good quality, low guaranteed degree
Ground water	Due to years of illegal overexploitation, underground water level in Xining Municipality declined continuously	Class-III groundwater, hard water	It is controlled strictly and the guaranteed abstraction quantity is not high	Water permit is required and water will not be charged for the time being	It is planned to shut groundwater wells and protect groundwater	Construction of new wells banned already. With falling of underground water level, the existing wells cannot effectively supply water any more	Constrained abstraction, difficult well construction in some areas, hard water
Reclaimed Water	New water source with low utilization degree and thus great development potential	Urban miscellaneous water	High water supply guaranteed degree based on analysis	1.2yuan/ton for urban miscellaneous water uses	City plan promotes use of reclaimed water for improvement of water use structure	Water quality of treated waste water in Xining is good with great potential of reuse, regional reuse of reclaimed water will save cost and facilitate management	Cheap, with guaranteed supply, consistent with water-saving policy

See table 4.1-2 for the proposed alternative water source of reclaimed water to be supported under this project.

Table 4.1-2 Proposed Reuse of Reclaimed Water as Alternatives Water Source

Water Users	Water Source	Alternative Water Source
For green space irrigation and road watering in core area of Beichuan	The area is still a planned development area, not yet established. However, for greening water uses, tap water is currently the main water source in Xining.	Discharge from the reclaimed water plant in No.5 WWTP

4.2 Current Situation of Water Pollution in Xining

In Xining Municipality, overall problems of water environment can be described as “water is dirty and muddy”, which are mainly reflected as follows:

Water pollution: In the suburb of Xining, there still are some drainage outlets that directly discharge wastewater into river.

Shortage of environmental water: The problems of seasonal water shortage, decreasing of general assimilative capacity of river, and under-utilization of reclaimed water still exist in rivers of Xining.

Solid waste: The problems of dumping garbage into river, reclaiming land by filling, imperfect urban facilities and filthy living environment still exist in some riverside areas in main urban district of Xining Municipality.

Sediment deposition of river: In Xining, there are still existing problems such as serious gravitational erosion in flood gullies and ditches, lack of adequate engineering measures, and flowing of rainwater with sediment directly into river in rainy season. In the gullies, there are some phenomena such as garbage dumping, severe deposition, overflow of wastewater, dirty, disorderly and bad environment.

Ever since 1990s when the central government put forward West China Development Strategy, a lot of efforts have been made in environmental development in Xining, including flood control and waste water collection and treatment projects in small watersheds funded by either the central government or the World Bank. However, due to financial limitation, many projects are scattered and cannot form a complete system. More engineering measures are still needed to address the environmental problems summarized as "water is dirty and muddy" in river, including unsolved problems relating to wastewater collection, river bank environmental management, reuse of reclaimed water and comprehensive treatment of torrential flood ditch. If such problems cannot be solved, even though economy and society of Xining can develop continuously, the environmental problem will be more and more severe in future, having great influence on production and living of residents. Current water quality of water environment in Huangshui River Basin is shown in Figure 4.2-1.

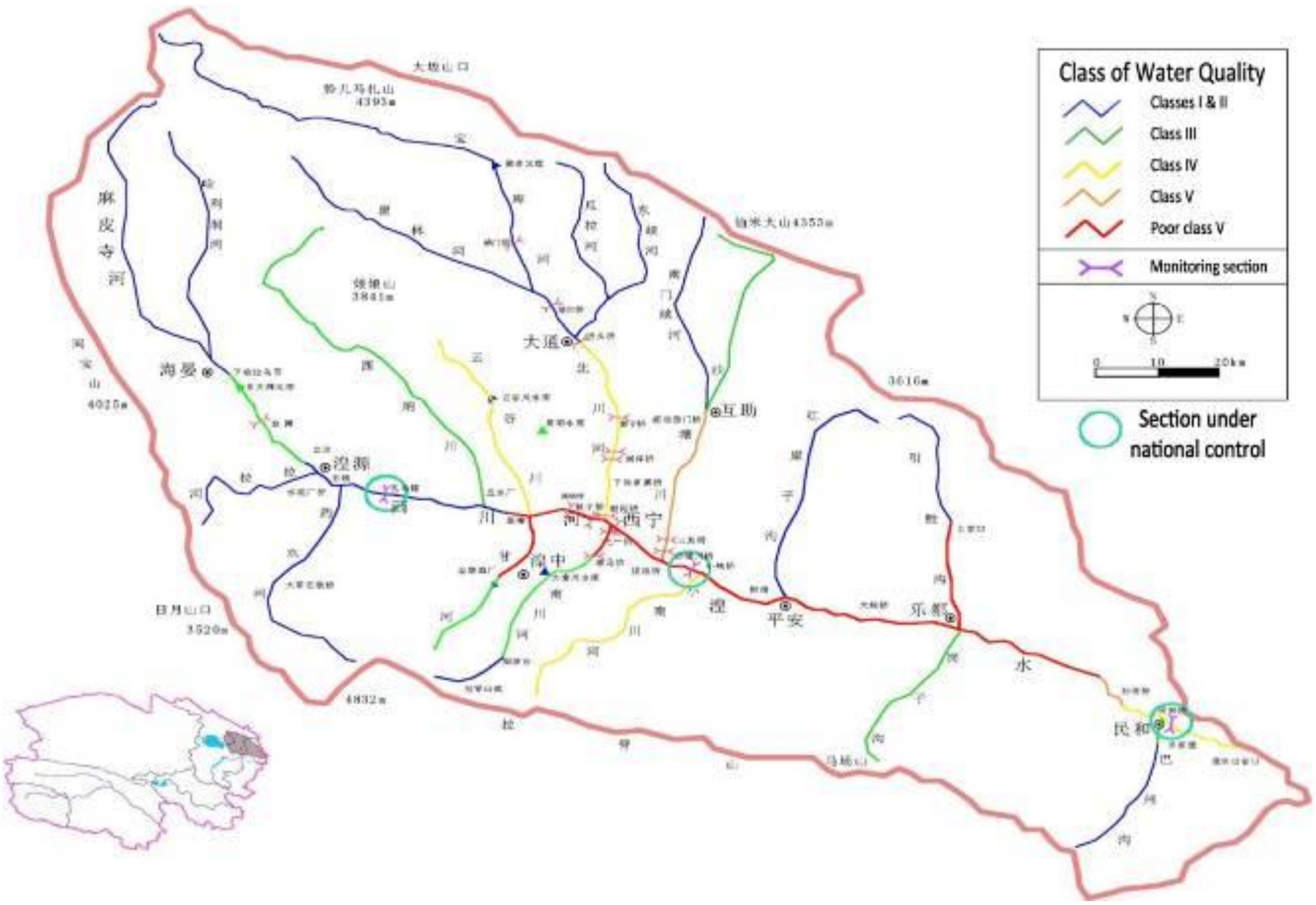


Figure 4.2-1Current Water Quality of Water Environment in Huangshui River Basin

4.3 Investigation on the Planned Project of Beichuan River (Core Area)

1) Overview of the Planned Project for Beichuan River

The planned project for Beichuan River is located in Chengbei District of Xining, Qinghai, with a total planned area of about 9.32 sq. km., and will be implemented in two phases, including phase 1 from 2013 to 2015 and phase 2 from 2016 to 2020.

Figure 4.3-1 Scope of the Planned Project

1）General Layout of Phase 1 Project

The area planned for Phase I project covers about 6.35 sq. km of land starting from south of Kangjia Bridge to north of Tianjun Road, and from west of Xining-Datong Expressway to east of Xining-Zhangye Highway. The project is located in the northwest of Xining, as shown in Figure 4.3-1.

The general layout for the planned Phase I project includes "One Core Area and Five Zones".

One core area refers to the Core Commercial Area. As the core area in the general planning and layout and with a total floor area of 32.28 hectares, it will be the commercial and financial center and landmark area of Chengbei District to support the development of surrounding parks such as Biotechnology Park, Qinghai University Park and Chaoyang Logistics Park in the future.

Five zones refer to the Comprehensive Commercial and Residential Zone, Waterfront Commercial and Cultural Zone, Ecologically Habitable Zone, Park Zone and Leisure Resort Zone. The **Comprehensive Commercial and Residential Zone** is located in the south and north sides of the commercial center with a total floor area of 63.52 hectares. It is mainly aimed to provide commercial and residential services for the surrounding urban park areas and the financial centre in the future.

Waterfront Commercial and Cultural Zone is located in the southeast side of the commercial center with a total floor area of 60.43 hectares. Combined with the large water landscape, such functions as culture, catering, entertainment and shopping are provided in the planning. Meanwhile, open landscape system is established to form complementary relationship with the dense layout of central area.

Ecologically Habitable Zone is located in the south of the site with a total floor area of 53.84 hectares. It is aimed to create an ecological and habitable low-carbon environment and space that is in harmony with nature and environmentally friendly.

Wetland Park Zone is located in the east of Beichuan River at the waterfront, west of Xining-Datong Expressway and with a total floor area of 143.48 hectares.

Leisure Resort Zone is located in the north of the site and west of Beichuan River with a total floor area of 60.72 hectares. With various landforms, good green vegetation and layout of water system landscape, a high-end tourist attraction can be created.

2) General layout for planned Phase II project

Phase II plan of the core section of Beichuan River covers Xining-Datong Expressway in the east, Dongshangen in the west, the boundary of Jiujiawan Village and Weijiazhuang Village in the north, and the boundary of Datong Shuangmiao Village and Shuangsubao Village in the south. The planned area is about 2.97 sq. km. In short term, it is planned to be used for the construction of new villages and development of urban leisure agriculture whereas in long term, it is planned to be reserved as the land for development. The comprehensive treatment and development shall in principle retain the Hehuang farming culture and the original features of villages, and improve supporting facilities.

(2) Due Diligence on Planned Project for Beichuan River

At present, the *Environmental Impact Assessment on Master Plan of Integrated Improvement of Beichuan River in Xining* has been reviewed and approved by Xining Municipal Environmental Protection Bureau.

Implementation of the Phase 1 has commenced, resettlement for Phase 1 plan area has been completed already, and relocation arrangement of residents of the area has been organized by the responsible resettlement office. Right now no one is living in the area, only some abandoned greenhouses and farmlands remain.

With the implementation of the project and after establishment of Beichuan Area is completed, there will be a large number of people moving in. With each of the planned zones formed gradually, follow-up issues such as increased traffic flow, generation of domestic wastewater and greening of urban streets will arise. Nevertheless, those issues have already been considered in this proposed project under assessment, and reasonable road network and wastewater pipe network have been incorporated in the project design based on the planning requirements.

(3) Main Conclusions of Environmental Assessment of Beichuan River Plan

Master Plan for Integrated Improvement Beichuan River (Tianjun Road – Kangjiaqiao) is in line with national government's industry policy and local regulations. It has accurate positioning of development, proper scope of planning and zoning, and rational special plans. The overall objectives and environmental protection objectives of the plan are achievable and in line with regional environmental protection requirements, without causing adverse environmental impacts. With full implementation of resettlement program, living environment of the native villagers can be improved under the plan, thus the plan received recognition and support of the public.

Specific environmental impacts of the planned project of Beichuan River during its construction and operation periods are as follows:

1) Analysis of Eco-environmental Impacts

Through adopting a series of eco-environmental protection measures in the process of project implementation, impacts of the project on regional eco-environment can be effectively reduced, and its adverse impacts on soil and water erosion, land uses and agriculture can be minimalized to ensure protection of ecosystem-type, ecological structure and function, fauna and flora and etc. Therefore, implementation of the plan won't impact on eco-environment adversely.

2) Analysis of Impacts on Ambient Air

Within the scope of the plan, no industrial development will be included, and the plan area is mainly for commercial, leisure, tourism, residential and recration parks purposes. Gas generated after the plan implementation will be mainly heating boiler smoke, exhaust gas from parking lot, and cooking fumes from reception center. To ensure good control of the above emissions, natural gas will be used for heating as a clean energy, woody trees with large crown and shade will be planted in the partition and surrounding areas of parking lot, and medium and large size catering enterprises will be required to install purification systems to meet fume treatment requirement.

3) Analysis of Impacts on Water Environment

After implementation of the plan, sewage will be drained to urban WWTP at the downstream of the city, so that the originally dispersed sewage can all be collected, therefore, quality of surface and groundwater environment in the region can be effectively improved.

4) Analysis of Impacts on Solid Waste

After project implementation, solid waste originally existing in the scope of the plan will be cleaned and the newly produced solid waste will be collected and transported to domestic garbage landfill in Xining for disposal. Therefore, the project implementation will effectively reduce solid waste pollution in the region and improve environmental quality.

5) Analysis of Impacts on Acoustic Environment

The planned area has functions mainly for commercial, leisure, tourism, residential purposes, hence some areas within the scope of plan are noise sensitive receptors. Implementation of the project will be within the strip like areas separated by 3 longitudinal roads/railway such as Xining-Zhangye Highway, Xining-Datong Highway and Xining-Datong Railway, noise from the 3 transport lines will cause impacts on the planned area. After project implementation, a road framework featured by ‘three longitudinal and three horizontal transport lines, and cluster development’ will be formed, so that road grids consisting of main, secondary and tertiary roads each with specific clearly-cut functions can be built. Such road design will be scientifically and properly done, and the newly added noise pollution source will mainly be social activities, but without much impact.

6) Analysis of Impacts on Social-economic Environment

On the premise that proper arrangements are made for the local residents, implementation of the Master Plan for Integrated Improvement Beichuan River (Tianjun Road – Kangjiaqiao) will benefit local tourism development, and thus actively promote regional economic development and upgrading of life quality of the local residents.

The planned project may cause certain impacts on environment, but, with corresponding measures taken, the impacts can be minimized. Meanwhile, the project will improve regional environment to a certain degree. Overall speaking, the planned project has little impact on ambient environment.

7) Recommendations

It is recommended to undertake moving of Xining-Datong Railway as soon as possible so as to ensure rational planning of the plan area by reducing segmentation by the railway and its noise impact on the plan area.

Also, for the purpose of protecting existing good eco-environmental status in the region, it is recommended to preserve the woodland within the scope of planning.

Further consideration regarding employment of the resettled people is suggested to enhance the resettlement plan.

From the point of view of water resources conservation and comprehensive utilization, it is recommended hereby to use reclaimed water from the reclaimed water plant within No.5 WWTP for low-end water uses such as landscaping and toilet flushing and etc.

4.4 Current Status of Wastewater Drainage

In recent years, with implementation of national projects and the World Bank project, urban districts in Xining has been provided with wastewater collection pipe network, so that the phenomenon of wastewater directly discharging into river in main urban district is improved significantly, treatment capacity of wastewater treatment plant is enhanced greatly, and quality of river water is also improved obviously. Drainage pipe network that has been installed in Xining is up to 915km long, mainly distributed in main urban district. The drainage pipe network that was laid in main urban district in earlier years is of combined system, mostly separate system. The separate system is adopted for water drainage of the roads that are newly-built, rebuilt or extended in the whole municipality. However, some areas in suburbs of Xichuan and Beichuan and Beichuan River area are still not provided with collection facilities such as drainage pipe network, as shown in Figure 4.4-1.

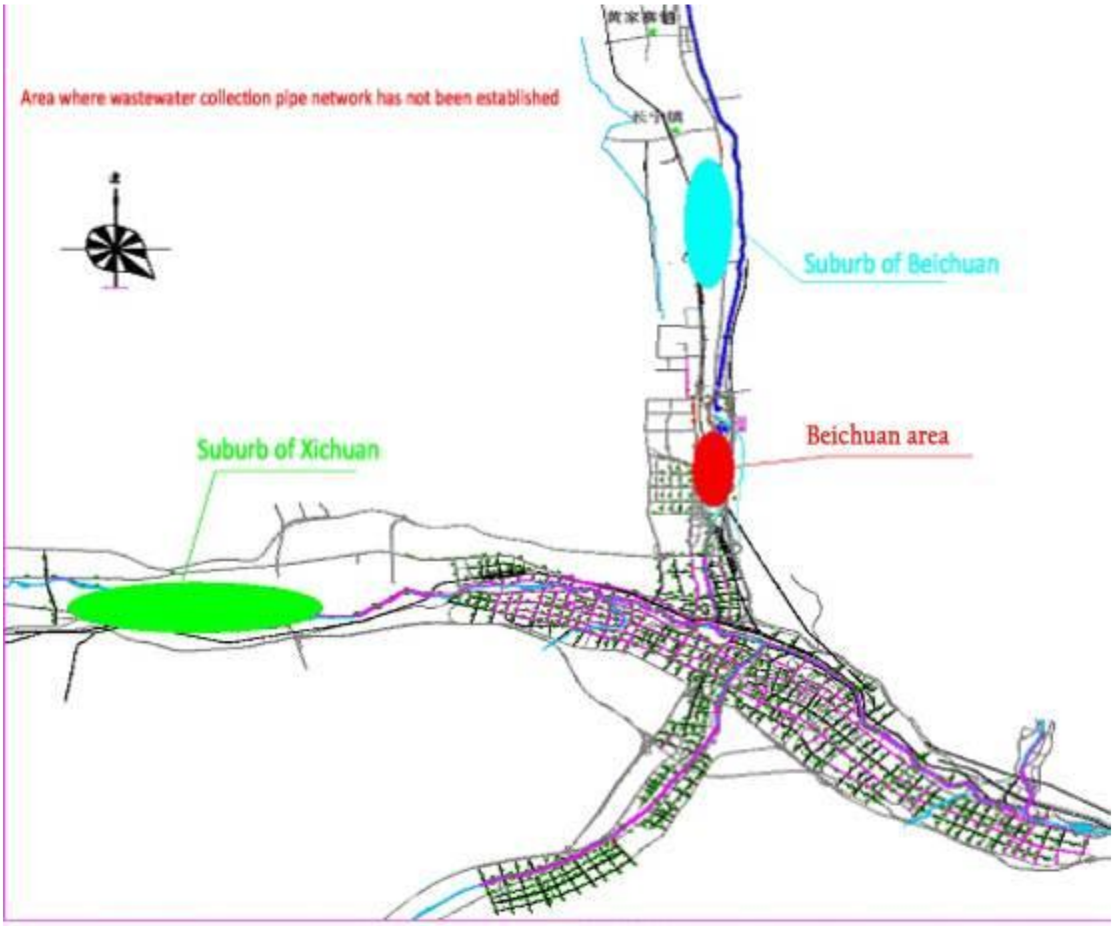


Figure 4.4-1 Area Where Wastewater Collection Pipe Network Has Not Been Established

1) Current Situation of Wastewater Collection System in Xichuan River Area

The wastewater collection system in Xichuan River area is eastward to Xigangqu, westward to Duoba Sports Training Base, northward to Beishan Mountain and southward to Nanshan Mountain. The wastewater collected by drainage system at Xichuan River is discharged into No. 4 wastewater treatment plant in the west of Huangshui Road on the north bank of Xichuan River. The No. 4 WWTP is currently under construction, with a capacity of 30, 000m^3/d for the short term and 60,000 m^3/d for the long term, a service area of 2569ha and total service population of 173,000. Refer to Figure 4.4-2.

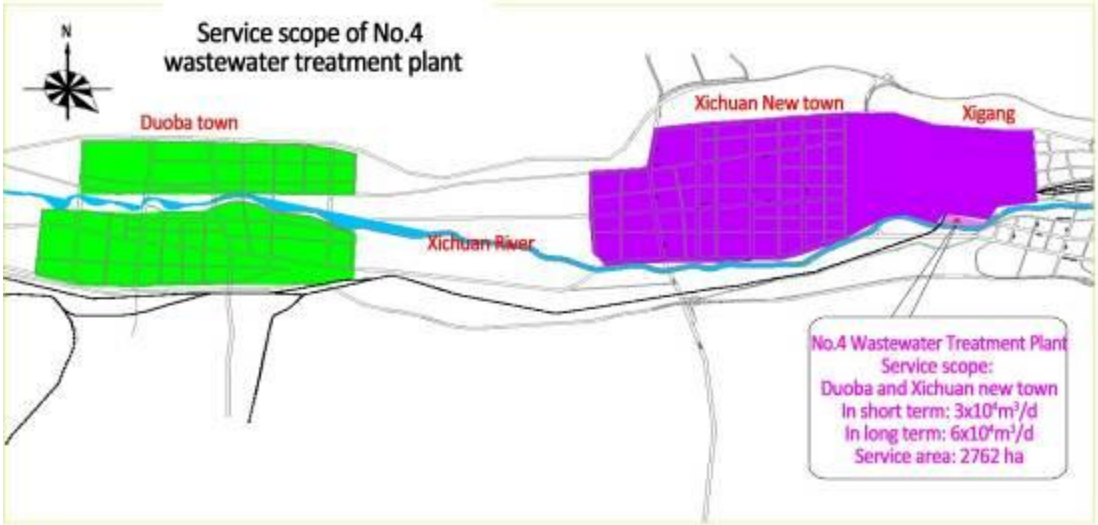


Figure 4.4-2 Service Scope of No. 4 Wastewater Treatment Plant

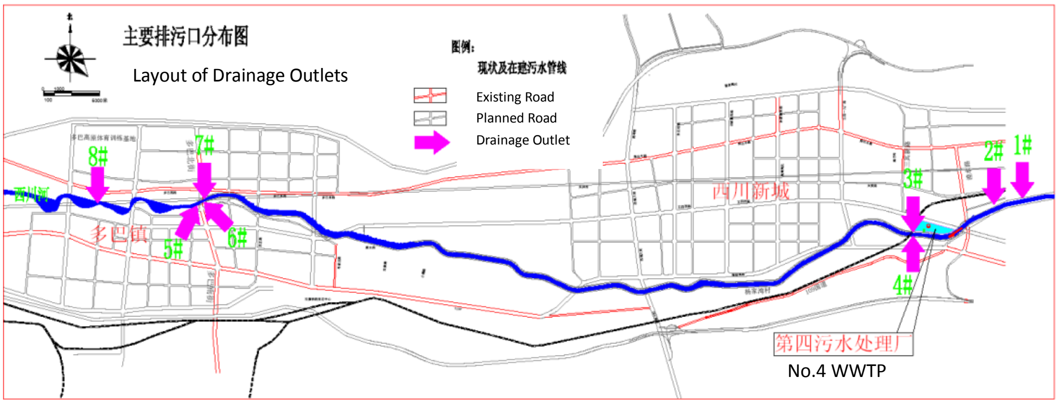
At present, the wastewater collection main pipe network supporting the No. 4 WWTP is being constructed in the section from north bank of Xichuan River to Duoba. After it is completed, wastewater along the north bank of Xichuan River can be collected in the No. 4 WWTP. On the south bank of Xichuan River, DN1000 wastewater collection pipe network has been laid in the section from the No. 4 wastewater treatment plant to Yangjiawan Village. The collected wastewater will flow through Huangshui River in the south of the No. 4 WWTP and discharge into the plant. The wastewater collection pipe network has not been established (or proposed to be established) in the section from Yangjiawan Village on the north bank of Xichuan River to Duoba Town.

Since main pipes leading to No. 4 WWTP and on the north bank of Xichuan River are now under construction, wastewater from both banks of Xichuan River is still discharged into the River from 8 drainage outlets, as shown in Table 4.4-1 and Figure 4.4-3.

Table 4.4-1 Drainage Outlets within Service Scope of No.4 WWTP

No. and Name	Flow (10,000 m^3/d)	Test Items and Results					
		PH	TP(mg/L)	SS(mg/L)	Ammonia Nitrogen (mg/L)	CODcr (mg/L)	BOD_5 (mg/L)
1#: Xigangshuiqu (1)	0.73	7.1	0.87	47	14.59	156.94	31.82
2#: Xigangshuiqu (1)	1.0	6.8	0.24	139	4.98	26.9020	3.14
3#: Wastewater interception pipe on north bank of Xichuan River	0.35	7.1	0.16	27	3.54	22.42	2.69
4#: Wastewater interception pipe on south bank of	0.20	7.1	0.14	584	4.51	31.39	3.78

Xichuan River							
5#: Drainage outlet in southwest of Duoba	0.015	6.9	0.67	136	15.61	170.39	52.36
6#: Southeast of Duoba	0.02	6.9	3.16	57	57.68	497.72	229.03
7#: Northeast of Duoba	0.06	6.8	0.67	40	7.22	161.42	57.46
8#: Duoba base	0.06	6.9	0.47	44	8.10	49.32	4.52
Total	2.435	6.96	0.45	126.40	8.25	74.23	15.26



Drainage Outlets along River

Figure 4.4-3 Layout of Main Drainage Outlets and Pictures

2) Current Situation of Wastewater Collection System of Beichuan River

The wastewater collection system of Beichuan River extends to Weisan Road of Biological Park in the south, Datong Wastewater Treatment Plant in the north, Xining-Datong Railway in the west and Beishan Mountain in the east. The wastewater collected by wastewater collection system at Beichuan River is discharged in No. 5 WWTP in the east of Beihai Park on the east bank of Beichuan River. The No. 5 WWTP is currently under construction, with a scale of 30, 000m^3/d in the short term and 45, 000m^3/d in the long term, a service area of 5490.5ha, and a total service population of 137, 000 in the short term. See Figure 4.4-4.

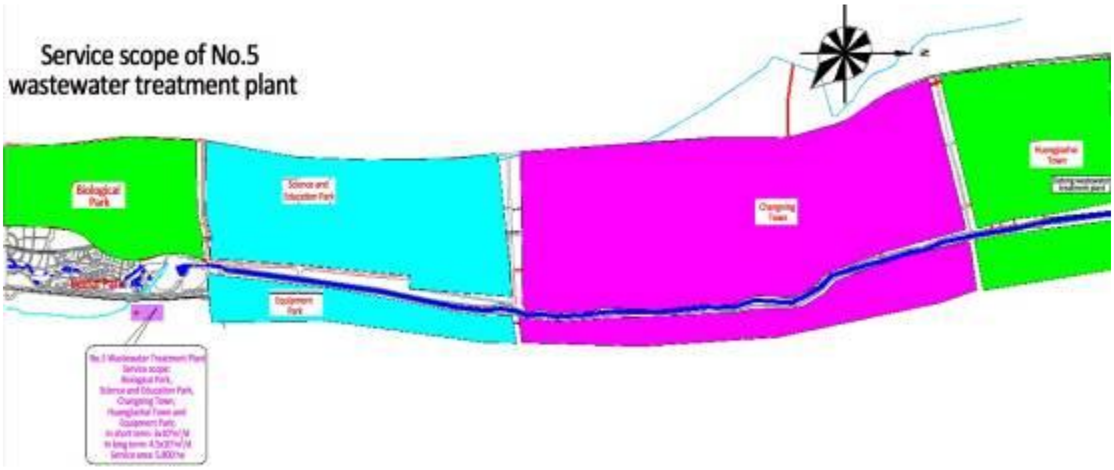


Figure 4.4-4 Service Scope of No. 5 WWTP

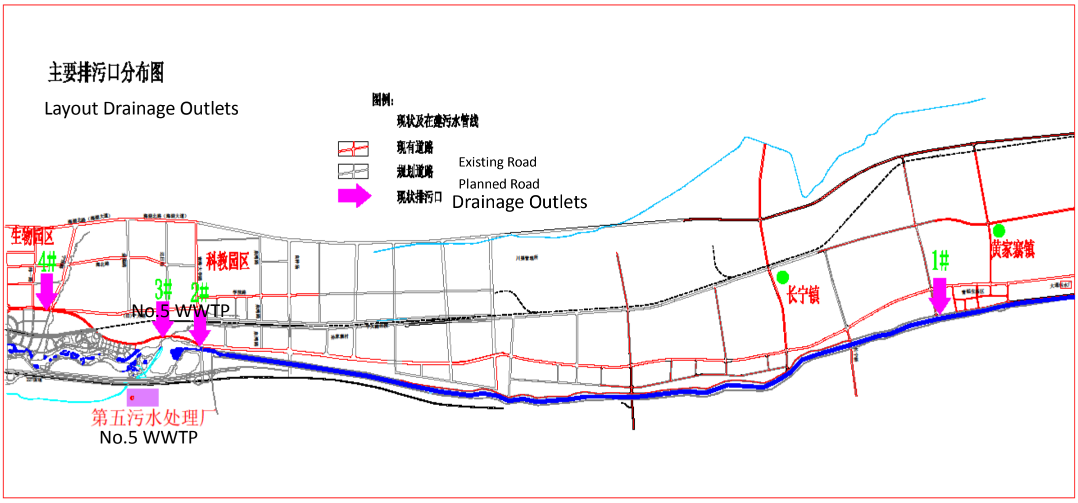
At present, main wastewater collection pipe network is being constructed on both banks of Beichuan River from Beihai Park to Xining-Datong Highway toll gate as supporting facilities for No. 5 WWTP. After construction is completed, the wastewater from both banks of Beichuan River in the above-mentioned scope can be collected in No. 5 WWTP. So far, no wastewater collection pipe network has been constructed (or has been planned to be constructed) from Xining-Datong Highway toll gate to Datong wastewater treatment plant on both banks of Beichuan River.

Since the No. 5 WWTP is still under construction, the wastewater from Xining-Datong Highway Toll Gate to Datong Wastewater Treatment Plant on both banks of Beichuan River is still discharged in Beichuan River nearby. The wastewater from Biological Park to Xining-Datong Highway Toll Gate is collected and discharged in the No. 2 wastewater treatment plant, which mainly has 5 wastewater drainage outlets. See Table 4.4-2 and Figure 4.4-5 for details.

Table 4.4-2 Main Wastewater Drainage Outlets from Biological Park to Datong Wastewater Treatment Plant on Both Banks of Beichuan River

No. and Name	Flow (10,000 m^3/d)	Test Items and Result					
		PH	TP(mg/L)	SS(mg/L)	Ammonia nitrogen (mg/L)	CODcr (mg/L)	BOD_5(mg /L)
1#:Domestic wastewater from Qinglv Living Quarter	0.4	6.1	0.43	9	0.46	17.94	2.11
2#:Wastewater drainage outlet at Quanwan Road	0.63	7.92	1.03	100	10.7	154	80
3#:Wastewater interception	0.97	6.5	0.97	104	18.02	201.78	63.86

pipe on west bank of Beichuan River							
4#:Biological park	0.33	6.5	0.18	875	2.36	582.92	211.09
5#:Liujiagou	0.01	-	-	57	0.2	17	-
Total	2.34	6.8	0.88	84	12.2	150	56.6



（Drainage Ditch in Village/Town）

（Drainage Outlet in Village/Town）

Figure 4.4-5 Layout of Main Drainage Outlets and Pictures

3) Current Situation of Wastewater Collection System of Beichuan Area

At present, no wastewater collection pipe network has been constructed for the Comprehensive Management Area of Beichuan (to Beihai Park in the north, Tianjun Road in the south, Beichuan River in the east and Ningda Road in the west), the wastewater discharged into depressions has caused dirty, messy and poor local environment.

To improve the environment of the area, main wastewater pipes are planned to be installed from Beihai Park in the north to Tianjun Road in the south, and from Beichuan River in the east and to Ningda Road in the west, on the basis of the existing wastewater pipe network of Chengbei District, so that wastewater in this area can be collected and conveyed to No.3 WWTP for treatment and waste water pollution problem can be solved for the area. See Figure 3.8-6 for the current status of wastewater discharge in the area.

Figure 4.4-6 Current Status of Wastewater Discharge in Beichaun Area

4.5 Investigation on Wastewater Treatment Plant

In this proposed project, wastewater intercepted by the main pipeline to be constructed along Xichuan River will be drained to No.4 WWTP; wastewater intercepted by main pipes along Beichuan River will be drained to No.5 WWTP where the wastewater is treated until certain standards are met and part of it is recycled and used as urban miscellaneous water for core area of Beichuan. The wastewater collected by wastewater collection pipe network of Beichuan area is carried to No.3 WWTP through existing urban wastewater pipes. Therefore, environment investigation this time will be focused on No.3, No.4 and No.5 WWTPs relied on by the project. The current situation of each WWTP is shown in Table 4.5-1.

Table 4.5-1 Current Situation of Each WWTP

Name	Capacity (10,000 m^3/d)	Treatment Process	Design Effluent Quality	Operation Status	Environmental Impact Assessment Carried out or Not	Approved or Not	Treatment Method of Sludge
No.3 WWTP	10	/	*Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB 18918-2002) first-level B standard	The operation load is 40,000-60,000 cubic meters every day and the actual effluent quality can reach the design standards.	/	/	Sent to landfill after mechanical compacting and dehydrating
No.4 WWTP	3.0 for short term, 6.0 for long term	Multi-stage AO dephosphorization and denitrogenation process; essentially the improved A/A/O process	*Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB 18918-2002) first-level A standard	Under construction; construction already begins and will be put into operation by 2015. At present, the construction process meets the requirements of the environmental impact assessment report and the approval as well as the national requirements for environmental protection.	Yes	Yes (See Annex 4)	
No.5 WWTP	3.0 for short term, 4.5 for long term			Under construction; construction already begins and will be put into operation by 2015. At present, the construction process meets the requirements of the environmental impact assessment report and the approval as well as the national requirements for environmental protection.	Yes	Yes (See Annex 5)	

No.3 WWTP is in operation now, see the following table for results of analysis and comparison of its effluent quality and design data based on online monitoring data (in March and June of 2011).

Table 4.5-2 Comparison of Effluent Quality of No. 3 WWTP with Design Effluent Standards

Main Pollutants	Actually Monitored Effluent Quality (mg/l)	Design Effluent Standard (mg/l)
CODcr	38	60
BOD_5	12.5	20
SS	6.25	20
NH_3-N	11.7	15

Based on the statistical average of actually measured data in the table, the effluent quality in actual operation satisfies the effluent standards of No.3 WWTP as originally designed.

4.6 Investigation on Treatment of Sludge from WWTP

(1) Investigation on Treatment Requirements and Disposal Scheme of Sludge from No.3 WWTP

As per the approval document for EIA of No.3 WWTP , it is required to enhance environmental management on sludge treatment workshop section, and adopt specific measures to prevent seepage and erosion from the roofed sludge storage pad. It is also required to store the sludge in airtight jars after concentration and dehydration process of the sludge. More specifically, compliance with the standards for use of sludge in farmland as stipulated in Standard for Pollutant Discharge from Urban Wastewater Treatment Plant (GB18918-2002) is imposed to avoid adverse impact on ambient environment.

No.3 WWTP is now in operation. It is understood from investigation that its sludge is sent to Yinjiagou landfill for disposal after being dehydrated. The landfill is the designated landfill by Xining. Such disposal arrangement is in compliance with requirements in the approval document of the EIA.

(2) Investigations on Treatment Requirements and Disposal Scheme of Sludge from No.4 &5 WWTPs

No.4 and No.5 WWTPs are still under construction. According to the approval documents of their EIAs, sludge from the WWTPs needs to be dehydrated to have moisture content below 50% and properly disposed. Residual from screens, sediment and domestic garbage should be collected and sent to landfill designated by environmental protection bureau at a regular time interval. Measures should be taken to prevent seepage, spill or erosion at the temporary storage pads for residual from screens, sediment and sludge. Sludge management records and transfer triplicate forms should be maintained to keep detailed records of produced amount, transferred amount and disposed amount, receiving body of sludge. Regular reporting to Xining Environmental Protection Bureau on details of sludge treatment is mandatory.

The existing standardized Yinjiagou domestic solid waste landfill in Xining can be used for treatment of sludge from No.4 and No.5 WWTPs after completion of their construction.

4.7 Feasibility Analysis for Collecting and Sending Wastewater from Beichuan Area to No. 3 WWTP

The scale of No. 3 wastewater treatment plant is designed to be 100,000 m^3/d. The existing operating load is 40,000 - 60,000 m^3/d. The wastewater volume collected by wastewater collection pipe network in the proposed Beichuan area is about 13,460 m^3/d. The No. 3 WWTP has the capacity to meet the treatment requirements. Besides, fluctuation of sewage is small and won’t cause any shock on stable operation of No.3 WWTP.

The Beichuan area is positioned as commercial, cultural, administrative and residential area. Wastewater mainly comes from the life and office emissions in the area, and is typical domestic wastewater. It doesn’t contain poisonous and harmful substances, and its components conform to the incoming water requirements of the No. 3 wastewater treatment plant.

Currently, the No. 3 wastewater treatment plant can operate normally. Based on data from monitoring, its effluent quality can reach the discharge standard class I-B as designed.

A completed urban sewage pipe system has been established in the south of Tianjun Road in Beichuan Area, therefore, the sewage interception main pipe in Beichuan Area can be connected to the existing pipeline system, so that waste water from the area can be sent to No.3 WWTP for treatment. See Figure 2.5-9 for details of the existing pipe system.

Tranfering wastewater from Beichuan Area to No.3 WWTP will resut in certain increase of sludge produced at the WWTP. Nevertheless, according to EIA for No.3 WWTP, its total capacity is designed to be 100 tons per day and the incremental sluge has been considered in the EIA, so the incremental sludge can be sent to the sluge treatment yard for treatment, without causing negative impact on the current sludge treatment scheme..

In conclusion, it is feasible that the wastewater in Beichuan area is collected to enter the No. 3 wastewater treatment plant for treatment.

4.8 Feasibility Analysis for Collecting and Sending Wastewater from South Bank of Xichuan River to No. 4 WWTP

In the long term planning year, a total volume of 43.6 thousand m3/day of wastewater will be collected along south bank of Xichuan River and sent to No.4 WWTP.

Through investigation it is understood that scope of wastewater collection system of Xichuan River is from Xigang canal in the east to Duoba Plateau Athletic Training Base in the west, and from North Mountain in the north to South Mountain in the south. All wastewater collected in the collection system of Xichuan River goes to No.4 WWTP in the west of Huangshui Road on the north bank of Xichuan River. The No.4 WWTP is now under construction, with a short term design capacity of 30 thousand m^3/day and a long term design capacity of 60 thousand m^3/day. Its service area totals 2,569 ha, service population is 173 thousand, as shown in Figure 3.8-2.

Wastewater along south bank of Xichuan River is within the service scope of No.4 WWTP, the wastewater quality composition and amount was taken into account at design stage of No.4 WWTP. Besides, sludge produced after collecting waste water from the south bank of Xichuan River was also included in the total sludge of No.4 WWTP, and proper arrangement has been made in the EIA for sluge treatment and disposal.Thus, it is feasible to send collected wastewater from south bank of Xichuan River to No.4 WWTP.

Construction of No.4 WWTP has begun and it is planned to have the commission in 2014. Hence scheduling of the WWTP construction can also meet service timing requirement of wastewater pipes of Xichuan River.

4.9 Feasibility Analysis for Collecting and Sending Wastewater from Both Banks of Xichuan River to No. 5 WWTP

Long term wastewater collection from east bank of Beichuan River totals 8 thousand m^3/day, and that from west bank of Beichuan River totals 16.4 thousand m^3/day, adding up to 24.4 thousand m^3/day of wastewater to be sent to No.5 WWTP.

Through investigation it is understood that scope of wastewater collection system of Beichuan River is from Weisan Road of Biological Industrial Zone in the south to Datong WWTP in the north, and from Xining-Datong railway in the west to North Mountain in the north. All wastewater collected in the collection system of Beichuan River goes to No.5 WWTP in the east of Beihai Park on the east bank of Beichuan River. The No.5 WWTP is now under construction, with a short term design capacity of 30 thousand m^3/day and a long term design capacity of 45 thousand m^3/day. Its service area totals 5,490.5 ha, service population is 137 thousand, as shown in Figure 3.8-4.

Wastewater along both banks of Beichuan River is within the service scope of No.5 WWTP, the wastewater quality composition and amount was taken into account at design stage of No.5 WWTP. Besides, sludge produced after collecting waste water from the both banks of Beichuan River was also included in the total sludge of No.5 WWTP, and proper arrangement has been made in the EIA for sluge treatment and disposal. Thus, it is feasible to send collected wastewater from both banks of

Beichuan River to No.5 WWTP.

Construction of No.4 WWTP has begun and it is planned to have the commission in 2014. Hence scheduling of the WWTP construction can also meet service timing requirement of wastewater pipes of Beichuan River.

4.10 Dependability Analysis of Reclaimed Water Recycling Works and Relevant Works

(1) **Dependability of Upstream Wastewater Treatment Plant**

The reclaimed water plant to be constructed will be based on existing No.5 WWTP. No. 5 WWTP has a designed capacity of 30,000 m^3/d, and will adopt wastewater treatment standard Class I-A as stipulated in *Discharges Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB18918). Its civil construction is planned to be completed in September 2013, and the commissioning will be finished in November 2013.

Design capacity of the reclaimed water plant is 5,000 m^3/d. The incoming water quality shall conform to the standard A Class I in *Discharges Standard of Pollutants for Municipal Wastewater Treatment Plant* (GB18918). After disinfection, the water is supplied to the downstream users. Its construction will commence in 2014, and operation is expected to begin in 2015.

Designed capacity of No.5 WWTP is 30 thousand m^3/day, and designed capacity of the reclaimed water plant is 5000 m^3/day, accounting for 17% of the total capacity of the WWTP. Based on investigation on current wastewater discharge in Beichuan Area, after construction of No.5 WWTP, the initial wastewater inflow to the WWTP will be 23.4 thousand m^3/day, reaching 78.2% of the designed capacity and being completely adequate for use by the reclaimed water plant as water source.

Quality indicators of discharged water from the reclaimed water plant are all designed within quality standards for municipal miscellaneous uses. As long as normal operation is maintained in the reclaimed water plant, water discharge from it can surely meet quality standards for users.

Since No.5 WWTP is not yet put into operation, data on its water discharge quality are not available. Analysis is therefore conducted based on quality of discharged water at several existing drain outlets in Beichuan Area of Xining and on treatment degree of processing techniques. References are also made to long term operational record and measured data of No.3 WWTP.

Results in Table 4.10-1 are based on quality measurement of discharged wastewater at several major drain outlets in Beichuan Area of Xining.

Table 4.10-1 Current Quality Status of Discharged Wastewater in Beichuan Area

Drain Outlet	Measured Results					
	PH	TP	SS	NH_4-N	CODcr	BOD_5

		（mg/L）	（mg/L）	（mg/L）	（mg/L）	（mg/L）
1#：Sewage from Qinglv Living Quarter	6.1	0.43	9	0.46	17.94	2.11
2#：Outlet along Quanwan Road	7.92	1.03	100	10.7	154	80
3#：Interception Pipe along West Bank of Beichuan River	6.5	0.97	104	18.02	201.78	63.86
4#：Biological Industrial Zone	6.5	0.18	875	2.36	582.92	211.09
5#：Liujiagou	-	-	57	0.2	17	-
Total	6.8	0.88	84	12.2	150	56.6

Table 4.10-2 Designed Incoming Water Quality Limits of No.5 WWTP

Pollutants	COD_{Cr}	BOD_5	SS	TN	NH_4-N	TP
Designed Incoming Wastewater Quality Limits	480	200	240	50	43	4.0

By comparing the above two tables, it is clear that the measured incoming wastewater quality are much lower than the designed limits. So, as long as the WWTP is operating normally, Class1-A quality standard of the discharged water can be sufficiently met.

The following table gives details on pollutant removal ratios of WWTP.

Table 4.10-3 Pollutant Removal Ratios

Pollutants	Inflow(mg/l)	Discharge(mg/l)	Removal Ratio %
BOD_5	200	≤10	≥95.0
COD_{cr}	480	≤50	≥89.6
SS	240	≤10	≥95.8
TN	50	≤15	≥70.0
NH4-N	43	≤5	≥88.4
TP	4.0	≤0.5	≥87.5

Multiple-stage and multiple-section AO treatment technology will be adopted, with hydrolysis and primary settling tank at the front, followed by coagulating sedimentation and infiltration chambers, so that higher removal ratio can be guaranteed for each of the pollutants.

It can be found from the above analysis that, design capability of No.5 WWTP can provide enough water for the reclaimed water plant, and the water quality can meet the incoming water quality limits. Its scheduling of construction also fits in with operation requirement of the reclaimed water plant. Thus, it is feasible to have the reclaimed water plant based on No.5 WWTP.

(2) Dependability of Downstream Water User

The reclaimed water is mainly used for urban miscellaneous water in Beichuan area (greening and road watering), and the water consumption is 5,000 m^3/d.

Its water quality shall meet the water quality standard for toilet flushing, road cleaning, urban greening (if the different index requirements are required for different water functions, the highest standard shall prevail) of *The Reuse of Urban Recycling Water – Water Quality Standard for Urban Miscellaneous Water Consumption* (GB/T 18920-2002).

The incoming water of the planned reclaimed water plant is water treated and discharged by No.5 WWTP. Its water quality can reach the Class I-A standards as defined in *Discharges Standard if Pollutants for Municipal Wastewater Treatment Plant* (GB18918), expect total coliforms exceeding the above water quality standard, the other indexes can meet the standard. Therefore, only disinfection by the reclaimed water plant is needed for reusing the treated wastewater for urban miscellaneous purposes in Beichuan area.

Therefore, it is feasible to use the reclaimed water from the reclaimed water plant in No. 5 WWTP for urban miscellaneous water purposes in Beichuan Area.

4.11 Current Situation of Rainwater Drainage

(1) Current Situation of Rainwater Drainage in Xining

In Xining, a complete rainwater drainage system is not yet established. Over recent years along road expansion a lot of rainwater collection pipes have been installed. In east part of the city, rainwater is mainly discharged into nearby Tieqi Ditch, Kushou Ditch and Huangshui River; in west part of the city, Huoshao Ditch and Xichuan River; in north part of the city, Beichuan River; and in the south part of the city, Nanchuan River. For the central urban area of the city, rainwater is mostly drained into sewage collection system due to lack of rainwater collection pipes, causing overload of the sewage collection system or even overflow of sewage in rainy days.

(2) Current Situation of Rainwater Drainage in Beichuan River Area

Rainwater collection system in Beichuan River area extends northward to Beihai Park, southward to Tianjun Road, eastward to Beichuan River and westward to Ningda Road. Rainwater collection pipe network has not been built in the area at present, so rainwater pipes are planned to be installed together with sewage collection pipes for the purpose of solving the problem relating to rainwater discharge in the area.

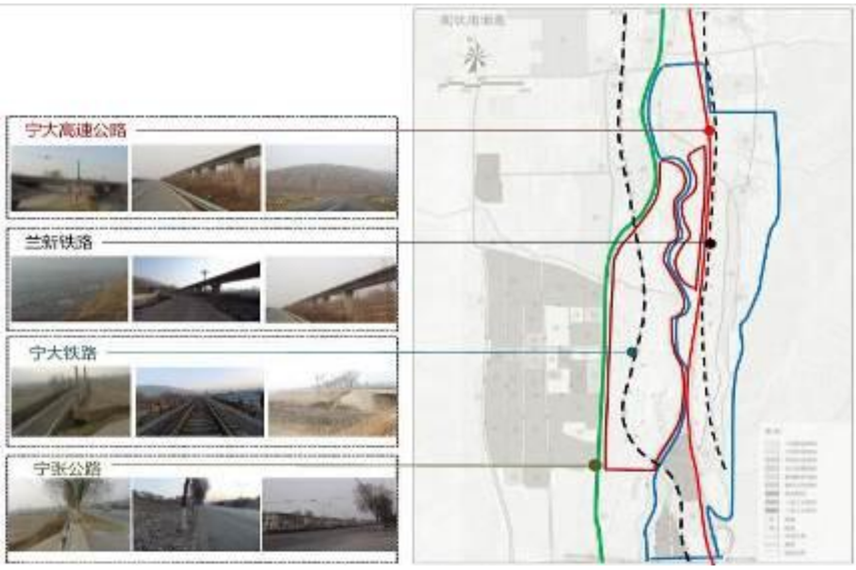
4.12 Current Situation of Traffic Condition of Beichuan River Area

(1) Current Status of Traffic Conditions

Within Beichuan river area (core area), traffic condition is relatively poor, mainly relying on tractor roads within the villages and some temporary access roads. Moreover, the existing roads are mostly north-southward, lacking traffic facilities for east-west transportation. For details see Figure 4.12-1.

Figure 4.12-1 Current Status of Roads in Beichuan River (core area) Area

Outbound traffic in Beichuan River Area (core area) is mainly dependent on two highways (north-south direction) and two railways (north-south direction), i.e., Xining-Datong Expressway (east side), Xining-Zhangye Highway (west side), Lanzhou-Xinjiang Railway (east side) and Xining-Datong railway (center of the area). The highways are mainly used for passenger and freight transport, and Lanzhou-Xinjiang Railway is mainly used for passenger transport, and Xining-Datong railway is mainly for freight transport. See Figure 4.9-2 for details.



(From left top to bottom: Xining-Datong Highway, Lanzhou-Xinjiang Railway, Xining-Datong Railway, Xining-Zhangye Railway)

Figure 4.12-2 Outbound Traffic Connections in Beichuan River (core) Area

(2) Traffic Analysis

Kept in poor condition and at lower level, roads in Beichuan River (core area) cannot function adequately to serve internal and external traffic needs, particularly lacking west-eastward road facilities makes it impossible to form an integrated and completed traffic system to serve travel demands of local people and needs for installation of municipal pipelines.

External traffic facilities in the area, including Xining-Zhangye highway and Xining-Datong railway, provide relatively close connectivity to internal traffics of the area with the outside, particularly Xining-Zhangye highway functions to link up transport between central urban area and relevant areas (such as Datong County) of Xining and Beichuan Rive area (core area). With further development and construction of Beichuan River area (core area) in future, Xining-Datong expressway will be linked with roads in north-south direction in the area, which will make traffic in the core area and surrounding areas more smooth and provide excellent road traffic infrastructure for development of Beichuan River area (core area) and the whole Xining Municipality.

4.13 Current Status of River Bank Environment in Beichuan Area

(1) Current Environmental Status of Beichuan Area

With railways within the city limiting the externality of urban functions, the area from the east of Xining-Datong Railway within Beichuan area to the west of Beichuan River has no municipal facilities and is isolated from overall trend of urban development. Consequently, problems such as dumped garbage, arbitrary spoil and land filling, heavy sediment content in river water and the resulted poor living environment are outstanding in the area. Comprehensive management is designed for the area in the project, including environmental management aiming at improvement of river water quality and living environment for the local people.

(2) Current Vegetation Status in the Project Area

Xining City is located in high latitude area and characterized by plateau semi-arid climate, with longer winter and little precipitation, and deciduous broad-leaved plants is its dominant vegetation type. Currently, land use along the river banks is mainly for farming, and singular species of agricultural crops form the local vegetation type. There are lots of willow and poplar trees existing in the land along river banks. However, due to lack of established forest area, singular vegetation species and poor quality of water, it is difficult to form diversified vegetation communities and a virtue cycle of eco-environment, only few stratification of natural landscape can be formed. Figure 4.13-1 shows current status of eco-environment.

Figure 4.13-1 Current Status of Eco-Environment in Beichuan Area

4.14 Current Environmental Status of Gullies and Existing Problem

4.14.1 Current Status of Gullies

(1) Liujiagou Gully

Liujiagou Gully is located at Ershilipu Town, Beichuan area, Xining Municipality. Its total catchment area is 14.50km², total length is 9.57km, average gradient is 6.3% and width is between 23-70m. At present, it passes through Haihu Road, Xining-Datong Highway and freight railway in sequence from upstream. The Haihu Road is provided with 2-hole corrugated steel pipe with diameter of 2.5m, and Xining-Datong Highway and freight railway are provided with stone masonry arch bridge with span of 6m. 42 stone check dams and 4 silt arresters have been built upstream the Haihu Road, thereby, water and soil loss in upstream section of Liujiagou is improved significantly. At present, severe gravitational erosion is caused to the section from Haihu Road to gully mouth, and large scouring depth and sever down-cutting are caused to the gully. Garbage is piled up at bank slope and wastewater overflows at the gully bottom, without engineering control measures taken for the gully. Torrential flood and debris flow greatly threaten life and property safety of residents at both sides of the gully. Current situation of the gully is shown in Figure 4.14-1.

Figure 4.14-1 Current Environment at Gully Mouth of Liujiagou

(2) Shengou Gully

Shengou Gully is located at Ershilipu Town, Beichuan area, Xining Municipality. Its total catchment area is 12.25km², total length is 3.57km, and average gradient is 2.2%. It passes through Chaoyangdianqu Canal and Xining-Datong Expressway in sequence from upstream. Chaoyangdianqu Canal is provided with circular reinforced concrete pipe culvert with diameter of 4m, and Xining-Datong Expressway crosses Shengou in the form of slab bridge with single span of 15m. Thirteen stone check dams and 4 silt arresters have been built upstream Shengou, thereby, water and soil loss in upstream section of Shengou is improved significantly. At present, large scouring depth and severe gravitational erosion are caused to the gully from Chaoyangdianqu to Xining-Datong Expressway. Construction and household wastes are dumped on bank, without any engineering control measures taken. Torrential flood and debris flow greatly threaten life and property safety of residents at both sides of the gully. Current situation of the gully is shown in Figure 4.14-2.

Figure 4.14-2 Current Environment of Shengou Gully

(3) Chaoyangdianqu Canal

Chaoyangdianqu Canal is constructed in 1963, with water diverted from Beichuan River at its upstream. After completed, it mainly is used for irrigation along the way and power generation, with normal diversion flow of 16m^3/s. At the early stage of completion, the canal is provided with 20 irrigation intake, 8 aqueducts for flood drainage, 5 culverts for flood drainage, 1 water release gate in Jiujiawan and two-cascade canal diversion type cascade hydroelectric station. The canal is 10.4km long in total, including the section of 4.9km long from water inlet to water release gate in Jiujiawan, the section of 3.7km long from Jiujiawan to forebay of cascade-I hydroelectric station, and the section of 1.8km long from cascade-I hydroelectric station to cascade-II tailrace. Water releases from the water release gate in canal of Jiujiawan to Shengou, and then pours into Beichuan River.

With economic development and expansion of the canal on both banks, as well as change of role of hydroelectric station in power supply for city and increasing of fees for station operation and maintenance, functions of current canal also have changed mainly in two aspects: firstly, Chaoyang power plant stops operating; secondly, irrigation scale along the line decreases with urbanization development in Xining, both of which cause reduction of water diversion amount in the canal, making its existing capacity much greater than currently required. Increasingly neglected by responsible department, the canal has not been maintained properly for many years. Due to lack of management, garbage is piled up on both banks of the canal and domestic wastewater is discharged arbitrarily into the canal, causing severe water pollution to the canal and having a strong impact on healthy living of residents along the canal. Current situation of Chaoyangdianqu is shown in Figure 4.14-3.

Figure 4.14-3 Current Environment of Chaoyangdianqu

4.14.2 Main Problems Existing with the Gullies/Canal

(1) There are piles of garbage at both sides of gully, having a strong impact on healthy living of residents on the gully banks;

(2) No wastewater collection pipe network is provided on the gully banks, causing overflowing wastewater in the gully and greatly threatening water environment of Xining;

(3) The gully banks mainly are characterized by loess slope with sparse vegetation, causing severe water and soil loss due to gravitational erosion;

(4) Exit sections of Liujiagou and Shengou are not set with renovation works, having low flood control standard and impacting life and property safety of residents on both banks;

(5) Road at top of Chaoyangdianqu Canal has not been repaired for many years, so the road pavement is damaged badly, dusty in fine days and muddy in rainy days, having a strong impact on traveling of residents along the canal;

(6) Without comprehensive improvement implemented to the gully/canal banks, poor visual effect of the gully/canal banks cannot match with overall water environmental development in Xining.

4.15 Investigation on Yinjiagou Landfill

About 12,951m^3 of existing household garbage in the project area will be cleaned under the proposed project and will be transported to Yinjiagou Landfill for sanitary disposal.

Table 4.15-1 Statistics of Household Garbage Cleaning and Transport under the Proposed Project

Project Activities	Amount of Garbage Cleaning and Transport (m^3)	Destination of Disposal
Beichuan River Bank Environmental Improvement	2300	Yinjiagou Landfill in Xining
Liujiagou Gully Improvement and Management	2640	
Shengou Gully Improvement and Management	2511	
Chaoyangdianqu Canal Improvement and Management	5500	
Total	12951	

Yinjiagou domestic solid waste landfill is invested, constructed and operated by Qinghai Shiquan Urban Environmental Engineering Co. Ltd. It is located in Yinjiagou gully, Yunjiakou in the northeast of the urban area of Xining city.

The filling space of the landfill covers a total area of 148,345 m^2, with a total storage capacity of 413 million m^3 and a designed treatment capacity of 466 tons/d. Currently, its actual daily disposal amounts to 420 tons/d. So this landfill can serve the need of the proposed project for solid waste treatment disposal.

EIA for the landfill was prepared and adopted officially prior to its construction (see Annex 10 for details). At present, the landfill is in operation following advanced scientific management procedures and technologies. All staff members working at the landfill have obtained special training and are operating in strict compliance with relevant national standards to check, weigh and record solid waste coming into the landfill. The landfill has prepared a set of complete and systematic emergency preparedness plans and is well equipped for emergency treatment. Therefore, operation of the landfill in compliance with requirements in EIA and the approval document for EIA review can be confirmed.

4.16 Investigation on Land Acquisition and Resettlement of Linked Projects

The details are in RAP.

5. Analysis and Assessment of Impacts on Environment

Based on project components and engineering features of project activities, environmental impacts of the project during construction and operation periods are identified and classified, as shown in Table 5.0-1.

Table 5.0-1 Classification of Proposed Project Activities

No.	Project Components	Activities	Type of Works
1	Urban Wastewater Collection Pipe Network	Wastewater Interception Main Pipes along Xichuan River	Pipe Network
		Wastewater Interception Main Pipes along Beichuan River	Pipe Network
		Wastewater Collection Pipes in Beichuan Area	Pipe Network
		Rainwater Collection Pipes in Beichuan Area	Pipe Network
		Ancillary Road and Pipeline Construction in Beichuan Area	Roads, Bridges
2	Reuse of Reclaimed Water	Reclaimed Water Plant within No. 5 WWTP	Reclaimed Water Plant
		Pipes for Reuse of Reclaimed Water in Beichuan Area	Pipe network
3	Low Impact Development and River Bank Environmental Improvement	River Bank Improvement, Greening and Ancillary Facilities of Beichuan River	River Bank Ecological management, Roads
		Rainwater Development based on LID concept	
4	Integrated gully/Canal improvement	Slope Improvement and Wastewater Collection Pipes along Both Banks of Liujiagou Gully	Gully Ecological Improvement, Pipe Network
		Slope Improvement and Wastewater Collection Pipes along Both Banks of Shengou Gully	Gully Ecological Improvement, Pipe Network
		Canal Improvement, Greening and Road of Chaoyangdianqu Canal	Canal Ecological Improvement, Pipe Network, Road and Bridge

During construction and operation, the project will have various impacts on environment and corresponding mitigation measures should be taken, as shown in Table 5.0-2.

It can be seen from Table 5.0-2 that, during construction, the project activities have similar impacts on environment, but their environmental impacts during operation differ greatly. Thus, in this EA, environmental impacts of project activities during construction are analyzed as a whole, for environmental impacts of project activities during construction, specific analysis by individual classification is conducted.

Table 5.0-2 Environmental Impacts of Various Project Activities

Classification of Project Activities	Description of Project Activity	Project Impact / Risk		Environmental Protection Measures			Monitoring
		During Construction	During Operation /accident	During Design	During Construction	During Operation	
Road, pipe network	Wastewater collection pipe network, reuse water pipe network, rain discharge pipe network and road works in Beichuan area	Construction impact (see Section 5.1)	See Sections 5.2.2 and 5.3.4 and Chapter 10	EMP attachment I	EMP attachments II, III, IV , VII and VIII.	EMP attachments IX, XI,, XII and XIII	For environmental monitoring during construction and operation, see Section 5.3 of EMP
Ecological management of river bank	Ecological comprehensive management of Beichuan River bank	Construction impact (see Section 5.1)	See Section 5.2.6		EMP attachment II	/	
Gully environmental management	Environment Control of Liujiagou, Shengou & Chaoyangdianqu	Construction impact (see Section 5.1)	See Section 5.2.7		EMP attachment II and attachment VI	/	
Reclaimed Water Plant	Reclaimed Water Plant of No.5 Wastewater Treatment Plant	Construction impact (see Section 5.1)	See Section 5.2.5		EMP attachment II and attachment V	EMP attachment IX and attachment XI	
Bridge, culvert	Road works bridge in Beichuan area and bridge in Chaoyangdianqu	See Part V of Section 5.1.2	See Sections 5.2.3, 10.2.2 and 10.2.3		EMP attachments II and III	EMP attachment XII	
Garbage clearance	River bank environmental comprehensive management and garbage clearance in Liujiagou, Chaoyangdianqu and Shengou	See Section 5.1.4	/		See solid waste measures in attachment II of EMP	/	
Disinfection Facilities	Chlorine dioxide disinfection and sodium hypochlorite disinfection of water reclamation plant	/	See Section 10.2.2		/	EMP attachment IX and attachment XI	
Water pump	Impact of submersible pump on acoustic environment	/	Impact of water pump on surrounding acoustic environment		/	EMP attachment IX and attachment XI	

5.1 Analysis and Assessment of Impact on Environment during Construction

5.1.1 Analysis of Impacts on Ambient Air Quality

During construction, main pollution factors for impacts of proposed project on ambient air quality are construction waste gas and raising dust, for which, the waste gas mainly includes the exhausts from various construction machineries and transport vehicles; during construction, the dust mainly generated from subgrade excavation, site excavation and backfill, discarding of soil and stone, and loading, transportation of knocked-down construction garbage, transportation, loading and unloading of construction materials, and construction process. And, a little dust is also raised by site leveling, and the main pollutant is TSP.

(1) Environmental Impact Analysis of Dust

The construction dust of project activities is mainly from subgrade excavation, site excavation and backfill, land leveling, stacking of construction materials and soil residues. During construction, its output changes along with the weather conditions and construction time, and the construction dust will become worse when encountering heavy wind, and which will have certain impact on surrounding ambient air quality.

During construction, the impact on surrounding environment is only limited within 50m of construction site. Thus, it will not cause serious impact on the surrounding ambient air quality. But during construction, certain emission reduction, dust prevention and dust fall measures shall be taken to strengthen the environmental supervision, so as to minimize the impact on environment.

The proposed project is located in dry area of West China, where precipitation is scares. The affected area of project resulted dust is large. The transportation distance of fine particle can reach over tens of kilometers. However, under condition of watering and avoiding strong wind day construction, the concentration of 50mTSP at down-wind direction will be less than $0.3mg/m^3$. Thus, mixing plant and other construction sites shall avoid the populated regions, and set beyond the 200m down-wind direction of sensitive point. During construction of works, certain emission reduction, dust prevention and dust fall measures shall be taken, and apron, tarpaulin shall be added to avoid raising dust, and meanwhile, environmental supervision shall be enhanced to minimize the impact on environment.

(2) Environmental Impact Analysis for Exhaust Emission of Construction Machinery and Transport Vehicle

Main pollutants in exhausts from construction machinery and transport vehicle include CO, HC, NO_X and SO_2, which will have certain impact on the nearby residential areas, enterprises, etc. However, the number of construction machineries is not large, and they are distributed dispersedly, and the construction period is short. Thus, the affected area of exhausts from construction machinery and transport vehicle is small, and the time period is short. Overload limit, speed limit, exhaust purifier installation, and other measures can be taken to reduce exhaust from transport vehicles and construction machineries impacting on the surrounding residential area. The impact of the exhaust from construction machineries and transport vehicles will end at the ends of construction period.

5.1.2 Analysis of Impact on Water Environment

During construction, wastewater produced mainly includes domestic wastewater discharged by construction staff, a small amount of production wastewater during construction, and a small amount of oily wastewater during machinery construction.

(1) Analysis of Impact of Construction Material Transportation and Stacking on Water Environment

Stacking of some construction materials, such as asphalt, fuel, chemicals, shall be managed properly, coverings shall be added when necessary, so as to avoid their falling into gully, being washed into downstream water in rainy season and thus causing water environment pollution. Therefore, when construction unit chooses the stacking site for construction materials, attention shall be paid to keeping away from gully and trying best to stack in open area far away from gully, and tarpaulin shall be covered during stacking. Meanwhile, during construction, based on different construction materials and characteristics, the corresponding management measures shall be enhanced to minimize the impact on water environment.

(2) Analysis of Impact of Construction Solid Waste Residue on Water Environment

Construction solid waste residue mainly includes the asphalt waste residue during works upgrade and construction. Pavement construction should avoid to occur in rainy season or anti-season , so as to reduce impact of asphalt waste residue on water environment. Besides, roller compaction shall be performed in a timely manner during construction to avoid rain washing and causing degradation of water quality. Various cancerogenic substances are contained in asphalt waste residues, which may pollute the surrounding water in case of improper management. Thus, during construction, the strict supervision and management shall be performed, and asphalt waste residues are not allowed to be poured in nearby water. They can be used as filler for upper subgrade, or transported to specified location for management.

The reclaimed water plant is located in rural area, the residues generated during construction mainly include solid waste from site evacuation, excessive earth rock after leveling and waster concentrate produced during plant construction. During construction, attention should be paid to avoid such solid waste being washed into gully and causing deterioration of water quality in rainy season.

(3) Analysis of Impact of Oily Wastewater on Water Environment during

Construction

During construction, the oily wastewater is mainly because of oil spill, overflow and leakage during repair, maintenance and operation of construction machinery. Oily wastewater contains mainly lubricating oil, diesel, gasoline and other petroleum substances. Once such substances enter the gully, the water body will be polluted. Such wastewater is featured by small discharge, great variation of concentration, and strong randomness, but its affected area is extremely limited. So, the construction unit shall strengthen management, and take proper treatment measures to avoid such pollution.

(4) Analysis of Impact of Production Wastewater from Concrete Mixing Plant and Component Factory during Construction

During production, concrete mixing plant and fabrication of prefabricated part will produce wastewater, mainly for washing of concrete drum and charging bucket.

Discharge of wastewater from concrete production is featured by high concentration of suspended substance, small flow, intermittent and centralized discharge, etc. According to relevant data, the wastewater produced by one time washing of concrete drum and charging bucket is about $0.5m^3$, SS concentration is about 5000mg/L, pH value is about 12, and the concentration of wastewater pollutant is far above the primary standard limit of Integrated Wastewater Discharge Standard. Thus, the wastewater shall be discharged after reaching the standard after centralized treatment in sedimentation tank, instead of being discharged directly, so as not to greatly affect surrounding water.

(5) Analysis of Impact of Bridge Foundation Construction on Water Environment

The bridges involved in the project include 5 bridges on Beichuan River and 15 bridges on Chaoyangdianqu, all being simply supported beam bridges.

The pollution to ground water during bridge construction on river is mainly from boring mud produced during bridge foundation construction and the production wastewater (drill polluted water and oily wastewater) caused by the construction. The proposed bridge crosses Beichuan River and Chaoyangdianqu. During construction, the spoil shall be removed regularly, and transported to river for storage according to relevant regulations. During construction, because of improper operation or insufficient management, the engine oil or waste oil of some mechanical equipment will enter water or river, to affect water quality. Generally, the domestic wastewater for bridge construction contains high concentration of COD, BOD5 and SS. The construction period for bridge is long, if such domestic wastewater is discharged to surrounding water directly without treatment, it will become long-term and stable water pollutant source during construction, which will reduce the water quality, especially, for those small rivers with small volume, low flow rate and poor self-purification capacity, the impact will be more obvious. Thus, intercepting ditch shall be set around the construction camp, and meanwhile, right numbers of anti-seepage sedimentation tanks and anti-seepage pit toilets shall be provided. The domestic wastewater shall be subjected to centralized treatment, and the sediment shall be buried deeply, and the water after clarification shall be spilled on the slope. The wastewater shall not be discharged into the water along the line. After construction, the pit toilet and sedimentation tank shall be buried by soil. In a word, during bridge construction, construction shall be performed according to bridge construction specification, enhancing site management and other measures shall be taken for construction machinery and construction materials, so as to avoid and slow down the bridge construction's surface water pollution along the line.

(6) Analysis of Impact of Domestic Wastewater of Construction Camp on Water Environment

During project construction, all kinds of constructors or operators will gather together. Domestic waste water is mainly from each of the construction camps. It mainly includes domestic wastewater and fecal sewage produced by dining and washing of constructors, which contains animal and vegetable oil, detergent and various organisms. See table 5.1-1 for main components of normal wastewater.

The wastewater discharge of construction camp shall be calculated as per the following formula:

$$Q_s = (K \times q_i \times V_i)/1000$$

Wherein, Q_s—domestic wastewater discharge, t/d;

q_i—water quota per person per day, L/(person·d), take q_i=70;

V_i—population of work area, person;

K—domestic wastewater discharge factor, 0.6-0.9 normally, and 1.7 is obtained for the project.

Table 5.1-1 Domestic Wastewater Components of Operators

Component	Concentration (mg/l)	Component	Concentration (mg/l)
Total Suspended Solids (SS)	100	Total phosphorus (P)	4
BOD5	110	Chloride	30
TOC	80	Calcium carbonate	50
CODcr	250	Grease	50
Total nitrogen (N)	20		

The works of the proposed project will be contracted through bidding as various packages. It is estimated that there are about 500 constructors during project construction. For the constructors, water consumption per person per day is calculated as 70L, and the wastewater discharge factor is 0.8. Thus 28 tons of wastewater will be produced every day. In such domestic wastewater, the concentrations of COD and BOD_5 are high. If it is discharged into the small river with small volume, low flow rate and poor self-purification capacity, water quality of the river will be degraded in short period; if it is discharged into the gully closeby, a lot of pollution will be caused to the gully environment. Thus, the domestic wastewater must be treated preliminarily.

In construction camp, the wastewater treatment facility should be provided, such as sedimentation tank, septic tank and etc. After treatment, the domestic wastewater should be used in the nearby woodland or farmland. The precipitated sludge is stacked centrally for anaerobic composting as agricultural fertilizer.

For site selection of construction camp, the environment sensitive point shall be avoided firstly, and shall not be set within 100m from the river bank. Meanwhile, effective measures shall be taken to control wastewater discharge, and dining and washing of operator shall be managed in a centralized and unified form, such as, centralized dining, and washing, so as to reduce the domestic wastewater in construction camp.

Based on investigation, in the proposed projects, only wastewater interception works along the banks of Xichuan River and Beichuan River and gully improvement works are away from the urban area, thus need to set up construction camps. But for the works in Beichuan area, except for establishing construction camp in construction area, renting residents' houses around the project area can be adopted, so that the domestic wastewater can be collected by the existing urban wastewater pipe network and pollution to surrounding environment can be reduced.

5.1.3 Analysis of Impact on Acoustic Environment

The proposed project includes construction road, pipe network, reclaimed water plant and integrated environmental improvement. The integrated environment improvement works include garbage clearance, greening and pedestrian walkway construction. Main noise source is construction vehicles, but with limited impact; road works are located in Beichuan area, with main noise source of excavator, leveler, mixer, etc. Resettlement in Beichuan area has been done, so there is no noise sensitive point and less impact; pipe installation is mainly along the existing road, and has a certain impact on the residents on both roadsides, and the construction of reclaimed water plant also has a certain noise impact on the surrounding residents. During construction, the main noise source is operating machinery, pipeline welding and etc. The types of equipment are mainly bulldozer, excavator, mixer and vehicles for equipment transportation, hoisting, installation and other operations. See Table 5.1-2 for their noise values.

Table 5.1-2 Mechanical Noise Value from Main Noise Sources during Construction

No.	Name	Noise Level dB(A)
1	Crusher	90
2	Excavator	84

3	Mixer	87
4	Paver	85
5	Hauling equipment	80
6	Piledriver	105
7	Crane	82
8	Electric saw	84

Generally, the above construction is outdoor working, without sound insulation and cutting measures, so sound spreads far, and the affected area is large. In different construction phase, equipment operation requires a certain operating space. The operation of construction machinery has a certain working spacing, so the construction equipment noise resource is strong, and acts as point sound source. And its noise prediction model is as follows:

$$L_p = L_{p0} - 20\log(\frac{r}{r_0})$$

Where in, r —distance from sound source to receiving point, m;

L_p —construction predicted noise value at a distance of r from the sound resource, dB(A);

L_{p0} —Reference sound level at a distance of r_0 from the sound source, dB(A);

During operation of common construction machinery and equipment, see table 5.1-3 for the noise value of the equipment with sound level exceeding 85dB(A).

Table 5.1-3 Predicted Noise Value of Construction Machinery at Different Places

Unit: dB (A)

Type of Machinery	Predicted Noise Value dB(A)						
	5m	10m	20m	40m	50m	100m	200m
Road Breaking Machine	90	84	78	72	70	64	55
Mixer	87	81	75	69	67	61	53
Paver	85	79	73	67	65	59	52
Piledriver	105	99	93	83	85	78	73

For construction of the works, the workload is large, and mechanization degree is high, so the noise has a certain impact on surrounding areas. According to Noise Limits for Construction Site (GB12523-90), at different stages, operating noise limit is 70dB(A) in the daytime and 55dB(A) at night.

During pipe network works, the construction machinery with louder noise mainly includes crusher, but its impact is random and the occurrence frequency is small. During construction, the impact of noise will be limited within certain boundary, dispersed and temporary, and will end at the end of the construction. Thus, it has less impact on the surrounding acoustic environment at construction site. During construction of reclaimed water recycling works, main equipment includes piledriver, and other high noise equipment. The sound insulation and noise reduction measures during construction shall be implemented, and environment supervision shall be strengthen, so as to try best to minimize the construction activity's impact on surrounding acoustic environment.

It can be seen from the above table that, at construction stage, the noise value beyond 40m can be attenuated to below 75dB(A), 85dB(A) and 70dB(A), which can basically meet the corresponding limits during daytime in Noise Limits for Construction Site (GB12523-90), and can reach the standard beyond about 200m at night (piledriver is forbidden). No matter weather there are residents around the pipe network or water reclamation plant, it's inevitable that the construction noise will affect them.

In order to ensure normal life of surrounding residents, the Construction Unit shall strictly execute the relevant national regulations for construction, and arrange the construction line reasonably. Effective noise control measures shall be taken, such as, partition board shall be provided in the sensitive area with serious noise pollution, and construction is forbidden within 200m of residential area during 22:00 - 6:00. With the end of construction, the effect of construction noise ends.

5.1.4 Impact Analysis of Solid Wastes

The investigation results indicate that household rubbish in the project area that needs to be cleaned amounts to 12,951m^3, which will be transported to Yinjiagou Landfill for sanitary disposal.

While the earth and stone excavated for the project amounts to 973,000 m^3, the total earth and stone filling is 3,056,000 m^3, the total borrowed earth and stone is 2,083,000 m^3 and total amount of dispatched and utilized earth and stone is 181,000 m^3(as shown in Table 2.10-1). Therefore, earth and stone that needs to be leveled or utilized in this project totals 181,000 m^3.

In addition, solid wastes that are generated during project construction, mainly including construction wastes, household rubbish generated by constructors, and other household rubbish within the project site, should also be cleaned.

Most construction wastes generated during construction are inorganic scraps, which mainly compose of offcut in the construction such as discarded earth, tiles and concrete blocks. Surrounding landscapes and environmental quality will be affected if these wastes are not disposed appropriately as they are non-perishable and insoluble. In order to avoid these problems, construction wastes generated during construction are suggested in the EIA to be transported to specified construction waste landfill in Xining Municipality for centralized disposal or comprehensive utilization. Discarded earth and stone excavated during construction shall be disposed locally by means of backfilling and compacting, so that they can be returned to the nature.

Household rubbish is mainly generated by constructors during construction which is about 1kg/ person ·day. The total household rubbish generated during construction is about 182.5t/a if number of persons engaged in the construction is counted as 500. The household rubbish mainly composes of organic scraps including leftovers and human wastes. If being left in the construction site without timely and effective disposal, these solid wastes will rot and smell and breed flies and mosquitoes and even trigger infectious diseases under serious condition which will affect health of the constructors. Therefore, household wastes generated during construction of the proposed project shall be collected at fixed place and transported to Yinjiagou Landfill for sanitary landfill.

In addition, about 12,951m^3 of existing household rubbish in the project area will be cleaned under the proposed project and they will be transported to household rubbish landfill in Xining Municipality for sanitary landfill.

5.1.5 Impact Analysis of Ecological Environment

Site selected for the reclaimed water plant to be supported under the project is within a piece of wasteland that used to be a plant site but was abandoned. It covers a small area, with few trees and living things around, thus construction over there will not have impact on biodiversity. Therefore, the reclaimed water plant will impact little on ecological environment during project construction. The effect of pipe network and gully works mainly occur during construction. Land excavation will cause ground surface exposure in a large area, damage to top soil and vegetations and hence soil erosion. In addition, excavated soil in the construction site is easy to be scoured by rainwater and cause soil and water loss due to loose structure. During pipeline construction, bottom soil in the excavated pipe trench area will be upturned, where the soil structure is almost changed, and vegetations in excavation areas are all destroyed which need long time for recovery. Therefore, relevant preventative and recovery measures shall be taken, especially via construction management and strengthening of protection and recovery during construction, to effectively control impact of proposed pipes on the ecological environment. Comprehensive management of Beichuan River bank and ditches has made some improvement to existing environment. There will be no adverse impact on ecology as land surfaces excavated and vegetations damaged during construction will be recovered later. For project components, the project mainly affects ecology of the north region of the city. Ecological assessment of the north region of the city is shown below.

(1) Impact of Permanent Land Occupation on Ecological Environment During Operation

Permanent land occupation reduces part of land used for production so biomass and grain output are reduced consequently, thus the contradiction between needs and supply might be intensified. In the meanwhile, change of land utilization and reduction of biomass will cause certain negative effects on structure and function of the ecological system. Some functions can be impaired, e.g. reduction of crops and vegetations in summer can weaken regulating function of local ecological system.

(2) Impact on Water and Soil Loss

Main causes of water and soil loss during project construction include the following aspects:

1) During construction, function of conserving soil and water of the original hardened ground surface is damaged as the ground surface is excavated and changed into ditches. Excavated earth and stone stacked during construction expose soil layer directly to winds and rains which provides condition for soil erosion. Impact of stacking of excavated earth and stone is particularly grave because it leads to loose soil structure which not only causes damage to surface landscape in a short term, but also causes fugitive dusts in windy days and soil erosion in rainy days. All these can lead to water and soil loss and pollution to urban air environment.

2) During filling construction, water and soil loss is easy to be caused by loose soil as protective layer has not formed yet on the ground surface before compaction of filled earth and stone or before roads are hardened.

3) During transportation of earth and stone, scattered earth and stone along the way caused by lack of coverage can easily lead to water and soil loss in windy days and wet season.

4) Large amount of earth and stone are discarded during project construction especially during laying of pipe networks. Water and soil loss can be triggered or intensified if these earth and stone are not appropriately disposed.

Therefore, management shall be strengthened during construction, contractors' awareness of environmental protection shall be enhanced, operation shall be strictly conducted according to design and technical specifications of the project, the construction shall be taken section by section, upon completion, the land shall be leveled, and roads shall be hardened and recovered. Pipe networks shall be laid synchronously with regional road construction of Xining Municipality. Pipe networks shall be laid under roads. For large-scale development and construction in the development area, earth and stone can be intensively dispatched to minimize impact of excavation and filling on water and soil loss. In order to reduce water and soil loss, discarded earth generated in Wastewater Treatment Plant and pipe network construction can be used for backfill of road and construction of green areas on the center and both sides of roads.

In conclusion, impact of project construction on water and soil loss is little.

(3) Impact on Land Utilization and Agricultural Production

Current utilization status of some lands along the proposed project will be changed. Absolute amounts of farmlands and woodlands will be decreased. In order to reduce impact of proposed project on farmlands, attention shall be paid to land resources conservation during development and construction of the project.

Production capacities of farmlands and woodlands occupied during construction of proposed project will be permanently or temporarily lost. Though ratio of lands occupied by the project is relatively small, the project site mainly lives on agricultural economy, so the agricultural production along the proposed project will be subjected to certain economic losses. Units who use relevant lands shall compensate for the farmers. The land distribution scheme shall be appropriately adjusted by local government according to size of lands that occupied.

(4) Impact on Vegetations

At present, the vegetations in the area are mainly crops cultivated artificially which contain certain part of cultivated or natural-grown woodlands. The original vegetations are destroyed because villagers are building houses and reclaiming farmlands in such area. Both vegetation coverage and quantities of vegetations will decline if such activities are not controlled.

During project construction, the vegetation habitat environment will be destroyed and the growing environment of individual life will be lost. The direct result of vegetation damage is that soil exposure, water erosion and wind erosion are intensified causing changes of structure and function of ecological system, which will finally lead to quality deterioration of regional ecological environment. Vegetations in the construction area will be obviously damaged due to mechanical grinding and trampling by constructors. Therefore, relevant environmental protection measures shall be taken during construction. Management of various items shall be strengthened to effectively control impact of construction project on local vegetations. For example, construction activities shall be limited within certain scope if possible. Construction period shall be shortened so as to recover vegetations as soon as possible and reduce impact on such areas.

After construction, various plants and trees that adapt to local living environment can be brought in and cultivated, so that not only the vegetation varieties and quantities and vegetation coverage in such area will be increased, but also the surrounding environmental quality and status will be improved which will provide a favorable environment for normal growth of vegetations.

Therefore, vegetation damage within the project area can be effectively reduced, vegetation varieties and quantities can be increased and the local ecological environment can be improved via environmental management along river bank of the project and the implementation of the project in the Beichuan area.

(5) Impact on Animal Resources

The project area is heavily influenced by human activities. Construction of the proposed project will not have siginificant impact on wildlife. After implementation of the project, areas of greenland will be greatly increased, Increase of greenland will also provide favorable habitat for some wild animals, thus regional ecological environment will be improved. Domestic animals and fowls will be transported out of the project area, but there will be little adverse impact as these are common animals with good adaptive capacities.

Therefore, a favorable habitat for wild animals will be provided and their varieties and quantities will be increased after implementation of the project.

5.1.6 Analysis of Impact on Social Environment

(1) Impact Analysis of Land Acquisition, Demolition & Resettlement

People's production and life within the project area will be inevitably affected in a certain period of time by demolition and relocation of the project. Construction units will make monetary compensation for resettlement and properly resolve living issues of residents and arrange their resettlement after demolition together with local government according to relevant policies, so as to avoid social problems and environmental destruction due to inappropriate resettlement. Responsibility of preventing water and soil loss caused by demolition and resettlement shall be undertaken by local government.

(2) Impact on Irrigation along the Construction Line

In order to guarantee smooth flow of water in farmland ditch and prevent water and soil loss, relevant measures must be taken for works involving change of farmland ditch, small bridge and culvert to avoid impact on irrigation and water conservancy along construction line of the project.

(3) Impact on Infrastructure like Current Traffic Facilities

Some surrounding public services and structures will be affected during construction of the proposed project, infrastructures such as existing roads, communications, electric power and pipe networks within the project scope are likely to be affected as well. For example, local roads might be damaged by transportation of raw and auxiliary materials or by large sized machines during the construction.

(4) Impact on Public Traffic

The impact of proposed project on traffic during construction mainly includes three aspects: traffic will be impeded due to road breaking for pipe networks construction; traffic flow will be increased due to stacking of earth and stone and pipe jacking construction on the one hand and increase of transport vehicles on the other hand.

The impact of pipe network construction on road traffic is obvious. Though construction can be carried out in stages, temporary stacking of some earth and stone is inevitable during the project construction, thus the road traffic along construction line will be affected consequently. If trench excavation method has to be taken when pipelines cross roads, vehicles on roads are likely to be impeded which will greatly affect traffic status. New roads which have to be crossed will not be excavated according to requirements of the construction party and relevant urban construction departments. Pipe jacking method will be adopted for crossing of pipelines which will reduce impact of road excavation during the construction. But in the mean while the carrying capacity (supporting capacity) of roads declines, so motor lorries are not permitted to pass within short time. All these will affect urban traffic. It is estimated that construction period for pipelines to cross each road need more than 20 days, thus the impact on traffic of road to be crossed will last for about 20 days. What's more, freight volume of raw materials (sands, cements, etc.) and discarded earth during construction is large, causing increase of traffic in certain parts which will lead to traffic jam.

1) Impact of Project Construction on Living of Local Residents

Impact on living of residents is inevitable due to re-placing of excavated roads and placing of pipelines involved in project construction, which mainly includes:

① Normal travel and daily life of residents along construction line of the project will be affected during construction. As both the quantities of road works and goods & materials required to be transported are huge, original traffic status is certainly to get worse which will severely affect daily life of residents along the construction line. Probable impact of pipe network construction on residents mainly lies in that areas of road surfaces in urban areas will be reduced due to foundation excavation, pipe trench excavation and pipe laying, backfill operation as well as cutting and occupation of roads, which will cause decline of traffic capacity and urban traffic problems such as road blocking and unsmooth traffic. All these will cause certain impact on social economy and traveling of residents in urban areas.

② During construction stage of the project, fugitive dusts and tail gas generated by construction excavation and transport vehicles as well as noises of construction machines will cause certain impact on residents along the construction line. Therefore, construction units shall take protective measures to minimize the impact.

③ Pipe network construction concentrates in downtown areas and the construction might involve other underground pipelines, therefore, disturbance to various pipelines along the construction line is inevitable. Once any accident occurs due to damage of pipelines, the normal life of residents will be affected. Therefore, in order to reduce impact on infrastructures to the least extent, the construction period of pipe networks in each section shall be controlled or shortened if possible. Besides, various temporary passageways and signboards shall be set. In the meanwhile, construction shall avoid underground pipelines if condition permits.

(5) Analysis of Impact on Appearance and Landscapes of the City

The project will cause certain impact on urban landscapes during construction. Main impact of road works on landscapes and environment lies in that, roadbed is excavated and surface vegetations are destroyed which produces visual contrast due to exposed ground surface; borrow pit, temporary works and the construction project are out of line with surrounding landscapes which changes landscapes along the construction line and affects original urban appearance in the project area. However, the impact is temporary. New landscape region will be added to the city after the project area is regulated and recovered with the implementation of engineering measures such as hardening and protection of roadbeds, greening, demolition of temporary works and cleaning of construction site.

(6) Impact on Social Environment

During construction of the project, pungent odor, noises and dust pollution will generate during cleaning and transportation of garbage. Normal life and production of residents around the project area will be affected if such garbage is not appropriately treated. Personal safety of local residents especially the senior citizens, children and pregnant women might be threatened by traveling of construction vehicles and waste slag, waste earth and wastewater in the construction site.

5.1.7 Preservation of Cultural Relics

Relevant units for preservation of cultural relics and units related to folk customs are not found in construction areas along the construction line of the project. But construction might expose cultural relics buried underground, therefore, the construction units and project supervision units shall suspend the construction immediately if any cultural relic is found, and then timely report to competent departments for preservation of cultural relics for proper treatment before re-construction.

5.2 Analysis and Assessment of Environmental Impacts during Operation Period

5.2.1 Positive Impacts of Project

The implementation of the project can make improvement in urban environment and social influence of Xining Municipality. As per *Social Assessment Report* prepared by Hohai University and findings of this environmental impact assessment, the positive impacts brought by the implementation of the project on society and environment are mainly as follows:

(1) Urban Wastewater Collection Pipe Network

1) Complete and Improve Wastewater Collection System in Xining Municipality

So far, the total length of wastewater pipes installed in urban area of Xining city is about 469km, and the discharged wastewater in 2010 was 40.52 million ton, including 36.07 million ton meeting discharge standard. The wastewater treatment plants that have been built and put into operation in Xining includes No.1, No.2 and No.3 WWTPs, and Urban South New Zone WWTP, with a total design capacity of 250,000 m^3/d and actually utilized capacity of about 200,000 m^3/d, accounting for 80% of the total design capacity. It is estimated that total wastewater discharge in Xining Municipality is now 264,000 m^3/d, and the collected and treated amount accounts for 76% of the discharged amount. It can be seen from above data that so far the overall status of wastewater collection and treatment in Xining Municipality is good, but there is still quite a lot of wastewater being directly discharged into the nearest river.

Wastewater interception pipe network can realize collection and intensive treatment of wastewater to reduce the discharge of pollution sources, improve the use efficiency of water, and reduce industrial and domestic wastewater discharged to surface water. After the wastewater is carried to wastewater treatment plant through wastewater interception pipe network, the quality of surface water will be improved, water use efficiency will be increased, and this will be conducive to realizing the aim of “Great Beautiful Qinghai, Summer City Xining”.

2) Improve Wastewater Collection Capacity

The collected wastewater under the project is related to the following works:

Wastewater collected along the south bank of Xichuan River will be 43,600 m^3/d in the long term and sent to No.4 WWTP;

Wastewater collected along the east bank of Beichuan River will be 8,000 m^3/d in the long term and sent to No.5 WWTP;

Wastewater collected along the west bank of Beichuan River will be 16,400 m^3/d in the long term and sent to No.5 WWTP;

Wastewater collected from Beichuan Area will be 11,000 m^3/d in the long term and sent to No.3 WWTP;

Wastewater collected along Shengou Gully area will be 224 m^3/d and sent to No.3 WWTP;

Wastewater collected along Chaoyangdianqu Canal will be 2220 m^3/d and sent to No.3 WWTP.

The total amount of wastewater collected will be 80,800 m^3/d in the long term as per statistics. Implementation of the project can significantly enhance wastewater collection capacity in Xining Municipality and improve water environment.

3) Help to Improve Water Quality in Project Area and Reduce the Occurrence of Waterborne Diseases

The discharge of untreated domestic and production wastewater into river will pollute water and cause relevant diseases. Implementation of this project is of positive significance on the improvement of water quality in project area and the reduction of occurrence frequency of waterborne diseases. Once these diseases intensively outbreak, it will have serious impact on people’s working and living and increase additional medical expenses of family. The construction of wastewater treatment project can reduce the contact probability between wastewater and clean water, guarantee the hygiene and safety of water for involved mass, and further improve health condition of local mass and reduce the incidence of water-related infectious disease.

4) Perfect the Environment in Project Area and Improve Resident’s Quality of Life

The implementation of wastewater collection pipe network works will make a change for the disorderly discharge of wastewater in project area and substantially reduce the discharge of pollutant. In addition, the implementation can effectively reduce the organic load of water environment within project area and improve the environment of project area.

5) Increase Job Opportunity

The construction period of the project is relatively long, and partial unskilled jobs (e.g. transporting stone on construction site and woman cooking for workman on construction campsites) will be increased during construction. In addition, during operation period, the resident in project area can be engaged in work related to maintaining pipe network.

Through communicating with the project owner, project office will supervise and urge implementation unit to provide above job opportunities to surplus laborers in project area and surrounding area with priority to disadvantaged groups (including poor people, ethnic minorities and women).

(2) Reuse of Reclaimed Water

1) Economize Water Resources and Improve Water Use Efficiency

Wastewater to be treated in reclaimed water plant is mainly wastewater produced by enterprises and public institutions in Xining Municipality, as well as domestic wastewater generated by urban residents. Reclaimed water produced by the reclaimed water plant shall meet the recycling standard for reclaimed water and can be reused for production processes, green space irrigation and road watering. In addition, the recycling of wastewater can reduce pollutants discharged into surface water, and therefore economize water resources and reduce environmental pollution.

In Xining, seasonal water shortage of rivers is still a problem, resulting in decline of pollution bearing capacity of rivers, and use of reclaimed water is insufficient. The reclaimed water plant reuses the wastewater discharged into surface water by wastewater treatment plant, through doing so, it can improve water use efficiency and mitigate water shortage in urban area, and thus help to realize sustainable use of water resources. Meanwhile, implementation of the project will also help in upgrading local resident's awareness of water-saving and environmental protection.

As per the feasibility study of the project and the land use table included in the *Overall Plan of Comprehensive Management for Beichuan River (Tianjunlu-Chaoyangyinshuikou)*, green land area totals 294 hectare, road area is 87.2 hectare. The estimated water use for greening is 3000 m^3/d and for road watering 1800m^3/d. Therefore, after implementation of the project, water saving by using reclaimed water for greening and road watering purposes will be 4800m^3 daily. The project is a pilot for using reclaimed water for urban greening and watering in Xining Municipality, and through subsequent promotion, more tap water, the major water source for urban water supplies, will be replaced with reclaimed water, which will produce remarkable water conservation effect.

2) Strengthen Social Benefits in Project Area

Implementation of the pilot project for reuse of reclaimed water can provide a large amount of water for road greening, urban miscellaneous water. Meanwhile, use of reclaimed water saves water resource, guarantees tap water supply and has positive impact on strengthening social benefits in project area. Meanwhile, the studies supported by the project on economic policy incentive mechanism to promote use of reclaimed water and on impacts of reclaimed water on soil and vegetation of green belts in Xining Municipality, are conducive to promoting the reuse of reclaimed water in Xining Municipality.

3) Improve the Pollution Bearing Capacity of River and Perfect Environmental Quality

It can be concluded from analysis of water supply data that, the overall water use efficiency in Xining reaches 70.5%, exceeding the generally accepted 40% as alert level for river water diversion and utilization, and compared with other basins, this ratio is higher. The high development and utilization ratio of water resources results in water shortage and relative lower pollution bearing capacity of river.

The water supplied by reclaimed water works can reduce river water consumption, enhance pollution bearing capacity of river, and improve water quality of river and local environmental quality.

(3) Low-impact Development and River Bank Environmental Improvement

The project component includes river bank improvement, rainwater utilization, greening and relevant supporting measures along Beichuan River. Implementation of this component will make changes to the currently dirty, chaotic and poor environment of Beichuan area. After construction of comprehensive management works for the river banks, scientific and reasonable roadside greening and restoration of ecological system can protect the ecological system along the road to some extent, and form beautiful road landscape in the urban area. After completion of road greening works, trees will be planted. The road green belt has a positive effect on shielding traffic noise along the road, absorbing toxic and harmful gas exhausted by vehicles and preventing dust. Besides, the road green belt can reduce pollutants discharged into river, protect water resource, and improve living environment of resident.

1) Environmental Benefit brought by Low-impact Development

Low-impact development concept is adopted for both banks of Beichuan River. Low-impact development (LID) technique, developed in the late 1990s, is for management of rainstorm and handling of non-point pollution sources. Meanwhile, low-impact development (LID) technique realizes control over runoff and pollution caused by rainstorm through controlling the scattered and small-scale pollution sources, and ensures that the developed area being closer to a natural hydrological cycle as much as possible, so it is different from traditional techniques (e.g. wet land, detention pond, grassed waterway etc.).

Implementation of low-impact development program will slow down the flow rate of rainwater on ground along both banks of Beichuan River while increasing amount of rainwater infiltration. Meanwhile, rainwater on ground surface can be purified by surface vegetation and the filtering layer specifically installed, so the quality of infiltrated water is improved and the non-point pollution caused by initial rainwater on both banks of Beichuan River is reduced. In addition, slowing of rainwater flow rate makes water and soil loss reduced, sediment content of rainwater finally flowing into Beichuan River greatly reduced and water quality increased.

As per the statistics of feasibility study design, rainwater of 39,000m^3 will be filtered and purified each year through implementation of low-impact development (LID) program, and part of the filtered rainwater is reused for green space irrigation in Beichuan area and the rest is used for replenishment into Beichuan River.

Through environmental recovery by implementing LID techniques supported by the project, eco-environment in the project will be greatly improved and water and soil erosion can be effectively reduced. As a result, erosion degree of the area involved will change from medium erosion to light erosion, meaning that effectively reduced soil erosion will be 1008 tons per year if the soil erosion module is taken as 500t/km^2.

2) Upgrade Environment in Project Area and Improve Resident’s Quality of Life

Beichuan River, being about 14 Km long and running through Xining Higher Education Zone and Datong Industrial Zone, is an important ecological channel in northern Xining. Because the railway within city limits the expansion of urban function, the area from the east of Xining-Datong railway within Beichuan area to the west of Beichuan River is without municipal facilities, but is with much dumped garbage, phenomenon of creating land by filling and dirty and chaotic living environment, and this area is always an untouched corner of urban development. In addition, this area has prominent environmental problems, e.g. floating debris in river of main urban district, river water carrying sediment etc.

Implementation of the project will be helpful to water saving, adjusting microclimate, improving water quality of downstream river, strengthening livability in new zone, perfecting the environment of new zone and upgrading living quality of resident.

3) Be Conducive to the Development of Secondary and Tertiary Industry, Job Enlargement and Economic Development

The implementation of the project will greatly improve the regional environment, further enhance the image of city, optimize investment environment, promote the quantity and quality of incoming investments, accelerate the cooperation and communication among regions and promote socioeconomic development and the building of harmonious society within region.

The implementation of the project will greatly improve regional environment, further enhance the image of city, optimize investment environment, increase the quantity and quality of investment promotion, and boost the development of countryside tourism on both banks of the river to create good conditions for the opening of rich tourism resource on both banks of Beichuan River. Meanwhile, the development of enterprise and tourism resource will create more job opportunities for local residents. Therefore, women and poverty groups will gain more job opportunities (e.g. clean-keeping, restaurant attendants, etc.) and benefit from government financial support.

4) Provide Place for Leisure and Entertainment

After the project is implemented, the whole Beichuan River will form a landscape structure with one zone, two districts and multiple sites, and the river environment and environment on both banks will be greatly improved, and good place for walking, chatting, leisure and entertainment will be provided for surrounding residents. Therefore, this will play a positive role in improving environment and humanistic atmosphere in the project area.

(4) Integrated Gully Improvement

1) Reduce Water and Soil Erosion and Improve Ecological System of the Gullies

Xining Municipality has been making efforts in gully improvement ever since 1982, however, due to lack of proper maintenance and management and follow-up investments, many previously established works have reached or are close to end of operation term. Because of freezing and thawing, scouring and other reasons, some of the works are losing water and soil conservation function. With many check dams built under the previously implemented gully improvement programs, but very few of them can perform key controlling functions. With small number of controlling works per unit area and unstable engineering system, it is very difficult to realize the goal to stabilize the gullies, control flood and block sediment. Along with the development of economy and society, human activities increasingly encroach into natural space, as illustrated by many illegal buildings along the gully, arbitrary garbage dumping, directly dumping of discarded dregs and household garbage on both sides of gully and etc., resulting in higher likelihood of water and soil erosion and intensified flood disaster due to blockage in the gullies.

The project will support cleaning of the garbage and sludge in the gullies, construction of stone masonry slopes of trapezoidal cross-section at gully mouth, and greening on both banks of the gullies. The above measures will help to reduce water and soil loss, improve river environment, restore and improve the ecological system of the gullies.

2) Reduce Occurrence of Infectious Diseases and Improve Living Quality of Resident

During interviews, local residents living along the gully banks generally complained about arbitrary garbage dumping (including the dumping from vehicle transporting construction waste at night and the dumping of domestic garbage by residents living in the central part of the city or nearby area). Consequently, rivers are increasingly narrowed down and siltation in the rivers is becoming more and more serious. In summer, piles of rotting garbage cause unpleasant odor and mosquito breeding, causing higher likelihood of spread of infectious diseases.

Implementation of integrated gully improvement will greatly improve environment in the project area and around, reduce occurrence and spread of infectious disease and help to guarantee the health of residents in project area. In addition, the improvement of environment will not only improve life quality of local residents, but also have positive impacts on strengthening local residents' environmental awareness. Furthermore, the improvement of environmental quality is of positive significance to development of tertiary industry in the project area and around.

3) Enhance Local Residents' Awareness of Environmental Protection

During project construction, awareness and capability of public participation of the local residents can be enhanced by their participating in project activities, their awareness of environmental protection and health and sanitation can also be strengthened, all of which will benefit environmental protection and sustainable development of the project area.

(5) Impacts on Ethnic Minorities

1) Implementation of urban wastewater pipeline works will help to establish a complete wastewater collection system in Xining Municipality, improve wastewater treatment capacity and thus reduce the probability of contact between wastewater and clean water, so as to guarantee the hygiene and safety of water for ethnic minorities in project area. As a result, health condition of ethnic minorities can be improved and incidence of water-related infectious disease can be reduced for them.

2) The implementation of pipe network works for rainwater and wastewater collection will be conducive to making a change for the disorderly discharge of wastewater in project area and substantially reducing the discharge of pollutant and conducting comprehensive management of environment combination with district planning. In addition, the implementation can effectively reduce the organic load of water environment within project area and be conducive to water conservation, adjusting microclimate, improving water quality of downstream river, perfecting living environment of minorities and increasing living quality of minorities.

3) The construction period of the project is relatively long, thus some unskilled job opportunities may be created, such as on-site building material delivery and cooking for workman and etc. In addition, during operation period, the minorities in project area can be engaged in work related to maintaining pipe network, greening, cleaning etc.

4) The implementation of the project will greatly improve local environment, further enhance the image of city, optimize investment environment, promote the

quantity and quality of incoming investments. Development of countryside tourism on both banks of the river can also be promoted because of environmental improvement, this will benefit the ethnic minorities. Meanwhile, development of enterprises and tourism resources will bring more job opportunities to local minorities.

5) After project implementation, the whole Beichuan River will form a landscape structure with one zone, two districts and multiple sites, and the river environment and environment on both banks will greatly be improved, so a good place for leisure and entertainment will be provided for minorities.

6) The project implementation will also help to improve local residents' awareness of water-saving and environmental protection.

(6) Summary

Implementation of the project can greatly promote eco-civilization development, improve urban water environmental infrastructure, and upgrade environmental service in Xining Municipality. The positive impacts of the project are as follows:

① Implementation of the project can improve and complete urban wastewater collection system, reduce not only wastewater directly discharged into water but also domestic garbage dumped into river, as well as solid pollution (e.g. flotage etc.) in river, and thus can improve living environment and optimize land development pattern.

② Implementation of the project can increase water use efficiency, conserve water resources and comprehensively promote resource conservation.

③ Implementation of the project can enhance natural ecosystem, effectively reduce sediment discharge into rivers in rainy season, dumping of domestic garbage and wastewater pollution in the gullies, and can therefore improve gully environment.

5.2.2 Negative Impact of the Project

The main goals of the project are to improve quality of regional surface water and upgrade water use efficiency in Xining Municipality. However, while achieving positive impacts, the project also has some negative impacts on environment during operation period. In addition, the project is complicated, with main constructions including pipe network, roads, integrated river bank improvement, reclaimed water plant and comprehensive gully improvement and management. See Table 5.2-1 for detailed impacts of different works of the project on environment during operation period.

5.2-1 Table for the Impact of Project on Environment during Operation Period

Project Activities	Major Environmental Impacts

Pipe network works	Impact on social environment
	Operational risk
	Impact on ecological environment
Roads	Traffic noise
	Vehicle emissions
	Domestic garbage
	Safety for pedestrian and traffic
	Operational risk, see the section on risk analysis
Reclaimed water plant	Noise from submersible pump in reclaimed water plant
	Discharge of domestic wastewater from reclaimed water plant
	Discharge of solid waste (e.g. domestic garbage)
	Impact on social environment
Integrated river bank environmental improvement	Social environment and traveler's safety
	Solid waste
	Ecological environment
Integrated gully improvement and management	Social impact and safety risk

5.2.3 Pipe network works

(1) Social Environment

After completion of pipe network works, the pipe is buried deep under the ground and normal operation of pipe network works will not impact on life of residents in project area. However, during pipe network maintenance, road surface in some sections shall be re-excavated, and short-term traffic blocking, dust caused by operation and temporary land occupation for placing material will arise, but the duration of these impacts is relatively short, and the impacts on local people will be limited. Measures to reduce these impacts include prior notification to local people, reasonable construction organization and scheduling, proper maintenance and management of construction sites during construction, proper land leveling and site recovery after construction.

(2) Acoustic Environment

After completion of pipe network works, no pump station will be built, so there is no impact of noise.

(3) Atmospheric Environment

After completion of pipe network works, pipes will be buried deep under the ground, so there is no pollution to atmospheric environment.

(4) Water Environment

The pipe network works related to the project include wastewater collection pipe network, rainwater collection pipe network and reclaimed water delivery pipe network. These pipe network works will not produce wastewater but collect previously dispersed wastewater instead, the pipes will be used to collect wastewater and rainwater in Beichuan area for treatment, and thus minimize the impact of wastewater on surface water. Meanwhile, the pipes for conveyance of reclaimed water will facilitate reuse of reclaimed water for urban greening and road watering purposes, which will further reduce the pollutants discharged into river and conserve water resources.

(5) Ecological environment

After completion of pipe network works, disturbed earth's surface will be recovered. The wastewater collection pipe network along both banks of Beichuan River and Xichuan River is linear works which will not cause large-range ecological damage in the region. Meanwhile, the main objects affected by wastewater collection pipe network are farmland, open woold land, uncultivated land and some sections of gravel roads, their original ecological characteristics and functions can be effectively restored by second ploughing, greening, restoration etc. Therefore, after having taken the above measures, wastewater collection pipe network works will not cause great impacts on ecological environment. In addition, the pipes in Beichuan area will be laid under the road of which the surface will be hardened as per the planning, so no serious water and soil erosion and ecological deterioration will arise.

(6) Risk

After being put into operation, the pipes may be cracked due to geological disaster, external force (e.g. rolling of vehicle) or aging of pipe material. If the pipe is cracked, the wastewater and reclaimed water in the pipe will infiltrate into soil and pollute the soil and underground water. Therefore, detailed maintenance program for operation stage shall be prepared so as to find out and handle the risk in a timely manner and reduce the impact caused by cracking of pipe on environment.

5.2.4 Roads

(1) Social Environment

Construction of roads is conducive to perfecting traffic system in Xining Municipality, providing convenience for vehicle traffic within the region and driving economical development. However, if without timely maintenance during operation period, the resulted poor drainage may affect traffic, cause traffic jam (under serious condition) and affect resident's daily traveling.

Construction of roads will benefit regional development. Meanwhile, roads also bring potential safety hazards (including the potential safety hazard in respect of vehicle traffic and pedestrian). In each road section, such necessary facilities as pedestrian crosswalk and street-crossing tunnel shall be set for convenience of pedestrians. Besides, traffic lights and safety barriers and the like shall be provided to ensure safety of pedestrians in walking.

(2) Acoustic Environment

The main impact of proposed project during operation period is traffic noise, which is mainly influenced by the following factors: road traffic parameters (e.g. traffic flow, speed, vehicle type ratio etc.), terrain conditions of road, road facilities etc. This assessment adopts *Technical Guidelines for Environmental Impact Assessment – Acoustic Environment* (HJ2.4-2009) for prediction of traffic noise of highway (road).

1) Prediction Method

First, classify the vehicle (e.g. big, medium, small cars) and then calculate the equivalent sound level per hour received at the predicted point when each type of vehicle runs in the day and night:

$$(L_{Aeq})_i = L_{W,i} + 10\lg\left(\frac{N_i}{v_i T}\right) + \Delta L_{\text{distance}} + \Delta L_{\substack{\text{longitudinal}\\\text{slope}}} + \Delta L_{\text{pavement}} - 16$$

$$(L_{Aeq})_{\substack{\text{traffic}\\\text{noise}}} = 10\lg\left[10^{0.1(L_{Aeq})_L} + 10^{0.1(L_{Aeq})_M} + 10^{0.1(L_{Aeq})_S}\right] + \Delta L_1$$

Where: L_{Aeqi} -i refers to vehicle type (generally including three types: big, medium and small), and equivalent sound level per hour of vehicle is dB;

$L_{Aeq\ \text{traffic noise}}$ - equivalent sound level per hour of road traffic noise, dB;

L_{oi} -average radiated noise level of this type of vehicle at reference point (7.5 m), dB;

N_i -hourly traffic flow of this type of vehicle, vehicle/h;

T -time calculating the equivalent sound level (T=1h);

V_i -average speed of this type of vehicle, km/h;

$\Delta L_{\text{distance}}$ -Distance attenuation of predicted point at a distance of r from noise equivalent lane, dB;

$\Delta L_{\text{pavement}}$ -traffic noise attenuation caused by ground pavement absorption, dB;

$\Delta L_{\text{barrier}}$ -attenuation of barrier during the transmission of noise, dB;

ΔL_1 -traffic noise correction caused by bending highway or section of highway in limited length, dB.

The formula to calculate the environmental noise prediction (LAeq)prediction at predicted point in day or at night is as follows:

$$(L_{Aeq})_{prediction} = 10\lg\left[10^{0.1(L_{Aeq})_{traffic}} + 10^{0.1(L_{Aeq})_{background\ value}}\right]$$

Where: (LAeq) $_{prediction}$ -environmental predicted noise value at predicted point in day or at night, dB(A);

(LAeq) $_{background\ value}$ -environmental noise background value when prediction at predicted point (taking the current environmental noise value at the predicted point), dB(A).

2) Determination of Parameters for Prediction Mode

① Traffic Volume Prediction

Based on field survey, planning data collected for land-use and population, results of qualitative and quantitative analysis, traffic volumes of the roads and surrounding road network in the planning base years are predicted, and thereby technical standards, forms of cross-sections and phased construction standard of roads are defined as references for investment decisions.

Construction of traffic facilities should not only meet current needs of urban transportation and, more importantly, shall meet the requirements of transportation development in the future. Prediction of traffic volume is the fundamental basis for investment and construction of traffic facilities, and the important premise of determining the construction scale of road facilities.

According to *Methods for Preparation of Feasibility Study Report of Marine and Highway Construction Projects* issued by the Ministry of Communications, the prediction period for traffic volume prediction is determined as 20 years after completion of main roads and as 15 years after completion of secondary roads and branches. The proposed project is planned to commence construction from the middle of 2014 and complete construction by the end of 2017. The prediction base year is set to be 2017, the planning years to be 2017, 2022, 2027, 2032, and 2037, by combining the social and economic development planning of project area with the construction schedule of proposed project. See Table 5.2-2 for the results of average daily traffic volume prediction provided by feasibility study report.

Table 5.2-2 Table for Average Daily Traffic Volume

No.	Road names	Road grade	Average daily traffic volume (pcu/d)				
			2017	2022	2027	2032	2037
1	Jinyi	Main	8455	10315	12171	13632	14586
2	Beiyuanbei	Tertiary	5251	6196	6939	7425	--
3	Beiyuan	Tertiary	5863	6919	7749	8291	--
4	Goubei	Tertiary	5513	6506	7286	7796	--

5	Liujiagou	Main	8666	10572	12476	13973	14951
6	Weisi	Tertiary	3792	4475	5012	5363	--
7	Huijin	Secondary	7215	8514	9535	10203	--
8	Erweibei	Tertiary	5951	7022	7864	8415	--
9	Erwei	Main	9089	11088	13084	14654	15680
10	Erweinan	Tertiary	5513	6506	7286	7796	--
11	Huiwen	Secondary	7314	8630	9666	10343	--
12	Sanweibei	Tertiary	4285	5056	5662	6059	--
13	Sanwei	Main	8138	9928	11715	13121	14039
14	Jinshui	Secondary	6918	8164	9143	9784	--
15	Yuquan	Tertiary	5863	6919	7749	8291	--
16	Siweibei	Tertiary	4082	4816	5394	5772	--
17	Weishisan	Tertiary	4523	5337	5977	6395	--
18	Weishisi	Tertiary	4681	5524	6187	6620	--
19	Siwei	Main	8890	10845	12797	14333	15336
20	Tiedong	Main	9847	12013	14176	15877	16988
21	Tiedong Rd. South Extension	Main	9721	11859	13994	15673	16771
22	Binhexi	Tertiary	5338	6299	7055	7549	--
23	Binhexi Rd. North Extension	Tertiary	5251	6196	6939	7425	--
24	Zhenxing	Tertiary	6038	7125	7980	8539	--
25	Zhenxing Rd. South Extension	Tertiary	4813	5679	6361	6806	--
26	Zhenxingdong	Tertiary	5251	6196	6939	7425	--
27	Zhenshui	Tertiary	5688	6712	7518	8044	--

After operation period of proposed highway begins, the impacts on acoustic environment mainly originate from the traffic noise radiated by the vehicles running on highway. Therefore, it is necessary to predict and evaluate the overall level of noise and the impacts of noise on the sensitive points within surrounding evaluation area in short, medium and long terms after the completion of highway, so as to make noise reduction measures rational and suitable for local conditions based on the actual situation of noise impacts, providing scientific basis by combining the relevant planning in future along the project.

② Traffic Vehicle Type Ratio

The proposed road is urban road. The type ratio of large vehicle, medium vehicle, and small vehicle of this urban road is determined as 6:3:1 as a rule of thumb via communication with feasibility study institute.

③ Traffic Flow Methods for Day and Night

The calculation interval for day of the proposed road is 6:00-22:00 and that for night is 22:00-6:00 (following day). As a rule of thumb, the proportion of traffic volume for day of this road project in average daily traffic flow is determined as 85%, that for night as 15%.

④ Calculation formula for Average Speed of Each Vehicle Type

$$v_i = k_1 u_i + k_2 + \frac{1}{k_3 u_3 + k_4} \tag{4.3-1}$$

$$u_i = vol\left(\eta_i + m_i\left(1-\eta_i\right)\right) \tag{4.3-2}$$

Where: v_i --the predicted vehicle speed of type i, km/h; when the designed speed is lower than 120 km/h, the predicted speed of such type shall be reduced in proportion;

u_i --equivalent vehicle quantity of such type;

η_i --type ratio of such type;

vol--traffic flow of single lane, Nr. /h;

m_i --weighting coefficients of other 2 types

m_i 、 k_1、 k_2 、 k_3 、 k_4 are respectively coefficients, as shown in Table 5.2-3.

Table 5.2-3 Coefficients of Calculation Formula for Vehicle Speed

Vehicle Type	k_1	k_2	k_3	k_4	m_i
Small vehicle	-0.061748	149.65	-0.000023696	-0.02099	1.2102
Medium vehicle	-0.057537	149.38	-0.000016390	-0.01245	0.8044
Large vehicle	-0.051900	149.39	-0.000014202	-0.01254	0.70957

Vehicle type is divided into small, medium, and large types. See Table 4.3-5 for Vehicle Type Classification Standard. The vehicle type ratio shall be determined based on the results of traffic volume investigation provided in the feasibility study report on project. See Table 5.2-4 for details.

Table 5.2-4 Vehicle Type Classification Standard

Vehicle Type	Total Weight of Automobile
Small vehicle	Below 3.5t
Medium vehicle	3.5t to 12t
Large vehicle	Above 12t

Note: Small vehicle generally includes small truck and car, wagon with or below 7 seats and so on;
Large vehicle generally includes container car, trailer, engineering vehicle, motor bus (above 40 seats), and large truck and so on; Medium vehicle generally includes medium truck and bus (7 to 40 seats), three-wheel and four-wheel farm vehicles and so on. The vehicles other than large vehicle and small vehicle can be classified into the nearest classification.

⑤ Single Vehicle Driving Radiation Noise Level L_{oi}

a. L_{oi}, the average radiation noise level (dB) of vehicle type i at reference point (7.5m away) shall be calculated by the following formula:

Small vehicle $L_{OS} = 12.6 + 34.73\lg V_S + \Delta L_{\text{Pavement}}$ (4.3-3)

Medium vehicle $L_{OM} = 8.8 + 40.48\lg V_M + \Delta L_{\text{Longitudinal slope}}$ (4.3-4)

Large vehicle $L_{OL} = 22.0 + 36.32\lg V_L + \Delta L_{\text{Longitudinal slope}}$ (4.3-5)

The S, M, and L marked at lower right corner of formula respectively represent small, medium and large vehicles;

V_i --average running speed of such type vehicle, km/h

b. Source intensity correction

The value is assigned according to Table 5.2-5 for the calculation of $\Delta L_{\text{Longitudinal slope}}$ source intensity correction of traffic noise caused by longitudinal slope of highway.

Table 5.2-5 Noise Level Correction of Pavement Longitudinal Slope

Longitudinal Slope (%)	Noise Level Correction (dB)
≤3	0
4～5	+1
6～7	+3
＞7	+5

Note: This Table is only for correction of large and medium vehicles without correction of small vehicle.

The value is assigned according to Table 5.2-6 for the calculation of $\Delta L_{\text{Pavement}}$ source intensity correction of traffic noise caused by highway pavement.

Table 5.2-6 Correction of Conventional Pavement $\Delta L_{\text{Pavement}}$

Pavement	$\Delta L_{\text{Pavement}}$
Asphalt concrete pavement	0dB
Cement concrete pavement	+1--2dB

Note: This Table is only for correction of small vehicle without correction of large and medium vehicles.

⑥ Calculation of Distance Attenuation $\Delta L_{\text{Distance}}$

When the hourly traffic volume on traffic lane is over 300 Nr. /h, $\Delta L_{\text{Distance}} = 10 \lg \frac{r_0}{r}$

When the hourly traffic volume on traffic lane is below 300 Nr. /h, $\Delta L_{\text{Distance}} = 15 \lg \frac{r_0}{r}$

r--distance from center line of equivalent traffic lane to receiving point, m;

$$r = \sqrt{r_1 r_2}$$

(4.3-6)

r--distance from receiving (predicted) point to center line of near lane, m;

r_2 --distance from receiving (predicted) point to center line of distant lane, m;

r_0--distance from center line of equivalent traffic lane to reference point, r_0=7.5m;

⑦ Calculation of Ground Absorption Sound Attenuation ΔL_{Ground}

$$\Delta L_{\text{Ground}} = -Agr$$

When sound wave travels above loose ground, or mixing ground most of which is loose ground, and when the receiving point is used for calculation of sound level A only, Agr can be calculated by the following formula

$$Agr = 4.8 - (2h_m / d)\left[17 + \left(300 / d\right)\right] \geq 0dB \tag{4.3-7}$$

Agr--attenuation value caused by ground impact, dB;

d--distance from sound source to receiving point, m;

h_m--average ground clearance of travel path, m; h_m= Area F/d, which can be calculated according to Figure 4.3-1:

If the calculation result of Agr comes to minus, Agr can be replaced by 0.

The calculation under other circumstances can be performed by referring to *Attenuation of Sound during Propagation Outdoors--Part 2: General Method of Calculation* (GB/T17247.2).

The method of estimation of average height h_m is indicated in Figure 5.2-1.

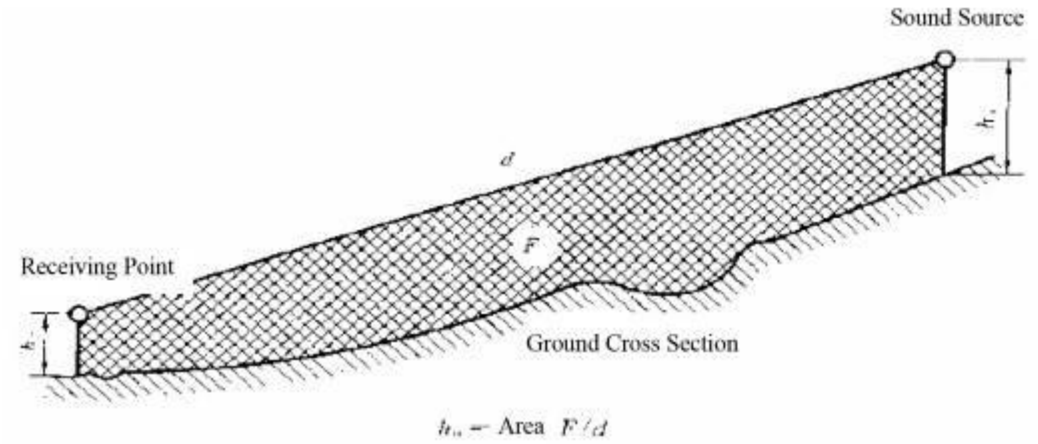


Figure 5.2-1 Method of Estimation of Average Height h_m

⑧ Calculation (4.3-8) Formula for Traffic Noise Correction Caused by Bending or Road Section with Finite Length of Highway ΔL_1

$$\Delta L_1 = 10\lg(\theta/180) \tag{4.3-8}$$

Where: θ -- angle between the two lines of sight from predicted point to each end of highway (°). See Figure 5.2-2.

Figure 5.2-2

Road Section with Finite Length Inward Bending of Highway Outward Bending of Highway

⑨ Calculation of Barrier Sound Attenuation $\Delta L_{Barrier}$

$$\Delta L_{Barrier} = \Delta L_{Forest} + \Delta L_{Rural\ house} + \Delta L_{Sound\ shadow\ zone}$$

a. ΔL_{Forest} is the barrier attenuation brought about by forest belt.

In general, the average attenuation of forest belt is calculated by using the following formula:

$$\Delta L_{Forest} = k \cdot b \tag{4.3-9}$$

Where: k--average attenuation coefficient of forest belt, assign k=-0.1dB/m;

b--width of forest belt traveled through by noise, m;

The barrier attenuations brought about by forest belt vary with areas, with the maximum not above 10dB. For instance, the attenuation properly reduces as the density of forest in northern region is small.

b. $\Delta L_{\text{Rural house}}$ is the barrier attenuation of rural buildings.

The value is assigned according to Table 4.3-8 for estimation of additional attenuation by rural civil houses that are relatively dispersed in general.

Upon noise prediction, the receiving points are set before the windows of the first row of houses. Then the estimation of environmental noise level of buildings is performed according to Table 5.2-7 and Figure 5.2-3.

Table 5.2-7 Estimation Value of Noise Attenuation of Buildings

House Condition	Attenuation ΔL	Remarks
Floor space of the first row of houses 40% to 60%	-3dB	The floor space of house is calculated according to Figure 4.3-5.
Floor space of the first row of houses 70% to 90%	-5dB	
Every increased row of houses	-1.5dB Maximum absolute attenuation ≤10dB	

Note: Table 4.3-8 is only applicable to the buildings at flat embankment and roadsides

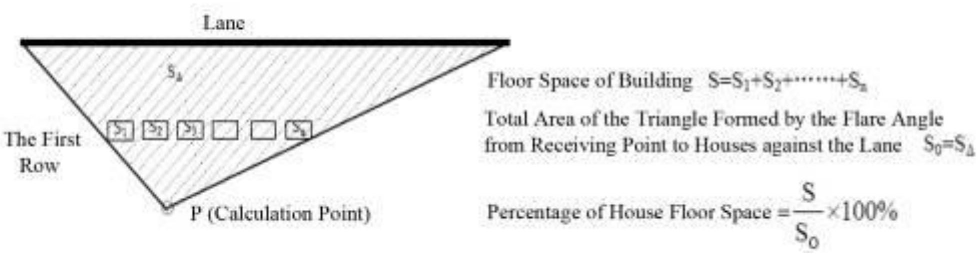


Figure 5.2-3 Schematic Diagram for Floor Space Calculation of the First Row of Houses

c. $\Delta L_{\text{Sound shadow zone}}$ is the diffraction sound attenuation brought about of predicted point at the sound shadow zone of embankment or road cutting.

When predicted point is located in sound direct zone, $\Delta L_{\text{Sound shadow zone}}=0$

When predicted point is located in sound shadow zone, $\Delta L_{\text{Sound shadow zone}}$ mainly depends on sound path difference δ.

Fresnel number $N_{\max}$ is used when the diffraction attenuation is calculated. Fresnel number is defined as:

$$N_{max} = \frac{2\delta}{\lambda} \quad (4.3\text{-}10)$$

Where: N_{max} --FRESNEL number;

λ--acoustic wavelength, m;

δ--sound path difference, m; δ is calculated by Figure 4.3-6, δ＝a+b-c；

a--distance from sound source to edges of roadbed (or top of road cutting), m;

b--distance from receiving point to edges of roadbed (or top of road cutting), m;

c--straight-line distance from sound source to acceptance (prediction) point, m;

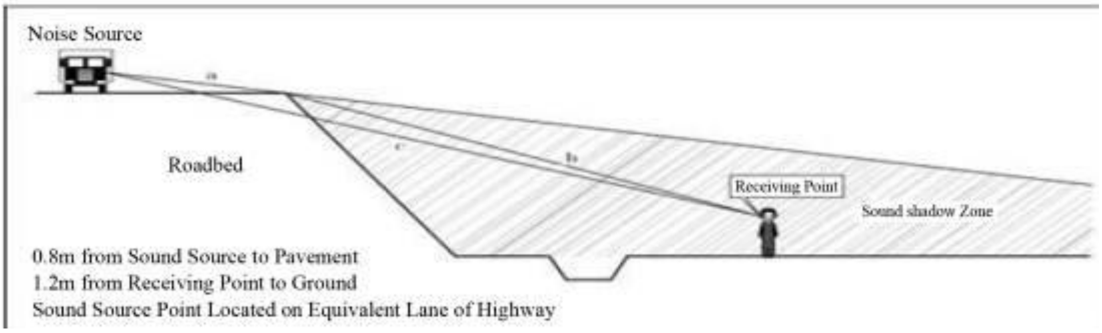


Figure 5.2-4 Schematic Diagram for Calculation of Sound Path Difference δ

The calculation mode of line source diffraction attenuation is indicated in the formula (4.3-11):

$$\Delta L_{\text{Sound shadow zone}} = \begin{cases} -10 \times \lg\left(\dfrac{3 \times \pi \times \sqrt{(1-t^2)}}{4 \times \tan^{-1}\sqrt{\dfrac{(1-t)}{(1+t)}}}\right) & (\text{when } t \le 1) \\ -10 \times \lg\left(\dfrac{3 \times \pi \times \sqrt{(t^2-1)}}{2 \times \ln(t + \sqrt{(t^2-1)})}\right) & (\text{when } t \ge 1) \end{cases}$$

(4.3-11)

Where, t=20× N_{max} /3.

3) Results of Traffic Noise Prediction

Environmental Quality Standard for Noise (GB3096-2008) is enforced for the acoustic environment of all road sections of this project. The class 4a standard is enforced within 35m from red line, class II standard beyond 35m.

Based on the prediction mode, by combining all the parameters determined for highway engineering, the road sections with largest traffic flows of trunk road, secondary trunk road and Tertiary are respectively selected for representative prediction to work out the annual predicted traffic noise value of evaluation characteristic of typical road sections along the highway. The prediction scope in this evaluation is 200m from each side of highway to center line. The traffic noise of each road section during each characteristic year under circumstances of flat roadbed and soft ground are respectively predicted, with 2017, 2027, and 2032 as prediction characteristic years.ee Table 5.2-8 for results of traffic noise prediction of each highway section. Thus it can be seen that the traffic flows of each road section during different prediction years much vary, so the predicted traffic noise values are also quite different. Generally speaking, the highway traffic noise has in some degree affected the acoustic environment of areas along highway. As the traffic volume increases, the impacts of such traffic noise are predicted to become more severe on an annual basis. The distances for reaching class 4a and II standards of traffic noise by each road section during each characteristic year under the circumstances of flat roadbed and soft ground are given in Table 5.2-9. The predicted traffic noise values in the table plainly reflect the distribution of highway traffic noise along each side, which can be used as reference for regional architectural planning.

Table 5.2-8 Results of Traffic Noise Impact Prediction for Proposed Road Unit: dB (A)

Road	Year	Duration	10m	20 m	30 m	40 m	50 m	60 m	80 m	100 m	120 m	140 m	160 m	180 m	200m
Extension part of Erwei Road (main road)	2017	Day	65.91	62.69	60.14	58.69	57.60	56.71	55.31	54.19	53.26	52.46	52.46	51.10	50.50
		Night	61.30	58.08	55.53	54.08	52.99	50.70	49.98	48.65	49.10	47.85	47.13	46.49	45.89
	2027	Day	66.97	64.04	61.67	60.25	59.17	58.29	56.88	55.76	54.83	54.02	53.31	52.66	52.06
		Night	62.41	59.48	57.10	55.69	54.61	52.97	50.73	49.85	49.46	49.06	48.74	48.09	47.50
	2032	Day	67.45	64.52	62.14	60.73	59.64	58.76	57.35	56.24	55.31	54.50	53.78	53.13	52.54
		Night	62.84	59.91	57.53	56.12	54.15	52.74	51.15	50.10	49.85	55.67	49.52	48.22	47.93
Weiba Road (secondary road)	2017	Day	64.18	60.51	58.43	56.94	55.75	54.75	53.09	51.72	50.53	49.48	48.52	47.65	46.85
		Night	59.57	55.90	53.82	52.33	51.14	50.04	48.48	47.11	45.92	44.87	43.91	43.04	42.24
	2027	Day	64.06	61.25	59.37	57.96	56.81	55.83	54.20	52.84	51.66	50.61	49.67	48.80	48.00
		Night	59.67	56.66	54.78	53.36	52.22	51.24	49.60	48.24	47.07	46.02	45.07	44.21	43.41
	2032	Day	64.31	61.50	59.62	58.21	57.06	56.08	54.44	53.09	51.91	50.86	49.92	49.05	48.25
		Night	59.71	56.90	55.02	53.60	52.46	51.48	49.84	48.48	47.31	46.26	45.31	44.45	43.65
Jingyi Road (Tertiary)	2017	Day	63.73	60.01	58.12	56.83	55.84	55.04	53.78	52.81	52.01	51.34	50.76	50.25	49.79
		Night	59.07	55.27	51.94	50.88	50.00	49.25	48.59	47.46	46.51	45.68	44.944	44.27	43.66
	2027	Day	64.90	61.10	59.15	57.78	56.72	55.84	54.43	53.30	51.52	50.78	50.11	49.49	49.18
		Night	60.29	56.49	54.53	53.17	52.10	51.23	49.81	48.68	47.73	46.91	46.17	45.50	44.88
	2032	Day	65.20	61.40	59.45	58.08	57.02	56.14	54.73	53.60	52.65	51.82	51.08	50.41	49.79
		Night	60.60	56.81	54.85	53.48	52.42	51.54	49.86	49.00	48.05	47.22	46.48	45.81	45.19

Note: Such prediction value excludes attenuation caused by road cutting, embankment and other barriers.

Table 5.2-9 Table for Predicted Distance for Reaching Class 4a and Class II standards of Traffic Noise by Each Road Section during Operation Period

Prediction Road Section	Prediction Duration		Class 4a Standard dB(A)	Standard Distance (m)	Class II Standard dB(A)	Standard Distance (m)
Main road	Year of 2017	Day	70	0	60	32
		Night	55	35	50	75
	Year of 2027	Day	70	0	60	45
		Night	55	45	50	85
	Year of 2032	Day	70	4	60	48
		Night	55	48	50	105
Secondary road	Year of 2017	Day	70	0	60	22
		Night	55	25	50	60
	Year of 2027	Day	70	0	60	25
		Night	55	28	50	75
	Year of 2032	Day	70	0	60	28
		Night	55	30	50	78
Tertiary Road	Year of 2017	Day	70	0	60	20
		Night	55	22	50	40
	Year of 2027	Day	70	0	60	23
		Night	55	22	50	65
	Year of 2032	Day	70	0	60	22
		Night	55	25	50	70

Note：Standard distance is the distance from road center

4) Traffic Noise Evaluation

According to road section prediction, if other noise attenuation factors are not taken into account, in the short term, during daytime, within the scope of influence of main roads class 4a standard can be met and at 32m away from the road center class II standard can be met; during nighttime, at 35m away from road center class 4a standard can be met and at 75m away from the road center class II standard can be met. In medium term, during daytime, within the scope of influence of main roads class 4a standard can be met and at 45m away from the road center class II standard can be met; during nighttime, at 45m away from road center class 4a standard can be met and at 85m away class II standard can be met. In the long term, during daytime, at 4m away from the road center class 4a standard can be met and at 48m away class II standard can be met; during nighttime, at 48m away from road center class 4a standard can be met and at 105m away, class II standard.

In the short time, during daytime, within the scope of influence of secondary roads class 4a standard can be met, and at 22m away, Class II standard; during nighttime, at 25m away from road center Class 4a standard can be met, and at 60m away, class II standard. In the mid-term, during daytime, within the scope of influence Class 4a standard can be met, and at 25m away from the road center, class II standard; during nighttime, at 28m away from road center Class 4a standard can be met

met, and at 75m away, class II standard. In the long term, during daytime, within the scope of influence class 4a standard can be met, and at 28m away from the road center, class II standard; during nighttime, at 30m away class 4a standard can be met and at 78m away, class II standard.

In short term, during daytime, within the scope of influence of Tertiary road Class 4a standard can be met, and at 20m away, class II standard; during nighttime, at 22m away from road center, class 4a standard can be met, and at 40m away, Class II standard. In the mid-term, during daytime, within the scope of influence of the road, Class 4a standard can be met and at 23m away, class II standard; during nighttime, at 22m away from road center Class 4a standard can be met, and at 65m away, class II standard. In the long term, during daytime, within the scope of influence Class 4a standard can be met, and at 22m away, class II standard; during nighttime, at 25m away from road center Class 4a standard can be met, and at 70m away class II standard.

The areas 105m away from each side of Main road, 78m away from each side of secondary Main road, and 70m away from each side of Tertiary of the proposed road reach class II standard for acoustic environment. It is suggested that the noise impact prediction results should be considered in planning for urban construction. Since the project is concurrently in the initial stage of planning and implementation, the traffic flow prediction and the noise prediction are both to some degree indeterminate. The prediction results put forward in this environmental impact assessment are only used as references for regional planning of Beichuan area. The environmental impact assessments shall be performed separately for each construction project when it comes to specific project construction.

5) Noise Isograms of the Representative Road Sections

Noise isograms are prepared for main roads during different assessment intervals of highway operation period, based on traffic volume and route relation. See Figures 5.2-10, 5.2-11and 5.2-12 for details.

(Translation for the following maps☺

宁张公路	Xining - Zhangye Highway
经一路	Jingyi Road
经二路	Jing'er Road
分布图	Distribution Map
图案	Pattern
声级	Sound Level
面积	Area
最大值	Maximum Value
最小值	Minimum Value
平均值	Average Value
高×宽	Height×Width
比例尺	Scale
标志图例	Legend of Sign
关心点	Concern Point

署名点 1	Signature Point 1
污染源	Pollution Source
路段 1	Road Section 1
图形	Graph
宁张公路	Xining - Zhangye Highway
经一路	Jingyi Road
经二路	Jing'er Road
铁东路	Tiedong Road
纬六路	Weiliu Road
二纬路延伸段	Extension part of Erwei Road
纬七路	Weiqi Road

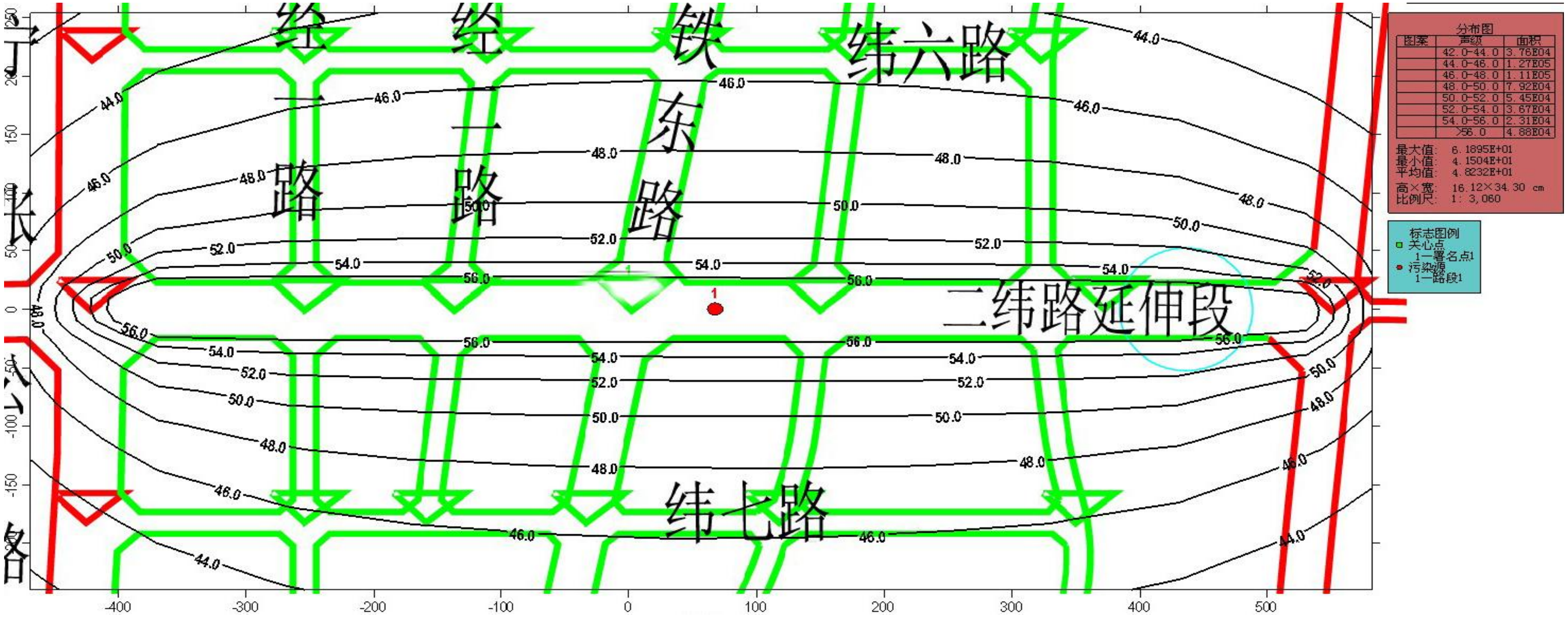


Figure 5.2-10a Isogram of Environmental Noise of Main Road during Nighttime in Short Term

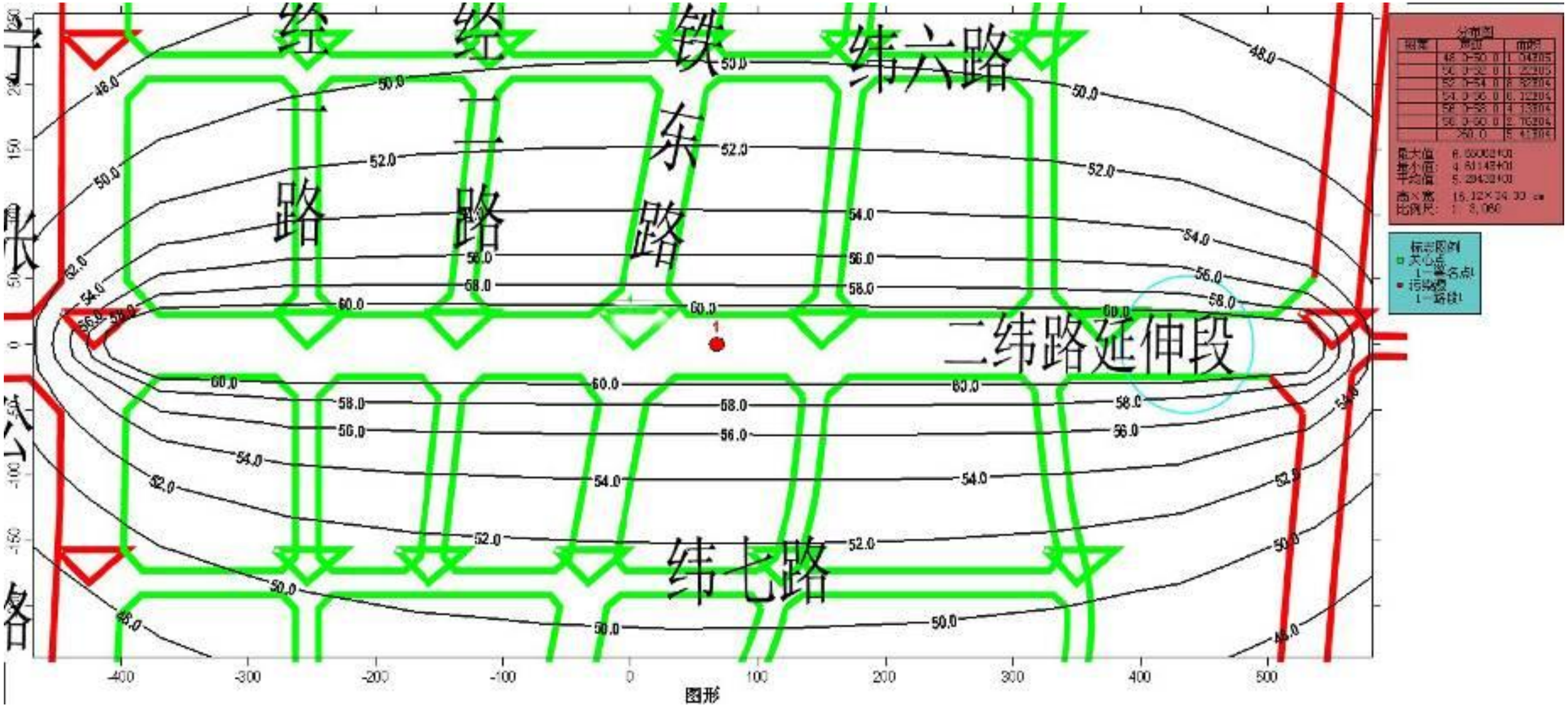


Figure 5.2-10b Isogram for Environmental Noise of Main Road during Daytime in Short Term

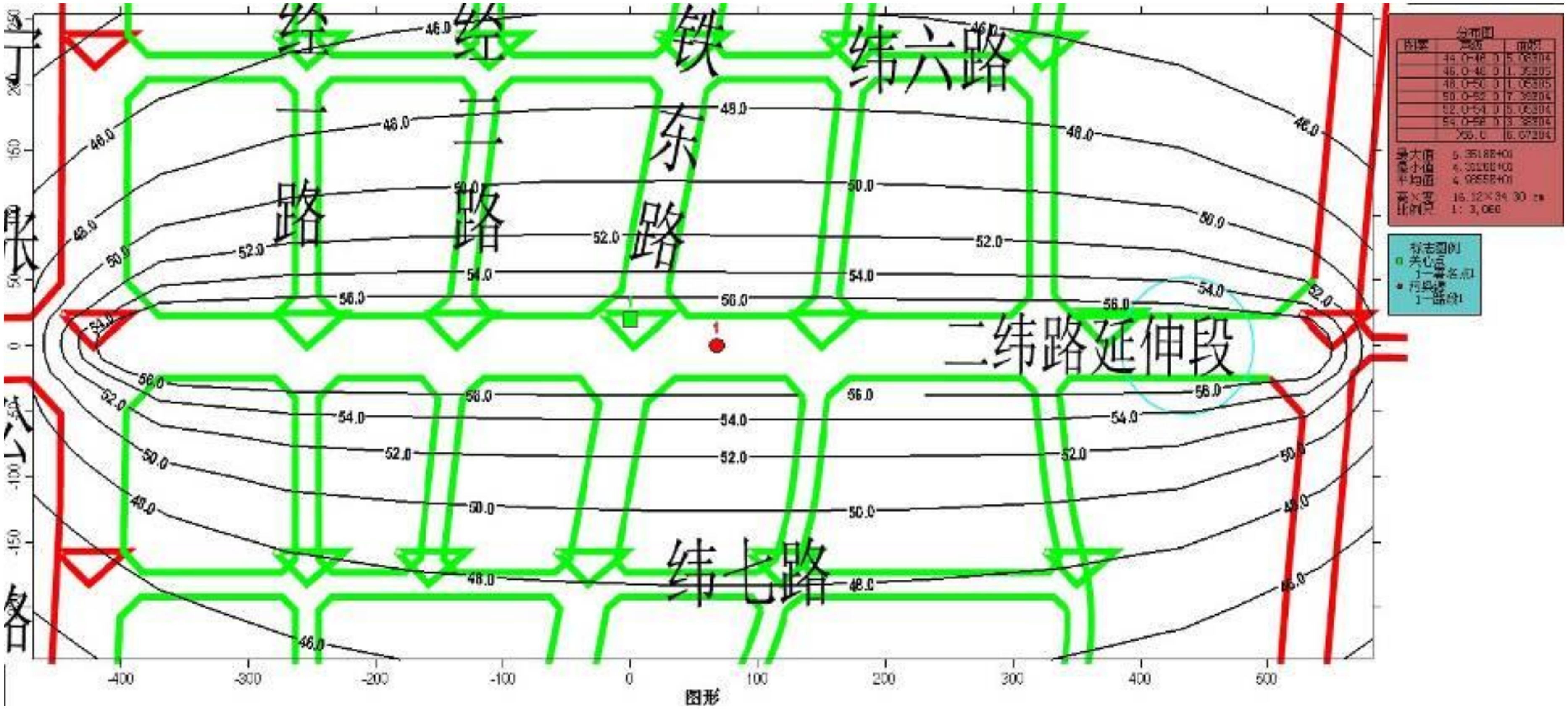


Figure 5.2-10c Isogram for Environmental Noise of Main Road during Nighttime in Medium Term

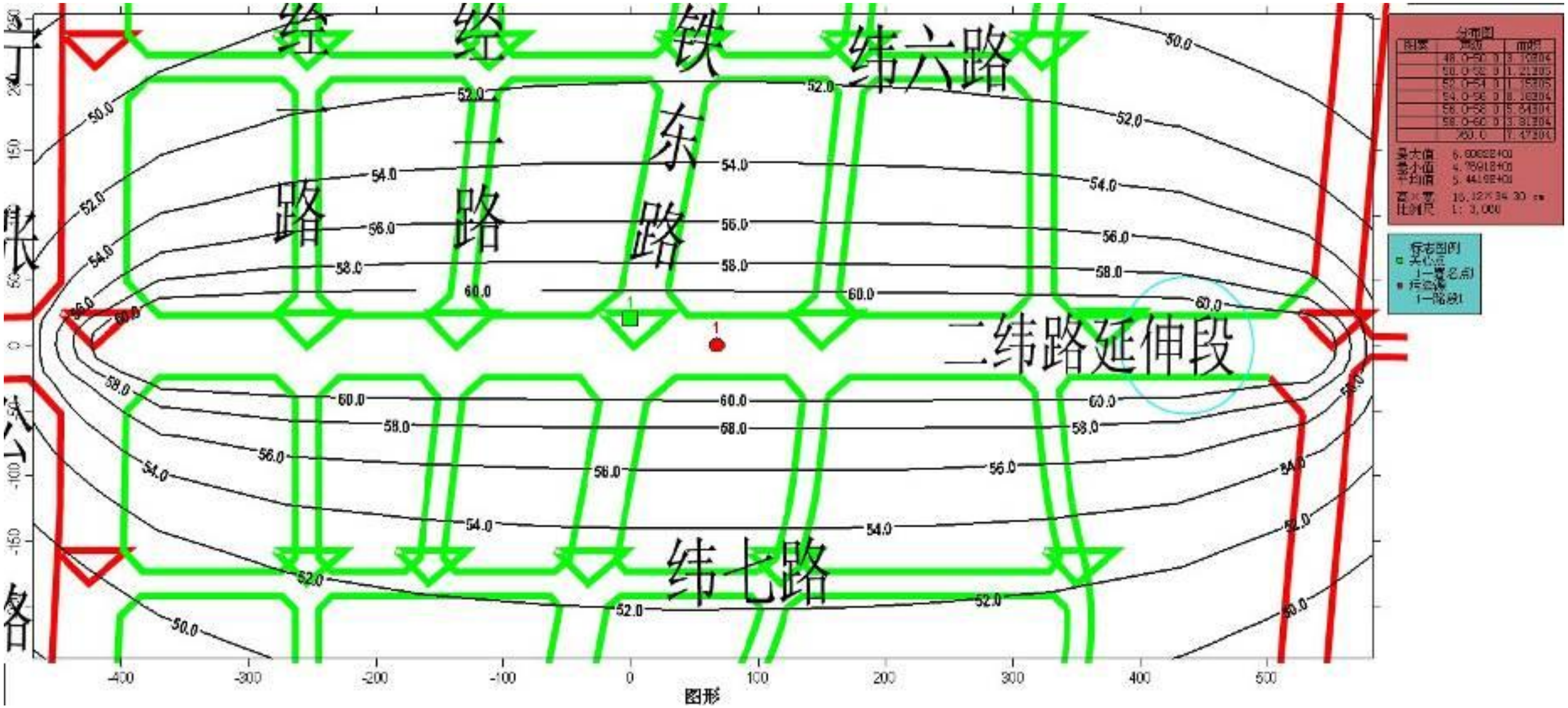


Figure 5.2-10d　　Isogram for Environmental Noise of Main Road during Daytime in Medium Term

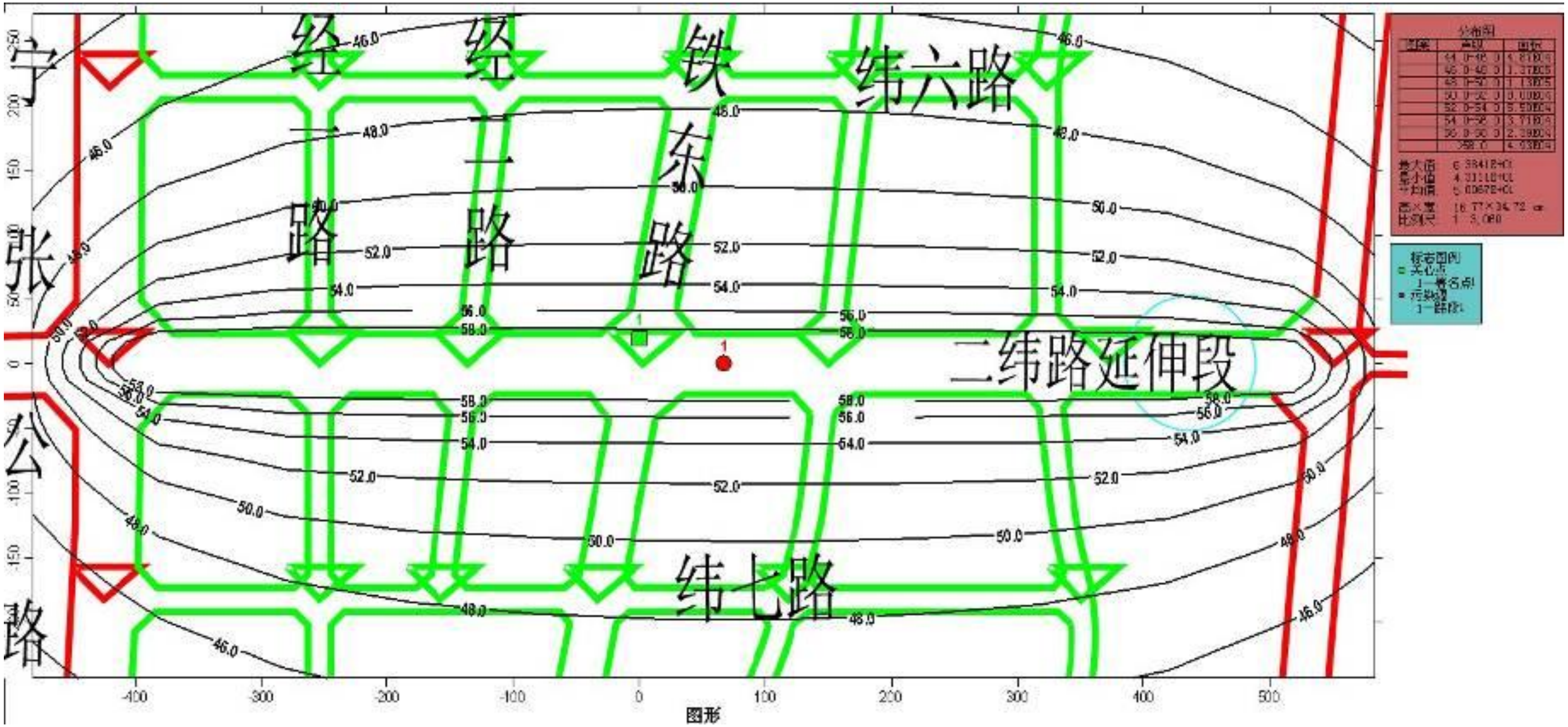


Figure 5.2-10e Isogram for Environmental Noise of Main Road during Night in Long Term

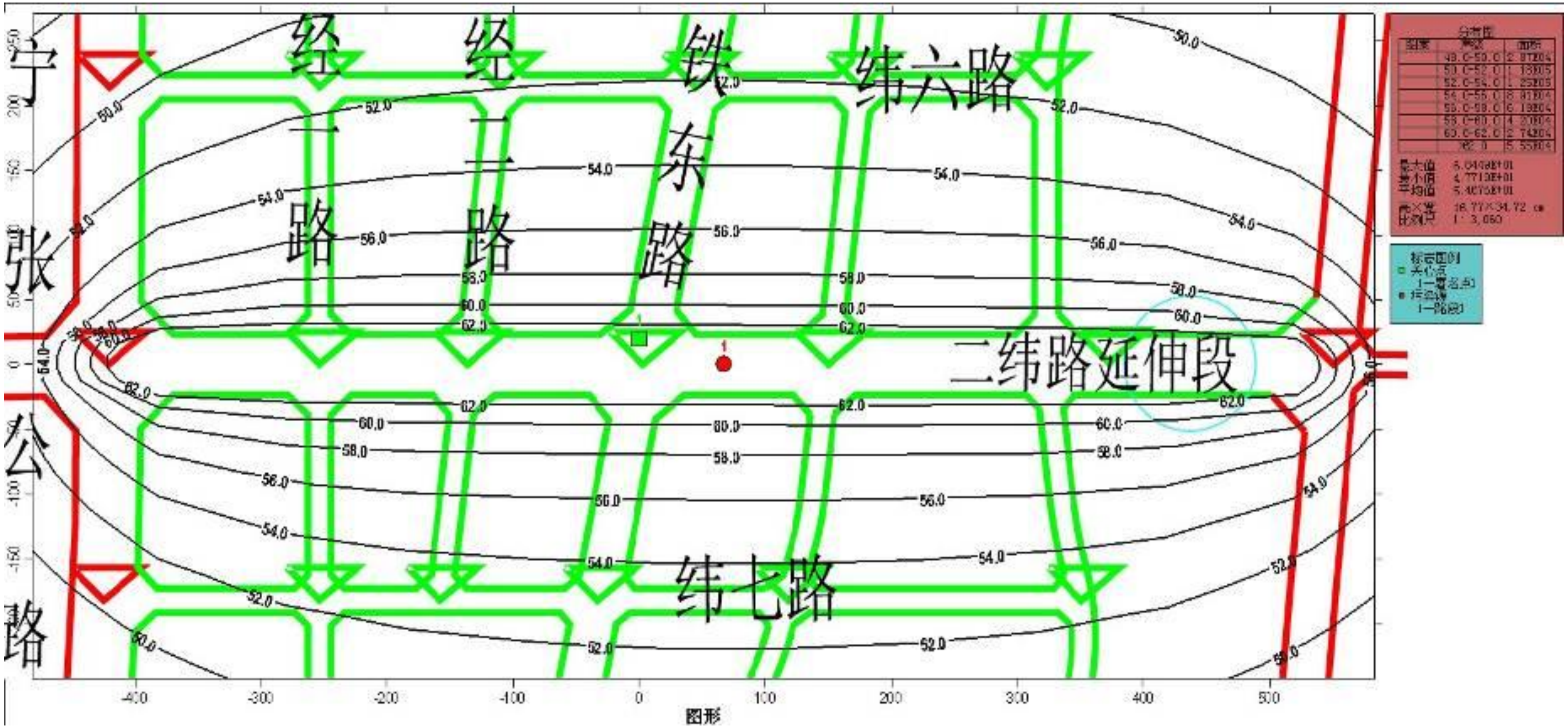


Figure 5.2-10f Isogram for Environmental Noise of Main Road during Daytime in Long Term

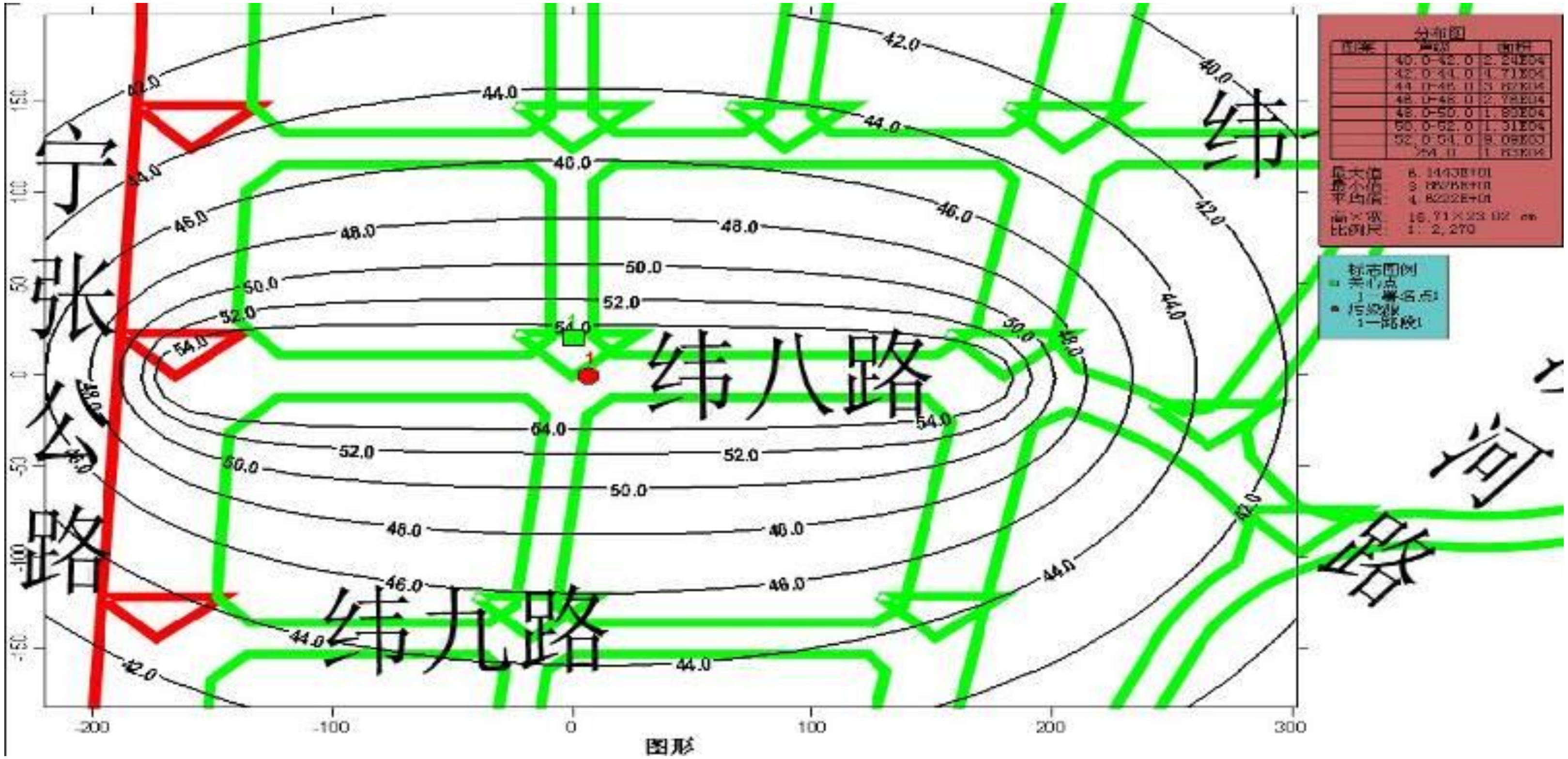


Figure 5.2-11a Isogram for Environmental Noise of Secondary Road during Nighttime in Short Term

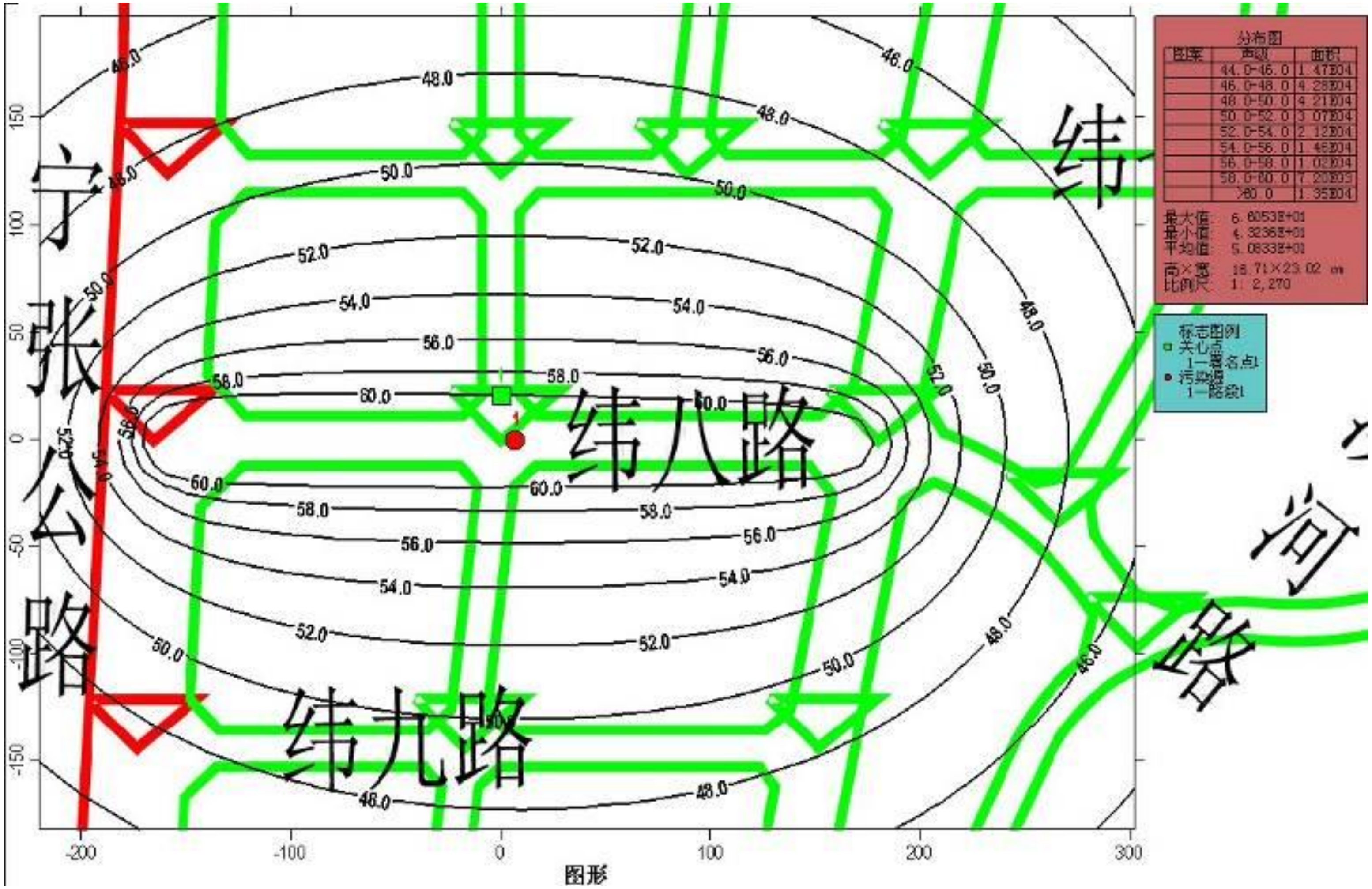


Figure 5.2-11b Isogram for Environmental Noise of Secondary Road during Daytime in Short Term

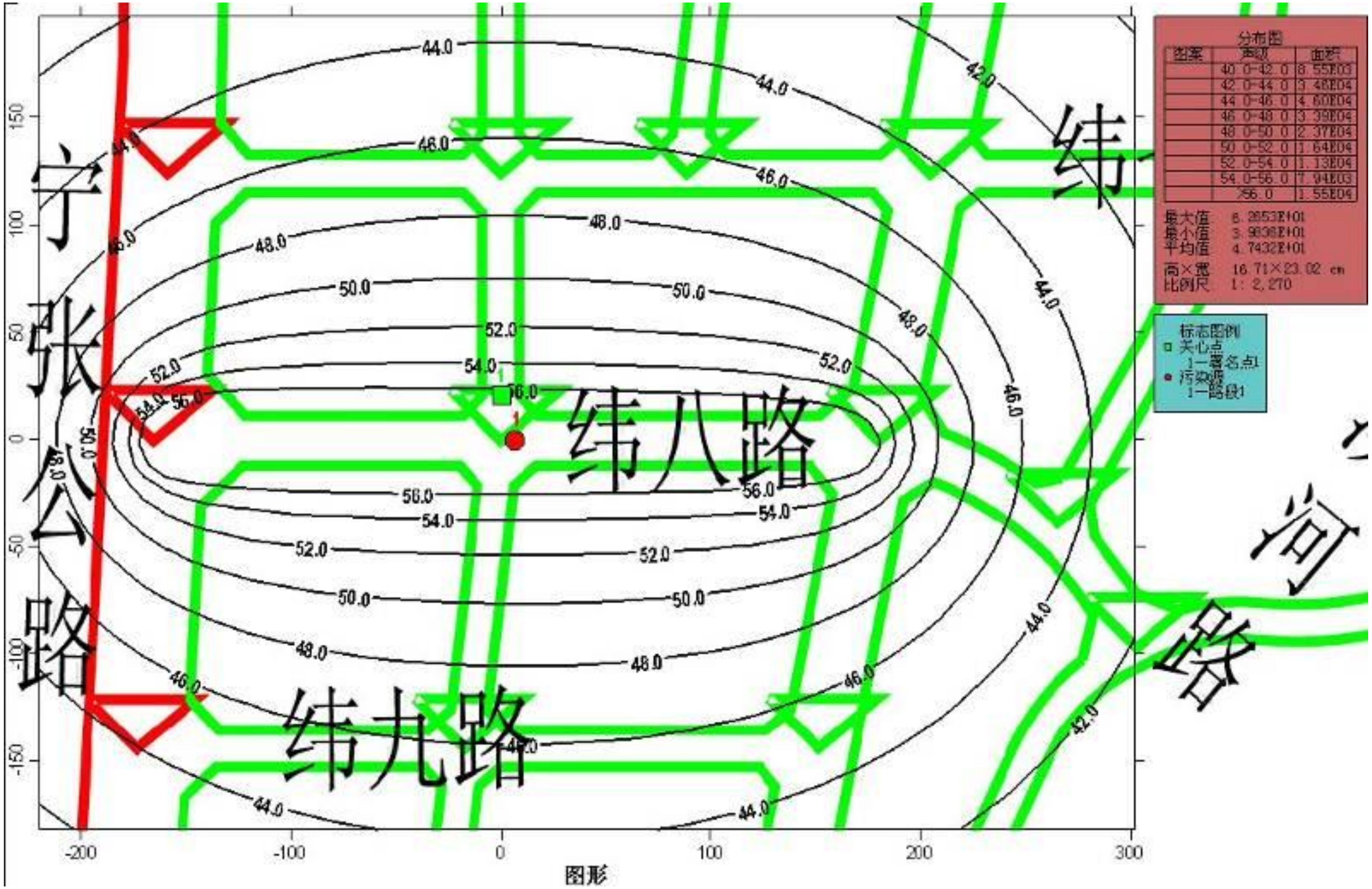


Figure 5.2-11c Isogram for Environmental Noise of Secondary Road during Night in Medium Term

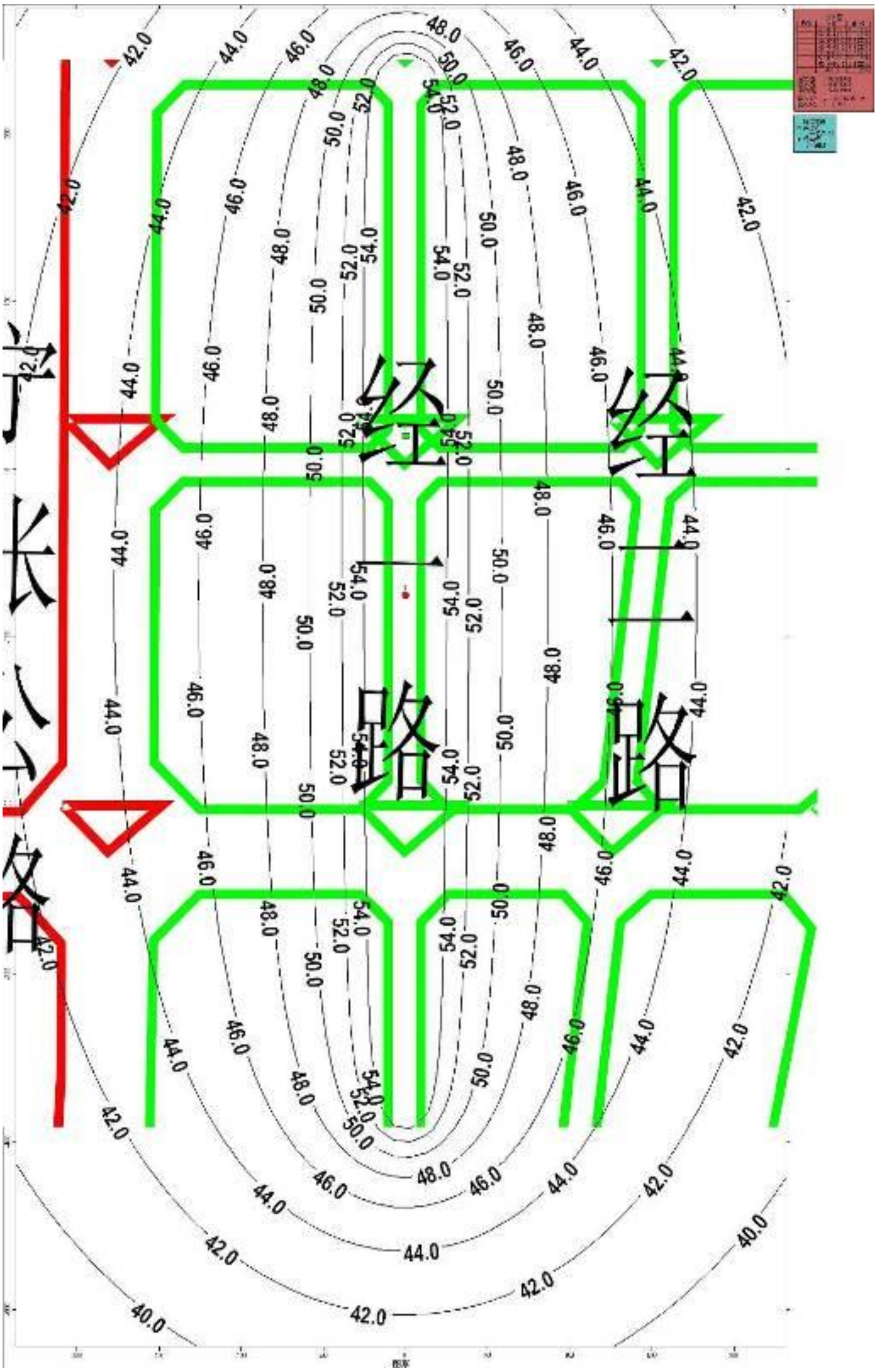


Figure 5.2-12a Isogram for Environmental Noise of Tertiary Road during Night in Short Term

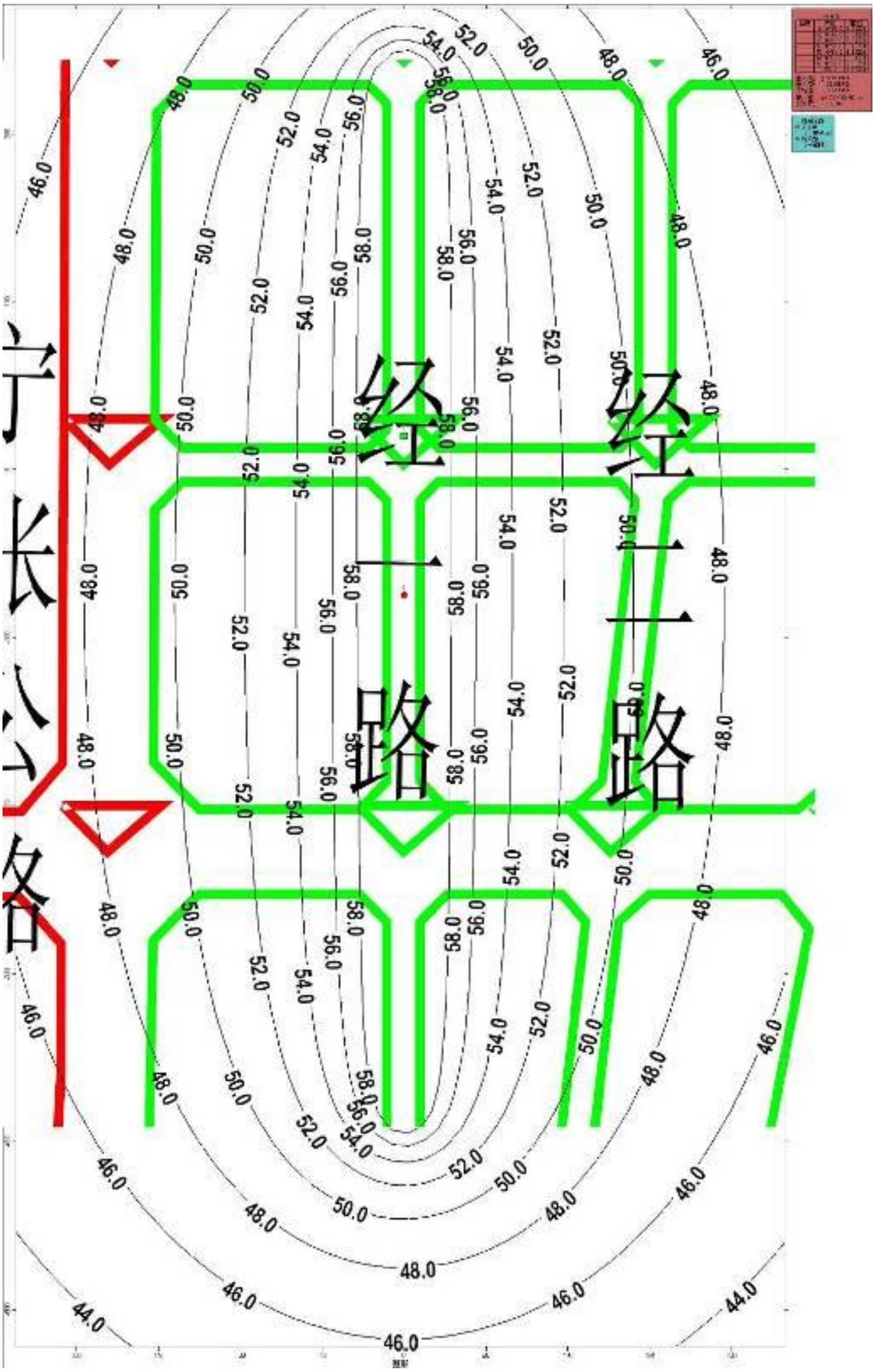


Figure 5.2-12b Isogram for Environmental Noise of Tertiary Road during Day in Short Term

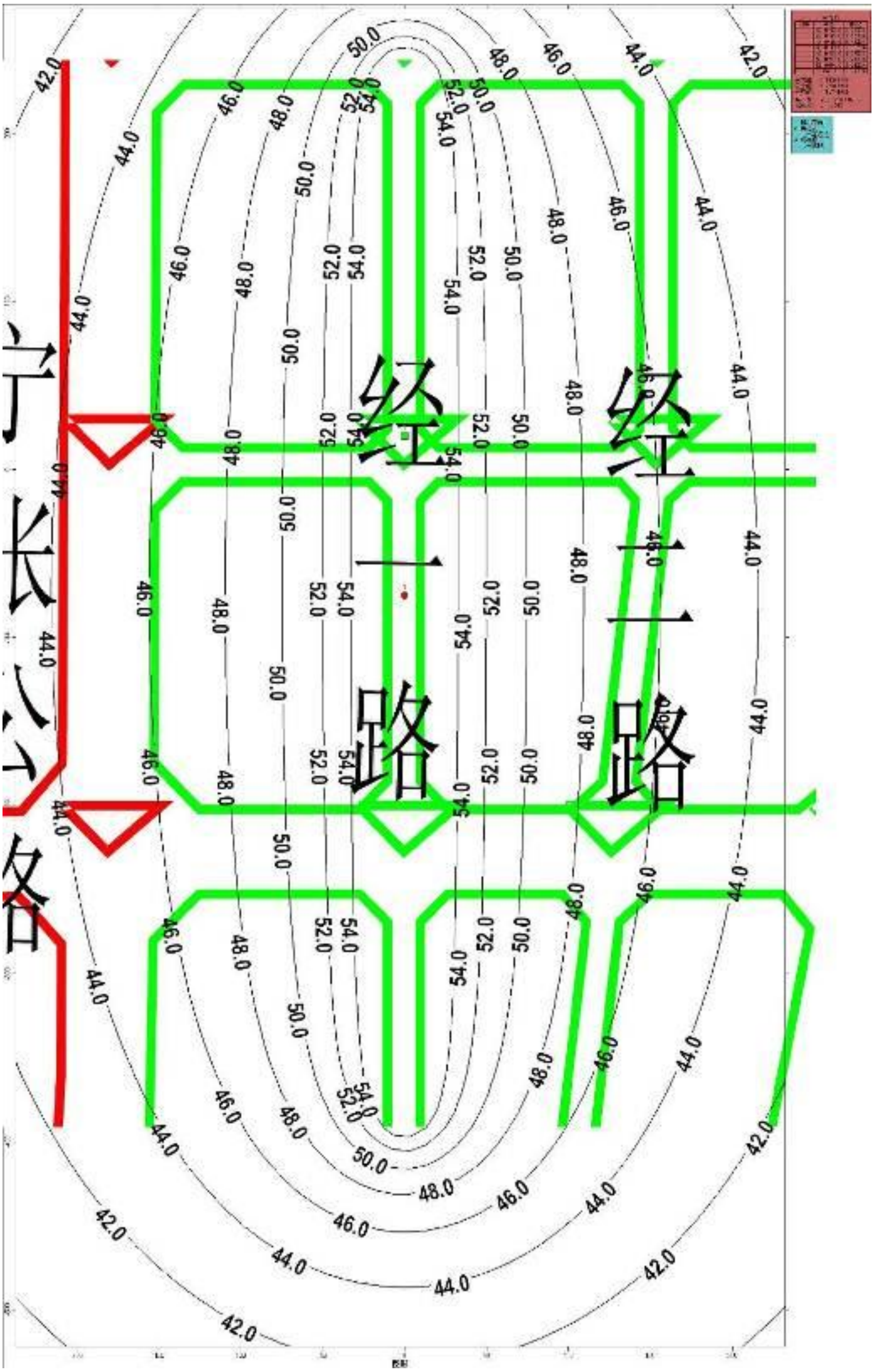


Figure 5.2-12c Isogram for Environmental Noise of Tertiary Road during Night in Medium Term

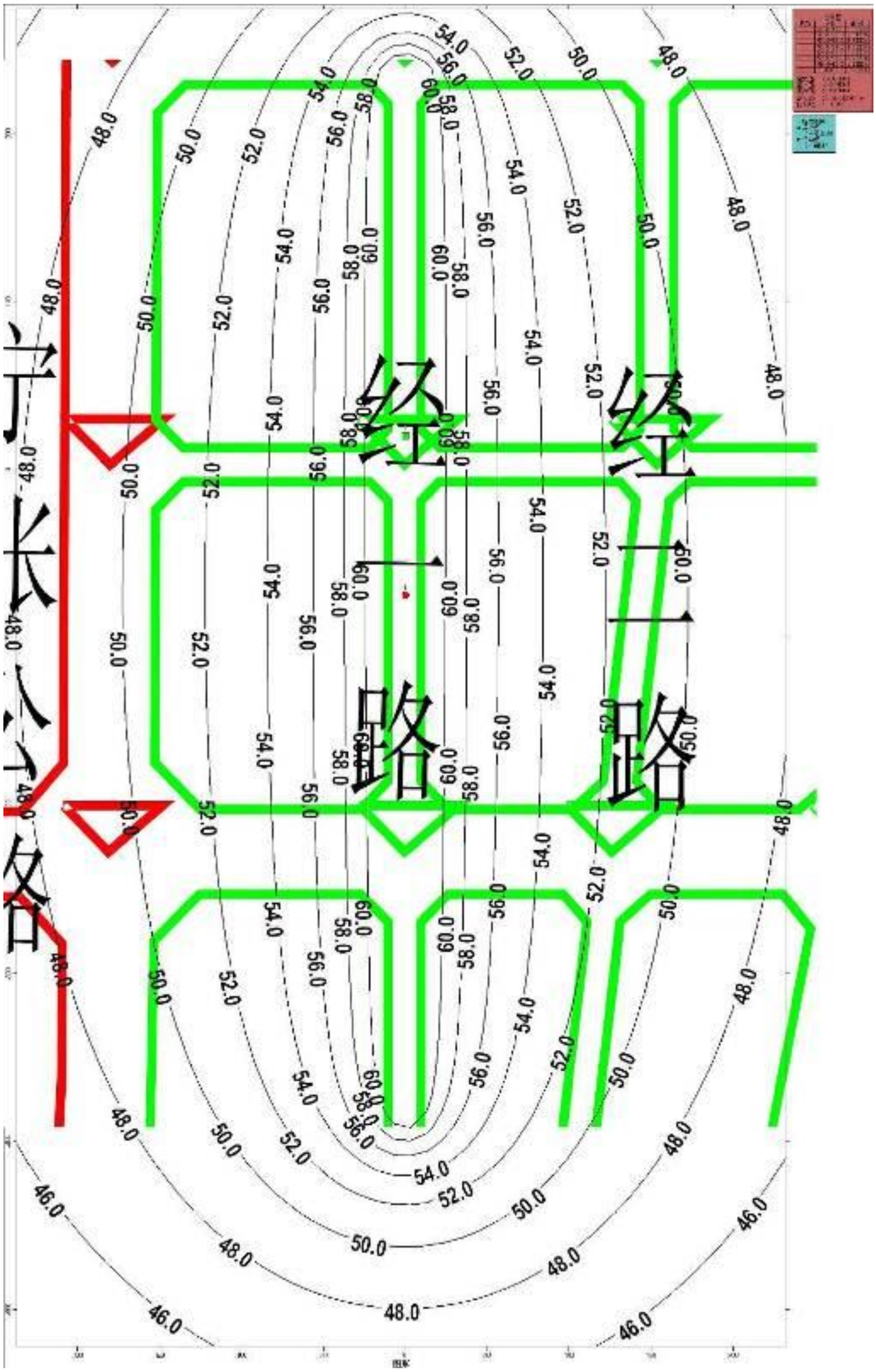


Figure 5.2-12d Isogram for Environmental Noise of Tertiary Road during Day in Medium Term

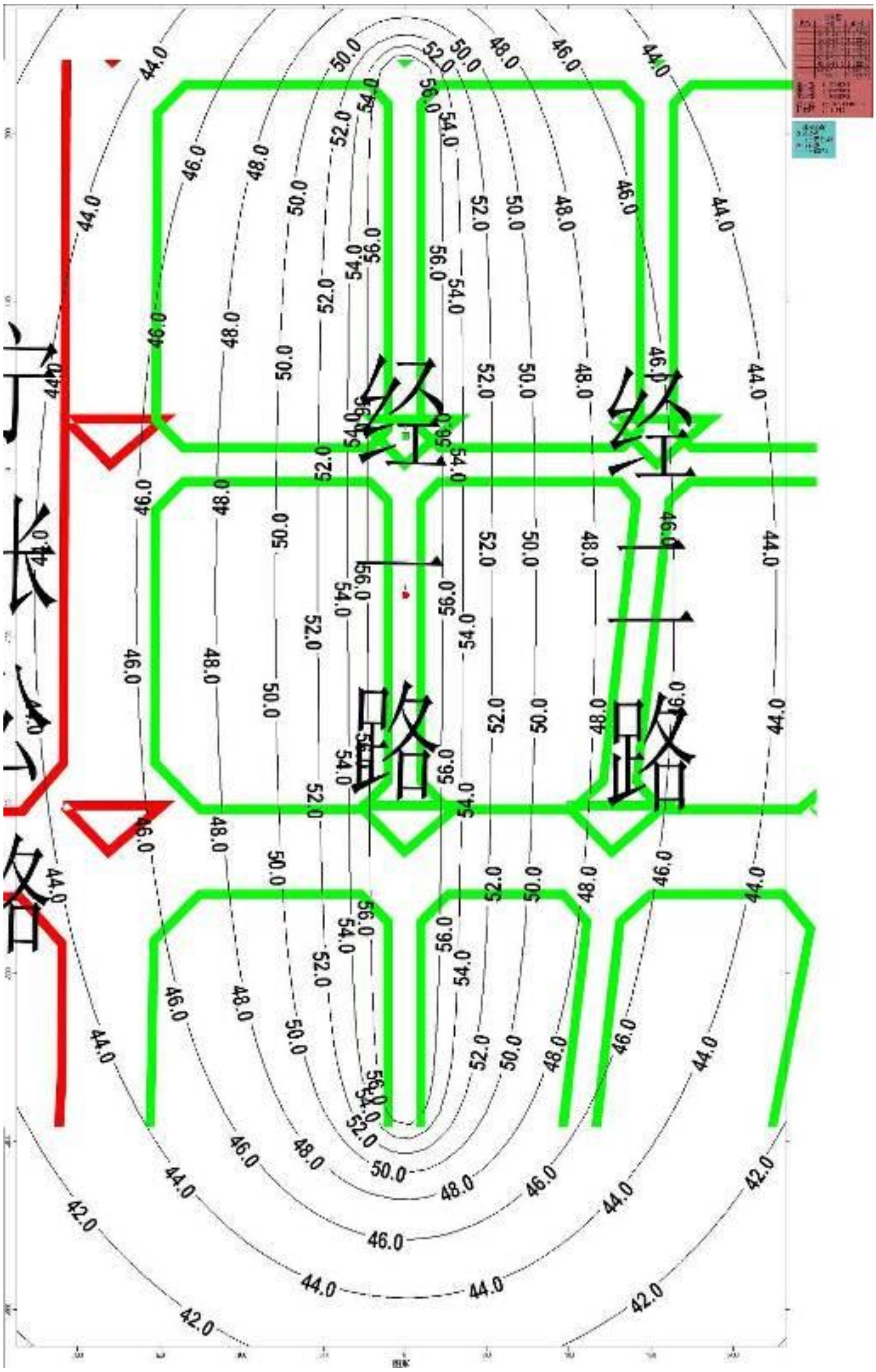


Figure 5.2-12e Isogram for Environmental Noise of Tertiary Road during Night in Long Term

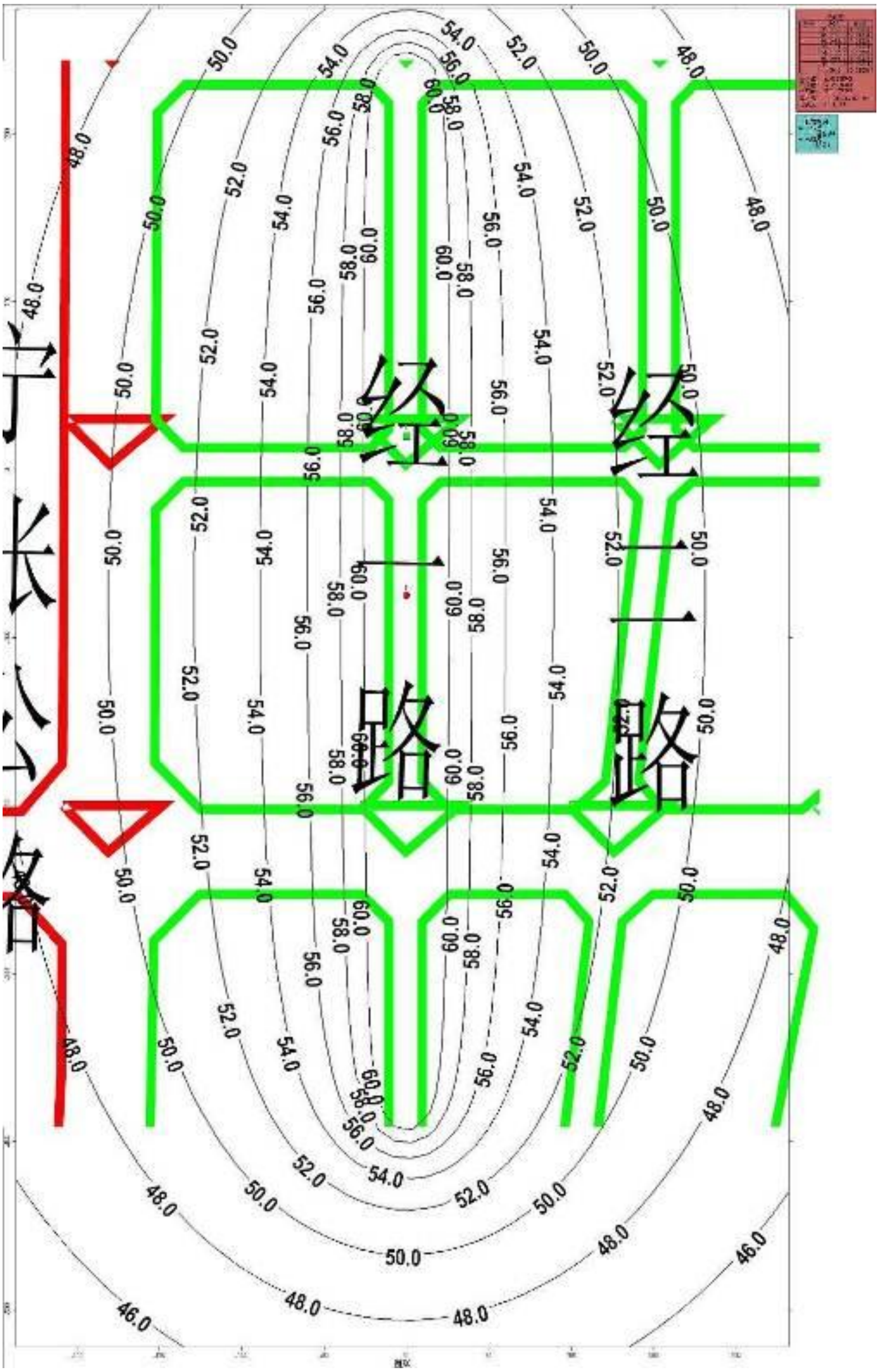


Figure 5.2-12f Isogram for Environmental Noise of Tertiary Road during Day in Long Term

6) Impacts on Sensitive Receptors in the Surrounding Area

Sensitive receptors to impacts of road construction in Beichuan Area include Kunlun College of Qinghai University and No.4 High School of Xining.

Kunlun College of Qinghai University is located on the west of Xining-Zhangye highway and will be impacted by traffic noise of the highway. More specifically, the teaching building and dormitory of Kunlun college are sideways to Xining-Zhangye highway and the planned Erwei Road, about 130 m away from Erwei Road.

No.4 High School of Xining is on the south of Beichuan Area and at the southern side of Tianjin Road, since its teaching building is directly facing Tianjin and Beijing-Tibet Expressway, it will be impacted mainly by noises of Tianjin Road and Beijing-Tibet Expressway, while the planned Tiedong Road southern extension is sideways to the teaching building, with a distance of about 130m.

Noise prediction results for these two sensitive receptors are shown in Table 5.2-10.

Table 5.2-10 Prediction of Noise Impacts on Sensitive Receptors

Sensitive Receptors	Time Period	Short Term	Medium Term	Long Term
Kunlun Collegeof Qinghai University	Daytime	57.29	57.98	58.22
	Nighttime	49.96	50.26	50.58
Xining No.4 High School	Daytime	55.91	56.32	56.56
	Nighttime	48.34	49.61	50.26

The prediction results indicate that two sensitive receptors will be impacted by noise from the planned roads, both will have daytime noise all within 60 dB(A). But during nighttime, noise exceeding the standard will occur in medium and long terms for both, and the maximal exceedance is by 0.58 Db(A).

Erwei Road and Tiedong Road southern extension are both main roads. According to prediction of noise of main roads, in the short term, at 32 m away from the road center noise may reach 60dB(A) during daytime, and at 75m away from the road center noise may reach 50dB(A) during nighttime. In the medium term, at 45m away from the road center, 60dB(A) during daytime; at 85m, 50dB(A) during nighttime. In the long term, at 48m, 60dB(A) during daytime; at 105m, 50dB(A) during nighttime.

The above mentioned two sensitive receptors are both 105m away from the main roads, so the planned roads will have little impact on them. But, since they are immediate neighbors to either Xining-Zhangye Highway or Tianjin Road and Beijing-Tibet Expressway, they are impacted mainly by traffic noise of these existing roads/expressway.

In order to reduce noise impacts on these two sensitive receptors and ensure their normal teaching activities, it is hereby suggested to construct sound proof walls for the college and school.

7) Analysis on the Noise Impacts on Surrounding Road Networks

The roads to be constructed are those included in Beichuan Area Road Plan and are categorized as main road, secondary road and tertiary road, which form an integral part of Beichuan Area road network. Construction of the roads will significantly improve connectivity of the existing road network in Beichuan area. With the completion of the project and the development of Xining economy, traffic volume will grow year by year, thus causing an increase of impacts of traffic noise.

The urban transport of Beichuan area will be mainly supported by the proposed Tiedong Road, Beiyuan Road, Erwei Road, Sanwei Road and Siwei Road. After completion of roads, the urban main roads connected to them, including Xining - Zhangye Highway, Ningzhang Road, and Erwei Road, will have their road capacities improved, and the traffic environment in Beichuan core area will be smoothed to form a complete system of Beichuan traffic routes, which will help to ease urban traffic pressure in Beichuan area and alleviate the current impacts of traffic noise of the main roads on the residents along highway. However, along with increasingly growing traffic volume, traffic noise within the urban areas of Beichuan Area will also increase to various degrees.

Therefore, with the completion of this project, the currently unreasonable road network structure of Beichuan area will be improved step by step to allow traffic diversion to reduce through traffic in urban area, and connection among the main roads will be streamlined, all of which are helpful in easing urban traffic pressure and reducing the impacts of noise on the residents along highway.

8) Impact Analysis on Road Noise of Environmental Restoration Works on River Bank and Comprehensive Treatment Project for Ditch

In addition to the noise impact caused by the road network works in Beichuan area, the environmental restoration works on river bank and comprehensive treatment works for Chaoyangdianqu also involve road construction. The analysis is as follows:

The roads involved in the environmental restoration works on river bank are mostly scenic plank roads which are mainly used for facilitating the entrance by people into area for resting and touring. The roads provided for vehicles are mainly used to catering to the need of daily maintenance and do not attract much traffic. No residents are found nearby within 200m. So the noise impact caused by such works is minor.

With respect to the roads involved in the comprehensive treatment for Chaoyangdianqu, the main task is to renovate the existing roads and the functions are to provide nearby residents with chance of exercises and touring and to concurrently provide nearby villagers with convenient transportation. The driving vehicles are mostly those of villagers' own and will not increase much due to the road construction and no significant change in the quantity and structure of driving vehicles before and after road construction will take place. Besides, the noise caused by driving vehicles can be reduced after the traffic conditions are improved. Therefore, the noise will not be significantly increased by such road construction.

(3) Atmospheric Environment

The overall quality of air environment of this project area is good. The data on air quality prediction in *Environmental Impact Evaluation Report on Chengxian-Wudu Section of Pingliang-Wudu Regional Expressway* is selected as reference for this evaluation. The analysis and comment on ambient air quality impact during operation period of this project is carried out by adopting analogy analysis method.

The ambient air quality prediction in *Environmental Impact Evaluation Report on Chengxian-Wudu Section of Pingliang-Wudu Regional Expressway* is performed based on the relevant type and calculation method in *Specification for Environmental Impact Assessment of Highways* of Ministry of Communications (JTGB03一2006). See Table 5.2-13 for traffic volume in 2015. Based on its prediction results, the NO_2 concentration in ambient air can be seen in Table 5.2-14.

Table 5.2-13 Predicted Traffic Volumes of Each Road Section of Chengxian-Wudu Section (Unit: pcu/d)

Road section\Year	2015	2025	2033
Zhifang Pivotal Flyover--Pingluo Flyover	7227	17705	34004
Pingluo Flyover-–Kangxian Flyover	7108	17438	31540
Kangxian Flyover--Ganquan Flyover	6778	16597	29961
Ganquan Flyover--Anhua Flyover	6603	15950	28655
Anhua Flyover--Majie Flyover	6491	15750	28374
Majie Flyover--Wuduxi Flyover	6258	15298	27597

Table 5.2-14 Predicted Value of Average Daily NO_2 Concentration for Chengxian-Wudu Highway (Unit: mg/m^3)

公路路段	距离 m	NO₂浓度		
		2015 年	2025 年	2033 年
纸坊枢纽立交～平洛立交	5	0.079	0.162	0.279
	20	0.071	0.144	0.246
	50	0.059	0.118	0.201
平洛立交～康县立交	5	0.089	0.171	0.266
	20	0.081	0.153	0.236
	50	0.070	0.128	0.195
康县立交～甘泉立交	5	0.092	0.171	0.268
	20	0.085	0.153	0.239
	50	0.074	0.130	0.198
甘泉立交～安化立交	5	0.080	0.155	0.248
	20	0.072	0.138	0.219
	50	0.062	0.115	0.180
安化立交～马街立交	5	0.081	0.155	0.247
	20	0.074	0.138	0.219
	50	0.063	0.116	0.181
马街立交～武都西立交	5	0.067	0.140	0.229
	20	0.060	0.123	0.202
	50	0.050	0.101	0.165
GB3095-1996 一级标准日平均浓度		0.08		
GB3095-1996 二级标准日平均浓度		0.120		

公路路段	Highway road section
距离	Distance
NO2 浓度	NO_2 concentration
2015 年	Year of 2015
2025 年	Year of 2025
2033 年	Year of 2033
纸坊枢纽立交~平洛立交	Zhifang Pivotal Flyover--Pingluo Flyover
平洛立交~康县立交	Pingluo Flyover-–Kangxian Flyover
康县立交~甘泉立交	Kangxian Flyover--Ganquan Flyover
甘泉立交~安化立交	Ganquan Flyover--Anhua Flyover
安化立交~马街立交	Anhua Flyover--Majie Flyover
马街立交~武都西立交	Majie Flyover--Wuduxi Flyover
一级标准日平均浓度	Class I standard for average daily concentration
二级标准日平均浓度	Class II standard for average daily concentration

The predicted traffic volume for this project can be seen in Table 5.2-2. The traffic flow in short term exceeds that of Chengxian-Wudu road section in 2015. However, in view of the small traffic flow and the weak environmental impact in short term, the traffic flows in medium and long terms of this project are both lower than those of Chengxian-Wudu road section. According to the prediction results of Table 5.2-14, all the tail gas emissions in short, medium and long terms of this project can reach class II standard for ambient air quality.

As the single vehicle emission standard executed by China is increasingly higher, the tail gas emission of single vehicle will be continuously reduced and the impact of highway on the air condition along highway will be gradually weakened.

(4) Water Environment

The wastewater produced during road operation period mainly originates from initial rainwater. The special rainwater collection pipe network and LID rainwater treatment scheme are provided for this project to effectively mitigate the impact of rain and to improve water quality.

(5) Ecological Environment

The roads involved in this project are mostly located in Beichuan area, including the road network in Beichuan core area, the roads in environmental restoration works on river bank and those in treatment works for Chaoyangdianqu which are all located in the urban area of Xining and classified into municipal roads. The involved ecology is mainly urban ecological environment. Performed by combining the urban area planning of Xining, the road construction will not cause serious ecological barrier block, with minor impact on urban ecological environment.

(6) Solid Waste

The domestic garbage generated by pedestrians along road can be recycled by providing garbage cans at roadsides. Meanwhile the urban health advocacy work shall be properly carried out to encourage pedestrians to throw garbage into garbage cans instead of littering at random and to maintain urban environmental sanitation.

(7) Risk

The risk of road operation mainly originates from the leakage after traffic accident caused vehicles carrying hazardous articles. The roads this time are all located in the urban area of Xining. According to the administrative provisions on vehicles transporting hazardous articles of Xining, the relevant vehicles are prohibited to pass through the urban area, so such risks can be completely eradicated in terms of administration. However, in order to guard against such risks, the relevant risk prevention requirements and emergency plans are still put forward in this environmental impact assessment. See Attachments 12 and 13 to *Management Plan for Environmental Protection* for details.

5.2.5 Reclaimed Water Plant

(1) Social Environment

During operation period, the reclaimed water is mainly supplied to Beichuan core area for urban road sprinkling and greening. If the water quality does not reach standard, great foul smell may generate, affecting the urban environment.

(2) Acoustic Environment

A water storage pool will be provided in the proposed reclaimed water reuse works of wastewater treatment plant. Two submersible pumps are placed in the pool with one in use and the other in reserve. The pumps are laid under water and their noise is minimal due to the attenuation of water and can be further reduced by sealing the pool with a cover. Therefore, the noise generated by submersible pumps of the project will not significantly affect the residents nearby.

(3) Atmospheric Environment

A reclaimed water pool will be provided in the proposed reclaimed water plant within the existing wastewater treatment plant. The water stored in the pool originates from the wastewater that has been processed by wastewater treatment plant and will generate a little stink. However, the area of the pool is small and the emitted foul smell will not significantly affect the surrounding environment after sealing with a cover.

(4) Water Environment

The wastewater during operation period mainly originates from the domestic wastewater of working staff. Such work relies on the No.5 wastewater treatment plant under construction. After construction completion, the life of working staff can rely on the living facilities of No.5 wastewater treatment plant and will not cause random discharge of domestic wastewater.

(5) Ecological Environment

The wastewater that has been processed by No.5 wastewater treatment plant will be recycled by reclaimed water reuse works of wastewater treatment plant of this project as urban greening water, whose quality can meet the relevant requirements of *Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Water Consumption* (GB/T 18920-2002), but whose salt content and organic material will remain higher than the greening water sources currently commonly used such as tap water and surface water. The use of reclaimed water can bring about soil salinization while bringing nutrient substances. Therefore, the subproject named "Study of Effects of Reclaimed Water Reuse on Soil and Vegetation of Xining Municipality" is specially established in the World Bank project this time. The pilot project with reclaimed water as greening water is carried out to study the effects of reclaimed water as greening water on vegetation and soil, providing scientific basis for the large-scale promotion of reclaimed water use in Xining in the future.

The areas of the project where reclaimed water is proposed for greening are small and are mainly distributed along both sides of Binhe Road for pilot. And the traditional green belt sprinkling scheme is applied for both sides of Jingyi Road for comparison. After implementation of the project, the soil and vegetation in these two areas will be tracked, compared and monitored to study the adaptability of each species to reclaimed water and concurrently monitor the salinization degree of soil. Once salinization of soil is found to be too severe to be suitable for vegetation to grow, problems can be solved by timely replacing soil or greening water source.

Therefore, the pilot project with reclaimed water as greening water will not seriously destroy and affect ecological system.

(6) Solid Waste

The reclaimed water reuse works of wastewater treatment plant relies on the No.5 wastewater treatment plant under construction. After construction completion, the life of working staff can rely on the living facilities of No.5 wastewater treatment plant and will not cause random discharge of domestic garbage by effectively collecting them.

(7) Risk

Only one reclaimed water pool is involved in reclaimed water plant works and it has received anti-seepage treatment, so the probability of leakage is minor to the extent that there is basically no risk of leakage.

And the sterilization of reclaimed water relies on No.5 wastewater treatment plant works. The risk prevention requirements and contingency plans on chemical medicines used for sterilization have been put forward in the environmental impact assessment of No.5 wastewater treatment plant works and have passed the examination and approval of Environmental Protection Department of Qinghai Province.

5.2.6 Low-impact Development and River Bank Environmental Improvement

(1) Social Environment

The ecological environment within project area can be greatly improved after completion of the project and can provide people with living environment of high quality. But there might be problems as follows:

① Due to weak environmental awareness, the enterprises and residents along both banks of Beichuan River still discharge wastewater and garbage into Beichuan River, which is likely to weaken the beautification function played by bank environment regulation works.

② The improvement of Beichuan river bank environment will promote the local economic development. Beichuan area is oriented as business financial center, and no polluting enterprises will enter the area. But too many incoming shops may also cause new pollution problems to Beichuan area. Besides, the development of tourism will also cause risk for water quality of Beichuan River, because the expanding visitors will generate much more wastewater and garbage. Wastewater drainage and garbage dumping by the increasingly growing restaurants, hotels and teahouses around Beichuan River may also put new pressure on water quality preservation of Beichuan River.

③ After completion of regulation works, good places for leisure are provided for Xining citizens. It is foreseeable that, with improvement of water quality and formation of leisure greenbelt along the river, some citizens will be attracted here for a tour, and some will even swim in the clean river. Drowning accident, even fatal accident may be caused if no attention is paid to this and consequently cause negative comments by citizens on the works.

④ The environmental impact factors of Beichuan River bank include tour road, toilet, garbage can and greening. In lack of strengthened management, tour road may suffer potential safety hazard from traffic congestion, and the surrounding green environment may also be damaged by visitors. Clean toilet is recommended to be constructed and the location besides major landscape shall be avoided as toilet is to influence urban landscape and emit unpleasant odor. If garbage can is not cleared timely, garbage will be piled up and generate foul smell. Greening works can improve regional landscape, but the risk of species survival rate exists in greening works, so relevant experts shall be consulted to select suitable species.

(2) Acoustic Environment

This project component aims at purification of rainwater along Beichuan River banks through greening and LID treatment, so as to upgrade landscape. No noise source or noise impact exists.

(3) Atmospheric Environment

This project component aims at purification of rainwater along Beichuan River banks through greening and LID treatment, so as to upgrade landscape. It will change the current situation of the river banks where construction wastes are found piled up at random, and will also reduce dust generation, thus being helpful for improving ambient air quality.

(4) Water Environment

The implementation of works of this project component can alter the current situation that construction wastes along the banks are piled up at random and washed away by rainfall during rainy season into Beichuan River. The implementation of LID can buffer the rainfall, increase retention time, reduce the rainfall carrying sediment into river, and meanwhile purify water quality, helpful for changing the current situation of dirty and turbid water in Xining.

After implementation of the project, citizens will head for a tour one after another. So the rational arrangement of public sanitary latrines within the area is needed to provide visitors with convenience. Meanwhile, the domestic wastewater generated by visitors can be effectively collected and be delivered by the municipal sewage collection pipe network to wastewater treatment plant for treatment so as to maintain the environment health of Beichuan River banks.

(5) Ecological Environment

1) Impact on Land Utilization

After implementation of the project, the impacts on land use pattern are mainly centered on Beichuan area. The current land use types are mainly village land and wasteland along Beichuan River banks. After implementation of the project, the reconstruction will be performed by combining urban planning, and the ecological environmental restoration and landscaping of Beichuan River banks will be carried out with the help of greening and rainfall low-impact development project.

Although the majority of original land use types within area scope are to be changed by implementation of the project, the goals of such changes are to provide better dwelling, living and touring environments. While improving the urban infrastructure, consideration is concurrently given to ecological protection with the ecological environment in the area improved. Therefore, after implementation of the project, the local land use is not only free from negative impact, but more beautiful natural environment will also be created.

2) Impact on Terrestrial Ecological System

Currently, terrestrial ecological system in the region mainly includes artificial ecological system, which mainly comprises human, crops and domestic animals, with relatively few other types and quantities of animals & plants. For this reason, food chain and food web formed are relatively simple. The ecological system is weak in resisting external interference.

After implementation of the project, an area mainly for human activities will be formed in residential area and commercial facility area. Planting a large number of native plants and other locally suitable plants will not only increase types and number of regional plants, but also provide a more suitable living environment for surrounding animals as well as attract more animals to come here for inhabiting and propagating.

Thus, components of the terrestrial ecological system change from people as single subject to multiple native animals & plants as subjects. At the same time, with the increase of species, food chain and food web will become complex and strong in resisting external interference.

Therefore, implementation of the project will not only improve ecological system structure within the region to a certain extent, making the ecological system develop in the direction of varied compositions and complex nutrition flow, but also improve stability of regional ecological system.

3) Impact on Agriculture

In the region, industrial structure is dominated by agriculture. The local villagers live basically by depending on growing crops. Remote sensing data show that farmland in the region is mainly the irrigated land. After implementation of the project, those farmlands will not be cultivated. Part of them will be used for construction, while the remaining will be greenbelt.

After implementation of the project, the original agricultural ecological system will be gradually recovered to artificial greenbelt through adoption of natural measures and artificial measures. This will reduce farmland, bringing adverse impacts on regional agricultural production, e.g., decreasing local agricultural output and reducing economic income of local farmers to a certain extent. However, those impacts will not last long, besides, farmland area can be compensated by reclamation of land another place to recover total arable land balance in the region and eliminate local adverse effect.

Therefore, implementation of the project generates relatively small impact on local agriculture. Adverse impacts caused can be relieved by taking corresponding measures.

(6) Solid Waste

After implementation of the project, with improvement of water quality and formation of leisure greenbelt along the river, some citizens will be attracted to come here to play, and a good leisure place can be provided for Xining's people. However, with the increasing of people, a large number of domestic garbage will be produced; therefore, rational garbage collection points and public toilets shall be set for convenience of visitors and effective collection of domestic garbage, so as to maintain environmental health.

(7) Pest management Plan

Since the project will establish greening area by planting trees and grasses, it may cause increase of pesticide usage in operation and maintenance process, which means increased responsibility for control of pests and plant diseases in the project area and threat to ecological security in the project area to some extent. Nevertheless, Xining has accumulated rich experience in pest and plant diseases control from similar projects and programs for greening of its South Mountain and North Mountain it has already implemented till now, through proper selection of tree and grass varieties, Xining is capable of effectively preventing large scale pest and plant diseases from happening. Besides, Xining is located in relatively cold and dry northwestern part of China, with lower incidence of pest and plant diseases. To ensure sound development of agricultural, eco-systems in the project area and ecological security, Xining has prepared an Pest Management Plan for the project area based on its existing pest and plant diseases control and management system.

(8) Landscape

In the project, 600,000m^2 region along banks of Beichuan River will be renovated, with specific work contents including rainwater treatment system, field renovation, field landscape engineering and other supporting facilities (including field lighting, water supply of field landscape engineering, scenic road in the field & house for maintenance, sanitation facilities, etc.

According to Xining local climate condition and geology & landform, landscape engineering will be carried out mainly by locally planting trees and rationally allocating arbors, bushes and ground covers, so as to make plants seasonally beautiful, have forest line and crown canopy line when growing healthily. Weeping willow is mainly used as street trees, with flowers & plants and ground covers, flowering shrubs and sub arbors successively allocated around. The plants get higher layer by layer, representing a picture of green landscape with orderly different heights. Plants used mainly include weeping willow, silk tree, clove, cathay poplar, reed, peony, purple-leaf amur barberry, dry celandine, osmanthus heterophyllus 'Jinye', etc. By implementing landscape engineering, a landscape system featured by urban landscape containing trees and rivers can be formed on both banks of Beichuan River, enabling the landscape along Beichuan River an important part of Xining landscape system and providing an environment-beautiful leisure place for surrounding citizens.

In the project, such supporting facilities as field footpath system, lighting system and sanitation facility will be constructed. According to design scheme of feasibility study, the design of such supporting facilities can closely reflect the landscape orientation of Beichuan River, in which citizens' use demand for relevant facilities is considered. For example, 30 signposts are set in the area in such a manner that viewer can view landscape with appropriate angle, direction and distance, and disabled viewer can also view landscape conveniently. Relevant systems shall be established in which layers are provided with appropriate-size spaces. The seats for leisure shall be designed to be matched with trees and suitable for people to relax. Garbage cans are set in such place where wastes are easily thrown away when people in walking and relaxing pass through or stay for a long time, and shall be set to be combined with landscape engineering in design and to be fully integrated into the surrounding environment. Primary and secondary scenic roads are clear. The design index of footpaths can satisfy use of corresponding functions. The footpaths are laid in trees along rivers, forming an elegant touring environment which is matched with whole landscape. To facilitate management, a house for management is also constructed for support. It is recommended that the house for management shall be designed by fully considering landscape features in the area, adopting environmentally friendly materials and combining LID design scheme, so that the house for management can be matched with nature and form a beautiful leisure environment.

5.2.7 Comprehensive Treatment Works for Ditch

(1) Social Environment

① According to introduction by villagers in Shuangsubao Village, only irrigation station conducted publicity on environmental protection. Because of insufficient environment publicity, villagers’ environmental awareness is generally weak, so that the residents along both banks of Beichuan River may still discharge wastewater and garbage into torrential flood ditches, which is likely to weaken the function played by environment renovation project in ditch mouth.

② The reason why residents throw garbage into ditch may be that sanitation facilities are not sufficient, or that sanitation facilities are provided but garbage truck needs too much time to collect and transport the garbage. Therefore, the residents have to throw garbage into ditches. If sanitation work can still not be improved after the implementation of the project, the implementation effect of the project will be greatly reduced.

(2) Acoustic Environment

This project component mainly involves gully improvement for Liujiagou and Shengou gullies and Chaoyangdianqu canal, during which no acoustic environment pollution will be caused.

(3) Atmospheric Environment

This project component mainly involves gully improvement for Liujiagou and Shengou gullies and Chaoyangdianqu canal, during which atmospheric environment will not be polluted.

(4) Water Environment

This project component mainly involves gully improvement for Liujiagou and Shengou gullies and Chaoyangdianqu canal. Its implementation will not cause wastewater discharge, so it won't cause pollution to water environment.

(5) Ecological Environment

This project component mainly involves gully improvement for Liujiagou and Shengou gullies and Chaoyangdianqu canal. The ecological environment can be improved by road hardening & landscape engineering of side slope, wastewater interception and improvement of currently dirty, disorderly gullies.

(6) Risk

After implementation of gully improvement activities, there is basically no environmental risk. However, a certain safety hazard will be generated due to relatively large elevation difference and deep water, therefore, protective fences shall be provided at both sides of ditch to prevent surrounding visitors from falling down.

5.2.8 Cumulative Impacts

(1) Strengthen Wastewater Collection and Improve Water Environment

In Xining Municipality, overall problems with water environment are embodied in dirty water and muddy water and can be summarized as water pollution, shortage of environmental water, solid wastes and sediment deposition of river. If without appropriate measures taken, water environmental problems in Xining Municipality will get increasingly severe. Implementation of the project including urban wastewater collection pipe network, integrated river bank environmental improvement, reuse of reclaimed water and integrated gully improvement, may reduce wastewater discharge and improve ditch & people's living environment. After completion of the project, Xining water environment will be partially improved in short term. In the long term, the project will obviously improve water environment through building strong capacity for wastewater collection, and thus is of great significance in terms of cumulative impacts on water environment.

(2) Save Water Resource

The project involves works for wastewater interception main pipes, integrated river bank environmental improvement, reuse of reclaimed water and integrated gully improvement. Projects related to this project include No.3, No.4 (under construction) and No.5 (under construction) WWTPs, and their main wastewater interception pipes.

In the project, main wastewater interception pipes will be used to collect the wastewater that is currently directly discharged into Beichuan River and Xichuan River as well as the wastewater in Beichuan area, and discharge the collected wastewater into No.5, No.4 and No.3 WWTPs respectively. Under the project, a demonstrative reclaimed water plants will be constructed within No.5 WWTP. Therefore, treated wastewater that is currently discharged into rivers will be re-used. After the operation of re-use works of reclaimed water, utilization rate of water in Xining Municipality will be significantly improved.

(3) Reduce Water and Soil Loss

This project will contribute to continuously improve ecological environment in the project area by supporting land leveling and trees &grass planting in Beichuan River area, slope protection and gully improvement in Liujiagou and Shengou. Increase of vegetation coverage and reduction of soil erosion can effectively control water and soil losses in the region, and further reduce content of sediment entering the rivers and improve currently muddy water in Xining Municipality.

In conclusion, by supporting wastewater interception pipe network, gully improvement and construction of reclaimed water plant in Xining, the project can reduce direct wastewater discharge, increase water utilization rate and improve people’s living environment.

The cumulative impacts of the project are summarized in Table 5.2-15.

5.2.9 Indirect Impacts

In addition to the above mentioned impacts, implementation of the project will bring long term impacts on the northern urban areas of Xining, especially Beichuan Area.

The core area of Beichuan Area is positioned as commercial, financial, cultural and administrative and residential area of the city. After project implementation and along with moving in of a great amount of public and private institutions, enterprises and residents, ancillary structures of various kinds will be put into use consecutively.

Wastewater collection pipes constructed under the project can effectively collect wastewater from different sources in the area and transport the wastewater to No.3 WWTP for treatment, so that potential adverse impacts on water environment can be avoided. In accordance with development positioning of Beichuan in the development plan, no pollution-related enterprise will be introduced into the area. Therefore, wastewater in Beichuan Area will all be sewage and can meet inflow quality requirement of No.3 WWTP, and, after being treated, the wastewater can meet discharge standard.

Construction of ancillary roads in Beichuan Area is designed based on consideration of Beichuan Area development plan, and will provide good framework and grids to favor future transport development of Beichuan Area in line with functional zoning of various land plots, thus making it possible to ensure that noise control standards of various buildings can be met. All of these will facilitate building of a harmonious society in Beichuan Area.

Furthermore, rainwater collection pipes, non-barrier facilities, lighting facilities and greening area to be established under the project will all contribute in various forms to upgrading image and public service of Beichuan Area and improving living standard of people, which, in turn, will help Beichuan Area to attract more investments and more public and private institutions, enterprises and residents to come and settle in Beichuan Area, and thus realize rapid development.

Table 5.2-15 Summary of Cumulative Impacts

Ecological Elements	Past Activities	On-going Activities	Activities under This Project	Future Activities	Cumulative Impacts
River Water Qualtiy	① In Xining, 4 WWTPs have been established, including No.1, No.2, No.3 WWTPs and Chengnan (South) New District WWTP. Their total designed capacity is 250 thousand m^3/d, incl. 85 thousand m^3/d for No.1 WWTP; 42.5 thousand m^3/d for No.2 WWTP; 100 thousand m^3/d for No.3 WWTP; and 22.5 thousand m^3/d for Chengnan (South) New District WWTP(Phase 1). Their current actual treatment is close to 200 thousand m^3/d. ②Up till now, totally 915 km of wastewater collection pipes has been installed in Xining. Newly installed pipes are of separate system for rainwater and sewage respectively, the existing pipes in old areas are of combined system that will be changed to separate system step by step.	①No.4 and No.5 WWTPs are under-construction, both with a designed capacity of 30 thousand m^3/d; ②Wastewater intercept ion main pipes along north bank of Xichuan River is now under-construction. ③ Till now, Xining has successfully implemented its first independent World Bank funded project, i.e. Xining Flood and Watershed Management Project. Implementation of the project enabled Xining to complete sewage and rainwater collection pipes of 72.5 km, with 66,300m^3/d of wastewater collected from 103 outlets in the city, which has greatly upgraded wastewater collection ratio of Xining.	This project will support wastewater interception main pipes along south bank of Xichuan River, wastewater interception main pipes along east and west banks of Beichuan River, and wastewater collection pipes in Beichuan Area, which will result in collection of wastewater of 68 thousand m^3/d.	①No.6 and No.7 WWTPs with ancillary pipes are planned to collect wastewater in Chengdong New District and Dongchuan District and Nanchuan Industrial Zone. No.6 WWTP has a designed capacity of 100 thousand m^3/d, and No.7 WWTP 80 thousand m^3/d; ② As per Master Plan of Xining, WWTPs are to be distributed to allow for concentrated or disperse treatment of wastewater, treatment ratio shall be at least 90% and treated amount 440 thousand m^3/d at the end of planning period.	① Along with continuous implementation of projects for wastewater collection and treatment, Xining's wastewater collection ratio has been gradually increased. Currently, its wastewater collection ratio is about 75.5%, with about 50 thousand m^3/d of sewage water directly discharged into river from surrounding areas of the city proper. Additionally, the existing No.1, No.2 and Chengnan WWTPs are still using Class-2 discharge standard, without nitrification process and resulting in high content of ammonia nitrogen in discharged water. Currently reuse of reclaimed water from sewage treatment is not yet implemented. ②Implementation of this project will effectively collect wastewater from areas along the banks of Beichuan River and Xichuan River, with a total collection amount of 68 thousand m^3/d. Collection and treatment of wastewater will greatly reduce pollutants entering in rivers and thus upgrade river water quality. ③Along with completion of No.6 and No.7 WWTPs, Xining will gradually increase its wastewater collection ratio and reduce pollutants entering rivers. Wastewater collected will amount to 440 thousand m^3/d at the end of planning period.

(Continued) Table 5.2-15 Summary of Cumulative Impacts

Ecological Elements	Past Activities	On-going Activities	Activities under This Project	Future Activities	Cumulative Impacts
Water Resources	① Water environmental capacity of rivers in Xining has saturated. Water resources of Huangshui river basin (excluding Datong River) only accounts for 3.5% of the total of the province, whereas its water resources utilization ratio reaching more than 51%. Along with rapid social and economic development, domestic, industrial and agricultural water uses are increasing sharply, resulting in water diversions exceeding the bearing capacity of some river sections. What's more, uneven temporal and spatial distribution of water resources reduces available water environmental capacity in main and branch rivers, self-purification capacity of rivers and environmental bearing capacity of water resources are markedly reduced. ② In order to conserve water source, Qinghai provincial government and Xining municipal government have imposed compulsory regulations to urge to 'start to shut down self-supply groundwater wells from 2003 and put an end to use of self-supply groundwater wells in 2005, start from 2010 to gradually shut down groundwater wells used by water supply company in Xining.' As a result, No.1 and No.2 water supply plants have been closed, and No.4 and No.6 water supply plants will be only used as stand-by water supply sources for Xining. Duoba water supply plant will be transformed to only for industrial use by Ganhe industrial zone.	Phase 1 Reclaimed water plant within No.3 WWTP is now under-construction, with a designed capacity of 35 thousand m^3/d, to be used to supply water to Dongchuan industrial zone, so as to realize comprehensive water resources utilization and thus save water.	This project will support construction of a demonstrative reclaimed water plant within No.5 WWTP. The reclaimed water will be used for road watering and greening in Beichuan Area, with a scale of 5,000 m^3/d. Additionally, by using LID design concept, rainwater will be collected and purified for uses of greening to realize conservation of water resources.	Xining is speeding up its implementation of reclaimed water reuse programs/projects. As is defined in Master Plan of Xining, 'A reclaimed water reuse system shall be established based on wastewater treatment plants, so that reclaimed water can be used for industrial, urban greening, dust reduction, road watering purposes, as well as ecological replenishment water and etc. At the end of the planning period, reclaimed water use ratio shall reach 31%, totaling 164 thousand m^3/d. This will produce great benefits of water resources conservation. In line with Comprehensive Water Environmnetal Improvement and Management Plan for Huangshui River Basin, 'comprehensive planning and construction of reclaimed water facilities will be conducted to promote reuse of reclaimed water in Xining, Haidong areas and other water shortage stricken areas. Efforts should be	The first reclaimed water plant within No.3 WWTP is now under-construction in Xining, with a designed capacity of 35 thousand m^3/d. After completion of the reclaimed water plant supported by this proposed project and located within No.5 WWTP and together with the reclaimed water plant within No.3 WWTP, reuse of reclaimed water totaling 40 thousand tons per day can be realized in Xining, Along with consecutive construction of ancillary reclaimed water plants in the planned waste water treatment plants, reuse ratio of reclaimed water in Xining will be further upgraded, which is in line with the requirement defined in various plans of Xining and will produce remarkable benefits of water conservation.

				strengthened to expand areas using reclaimed water, so as to reach reclaimed water reuse ratio of above 35% in Xining Municipality. To meet the above mentioned objectives, reclaimed water plants within No.4, No.5, No.6 and No.7 and Chengnan WWTPs are planned in Xining, so as to establish a reclaimed water reuse system to continuously upgrade usage ratio of reclaimed water.	

(Continued) Table 5.2-15 Summary of Cumulative Impacts

logical Elements	Past Activities	On-going Activities	Activities under This Project	Future Activities	Cumulative Impacts
Water and Soil Erosion	① Sediment distribution of Huangshui River is largely uneven temporally and spatially, mostly concentrated in 4 months from June to September. Sediment in the river basin mainly comes from areas with water and soil erosion problem. Based on analysis of 50 year data of water-sand composition at Minhe and Xining stations on Huangshui River, long term average measured runoff at Minhe station within Qinghai is 1.496 billion m^3 and long term average measured sediment load is 16.44 million tons, long term average sediment concentration is 9.98kg / m^3. Average sediment module of Huangshui river basin is 1075t/(km^2·a). At Xining station, long term average measured runoff is 1.02 billion m^3 and long term average measured sediment load is 3.43 million tons,	Xining is making active efforts to improve gullies in its surrounding areas, with huge investments every year to support planned improvement of gullies.	This project will support ecological improvement of both banks of Beichuan Area, and improvement of Liujiagou, Shengou gullies and Chaoyangdianqu canal in the surrounding areas of the city. After completion, the project can	As stated in the Comprehensive Water Environmnetal Improvement and Management Plan for Huangshui River Basin, 'comprehensive river bank environment improvement shall be implemented, mainly including flood control, roads, greening, lighting, water landscaping activities;	Control of water and soil erosion is a long-term endeavor. Xining is located in northwestern part of China, with lower vegetation coverage and poor eco-environment. Only with continuous and strengthened gully improvement can eco-environmental improvement and erosion reduction be possible. Outstanding results have been produced by gully improvement programs implemented in Xining.

	long term average sediment concentration is 3.46kg / m^3 ②In recent years, with attention and support from leaders of governments at all levels, gully improvement projects of various forms have been implemented using funds from various sources. Meanwhile, slope land leveling and tree planting together with other water and soil conservation measures have been implemented under south and north mountainous area greening programs. Up to 2011, water and soil erosion improvement has been implemented in a total area of 147.12km^2 in 60 small watersheds in the suburb areas of the city, with 1293 stone check dams, 84 gully head improvement structures, 6 key control dams constructed. As a result, most of the gullies in the surrounding areas of Xining have been effectively improved. However, due to influences by human activities, serious pollution along gullies is still seen along some gully banks, causing severe impacts on overall water environment of Xining.	Till now, Xining has successfully implemented its first independent World Bank funded project, i.e. Xining Flood and Watershed Management Project. Implementation of the project enabled Xining to effectively upgrade flood control standard of gullies in its surrounding areas, and has greatly enhanced flood control, early warning and protection capabilities of Xining.	effectively reduce water and soil erosion by 1008 tons annually.	Supervision and control on sand mining from and solid waste dumping into the river channel should be strengthened to further improve eco-environment along the river, vegetation coverage ratio along the river banks should be further increased by continuously implementing water and soil conservation and ecological recovery programs in Xining, so as to reduce discharge of sediment and pollutants into the river. Gully improvement is a long-lasting environmental undertaking of Xining. Through continuous improvement, serious water and soil erosion situation will be gradually altered, making it possible for eco-environmental improvement.	As of 2011, totally 60 small watersheds in the suburb area of Xining had been improved, covering a total area of 147.12km^2. After implementation of the proposed project, annual reduction of soil and water erosion can reach 1008 tons. Continuous improvement of gullies in the surrounding area of Xining will help to gradually realize the objectives defined in Comprehensive Water Environmnetal Improvement and Management Plan for Huangshui River Basin.

6 Water and Soil Conservation

In order to control and reduce new water and soil loss caused during construction of road works, construction of reclaimed water plant and pipe trench excavation in the project, project production construction and safety must be guaranteed, water & soil resources must be protected, and ecological environment must be improved. Since water & soil conservation scheme has not been prepared for the project, in the evaluation, preliminary estimate is performed for water and soil losses caused by work disturbance based on clarification of current situation of water & soil conservation in evaluation area, besides, water & soil conservation measures suitable to the project are also put forward.

6.1 Current Situation of Regional Water and Soil Loss

(1) Region Zoning of Water and Soil Erosion

Xining Municipality is located in the transition area between Loess Plateau and Qinghai-Tibetan Plateau with serious water and soil loss, and belongs to the fourth sub-region of hilly and gully region in terms of divided type area of water & soil loss in Loess Plateau. According to Notification on zoning of Important prevention Region for Water and Soil Loss issued by People's Government of Qinghai Province and map of 3-region zoning for water and soil loss in Qinghai, it is determined that planned area is located in the important treatment region for water and soil loss in Qinghai, with main erosion type being water erosion.

(2) Current Situation of Water and Soil Loss

Administrative region of Xining Municipality is one of most serious regions for water and soil loss in the province, with an area of water and soil loss being about 5832 km^2, accounting for 72.4% of the municipality area. Thereinto, the area of water and soil loss in the downtown is about 150 km^2, accounting for 39.5% of total area of the downtown. Rainfall, landform and soil are the fundamental factors affecting water and soil loss, while human activities accelerate the process of water and soil loss on the basis of natural factors. The interaction of heaven, earth and man widens the scope of water and soil loss, deepens degree and increases hazard, greatly damaging ecological environment in the region, influencing people's production and life and restricting economic development.

In Huangshui river basin, the water and soil loss is serious and covers large area with obvious regional difference, and is mainly reflected in water erosion, followed by gravity erosion and wind erosion. Regional water and soil loss is mainly caused by rainstorm erosion. Soil erosion is mainly reflected in slope surface erosion, gravity erosion of ditch bank and headward erosion of ditch head. In ditch with small basin, the ground components mainly include red soil, diluvium and glacial deposit. The soil layer here mainly contains gravel, pebble, rock block and other big particles, and is thin with loose structure, therefore, in case of a rainstorm, sediment carried by ground runoff will enter into ditches, leading to downcutting on ditch bottom, collapse of ditch bank and forward movement of ditch head. Flood and debris flow disasters are consequently caused. The main ditch with small basin is mainly "U" type being wide and deep with relatively small gradient being about 12%, while small branch ditch is mainly "V" type and the transition type of "U" and "V", with relatively big gradient being about 16%. Except for secondary woodland and terrace land with gradient being less than 5 degree, most areas suffer water erosion. Gravity erosion is mainly reflected in scope surface collapse and ditch bank collapse, which extensively occur in middle and lower streams of Huangshui River. Wind erosion mainly occurs in grassland with small erosion area. In Huangshui River basin, the water and soil loss reaches an area of 13,000 km^2, and is mainly distributed in the transition area of low hill region & high hill region and the low hill region, with erosion modulus increasing from west to east. Serious water and soil loss is distributed in the middle & short low hill regions with the erosion of sunny slope being the most serious and annual average soil erosion modulus being 5000t/km^{-2}. Moderate water and soil loss is mainly distributed in the middle part of low hill regions with annual average soil erosion modulus being 2000t/km^{-2}. Mild water and soil loss is mainly distributed in the transition area from low to high hills with annual average soil erosion modulus being 500t/km^{-2}. Current situation of soil erosion in Beichuan area is shown in Figure 6.1-1.

The municipality has an average soil erosion modulus being about 2300t/km^{-2}, as a result, Huangshui River reaches the sediment content being 7-75kg/ m^3 and annual average sediment runoff being 580,000t. Serious water and soil loss not only takes away soil with fertile earth surface to reduce agricultural output, but also exert severe impact on industrial production and town development and make fragile ecological environment more fragile.

(3) Hazard of Water and Soil Loss

①Water and soil loss exacerbates occurrence of flood and drought and other natural disasters, makes land more barren, leads to movement forward of ditch head, shrinks tableland area, causes undercutting of ditch bed, expands ditch bank, generates gully, and damages farmland & village & road. Moreover, a large number of sediments flow into ditch, reservoir and irrigation channel deposit, damaging water-and soil-retaining properties of land and growth condition for plant.

②Water and soil loss makes agricultural production condition unimproved for long time, erodes fertile soil of surface layer, reduces fertility, leads to land desertification, impairs productivity, makes grain yield low and unstable, and leads to grain yield of slope cropland being generally under 50kg. As results, local people's life is greatly influenced and sustainable development of economy is restricted.

③Water and soil loss leads to large content of sediment, water for irrigation and human & animal can therefore not be guaranteed, affecting comprehensive development and utilization of water resource.

Since most towns are located in river valley, coupled with man-made environmental destruction, rainfall is little and concentrated. Consequently, administrative region of Xining Municipality suffers serious water and soil loss, with loss area accounting for more than 62% of the municipality area. Water & soil loss and local debris flow will not only cause loss of topsoil and damage on agricultural production condition, but also damage such urban infrastructures as road & bridge and house, resulting in huge losses of lives and properties of people.

6.2 Overview of Prevention Against Water and Soil Loss

Currently, in Xining Municipality, treatment of water and soil loss has been carried out for 23 small watersheds in the areas of city suburb, Datong County, Huangyuan County and Guojia Village & Sitai Village of Pingan County, with an area of 90.54km^2 being treated.

In recent years, benefited from care and attention of government leaders at all levels, fund has been raised through multiple channels, various forms of water and soil conservation work have been carried out. What's more, some water conservation and treatment measures including land leveling & forestation are conducted for slope improvement, with focus placed on southern and northern mountains greening. By the end of 2011, preliminary treatment has been carried out for 26 gullies in 60 small watersheds in suburb areas, water and soil loss with area of 147.12km^2 has been treated, with treatment rate being 36.32%, including 1293 stone check dams, 84 protection dams of gully head and 6 key control dams.

6.3 Prediction of Soil and Water Loss

In the project, subgrade treatment of road, excavation for pipe trench and construction of station yard will produce a certain amount of earth-rock, change landform along the line in the region, generate different levels of impact on vegetation, soil and landform within project area, and will inevitably cause a certain number of water and soil loss. Therefore, objectively and accurately predicting form, cause, degree, hazard and quantity of water and soil loss during construction, has great significance on preparation of water and soil conservation scheme and prevention of water and soil loss during construction and operation of the proposed project.

6.3.1 Analysis of Influence Factors for Water and Soil Loss

(1) Natural Factors

1) Climatic factor: The rainfall in project area is not too large and is not in uniform spatial and temporal distribution. During July to September, the rainfall accounts for above 50% of that of the whole year and it usually occurs in the form of rainstorm with short duration, centralized slope runoff and strong scouring force. Therefore, the heavy rainfall with short duration in summer and autumn is one of the main factors intensifying water and soil loss.

2) Vegetation factor: Since the vegetation coverage rate in the project area is not quite high, the main artificial vegetation is seasonal crops and large tracts of farmland lack effective protection by vegetation in summer and autumn, the bare surface tends to be easily eroded to moderate degree in case of heavy rainfall.

3) Landform factor: Since the project is located in the hilly and gully region where steep slopes, deep ditches, and loess hills coexist and the topographic relief varies greatly, after disturbance, more serious water and soil loss will be caused.

4) Soil factor: The soils in the project area mainly include loessal soil, heilu soil and alluvial soil, which have developed vertical joints, loose structure and poor resistance to erosion, presenting great possibility of water and soil loss.

(2) Human Factor

Any unreasonable human activities in the project area may cause or intensify water and soil loss. For example, main factors which transform the original landform and cause water and soil loss, including artificial disturbance of original landform, destruction of vegetation and discarding of slags.

6.3.2 Analysis of Impact of project Construction on Water and Soil Loss

During project construction, apart from the above-mentioned natural factors influencing water and soil loss, human factors are the main causes of water and soil loss. Any unreasonable human activities may cause or intensify water and soil loss. Exploration, excavation and stacking in violation of certain regulations by humans are the cause of increasingly serious water and soil loss. Since the construction of the project disturbs the original surface and destroys the ground vegetation, water and soil loss is intensified. According to analogy analysis, main areas of the project that have water and soil loss include borrow and spoil areas, roads, bridges and culverts and pipeline excavation area.

During the project construction process, since the original functional facilities for conservation of water and soil are destroyed and water conservation function of original earth surface is changed, the water and soil loss of each area presents relatively obvious difference under the exogenic force such as rainfall.

(1) During the construction of roads, relatively large impact is exerted on water and soil loss.

(2) Construction of subgrade and laying of pipes have the largest impact on water and soil loss. Since excavation of roadcut and pipe ditch and filling of embankment and pipe ditch damages the earth surface, moves the earthwork and destroys the original vegetation and sand crust, new water and soil loss is caused and it becomes the core problem to be handled in terms of control of water conservation. If corresponding control measures are not taken, soil wind erosion will be aggravated.

(3) The land temporarily occupied during the construction (mainly the construction camp for the project) will cause sudden damage to the vegetation and earth surface of such land, leading to water and soil loss.

(4) During the restoration of vegetation, with the water and soil conservation facilities functioning, water and soil loss is controlled to a certain degree.

Thus it can be seen that water and soil loss of different degrees are caused or intensified due to natural force such as rainfall and human activities and adverse impact is exerted on the ecological environment. Therefore, corresponding control measures must be taken so as to reduce to the largest extent the impact of water and soil loss caused by engineering construction on the environment.

6.3.2 Prediction Mode

(1) Determination of Soil Erosion Modulus of Original Earth Surface

The project area, Xining city, is located on Huangshui River basin where the area of water and soil loss reaches 13,000 km^2, is mainly distributed in the transition area of low and high hills and the low hills, and the erosion modulus increases from west to east. The area with serious water and soil loss is distributed in the middle, low and low hill areas with the erosion of sunny slope being the most serious (annual average soil erosion modulus is 5000t/km^{-2}). The area with less serious water and soil loss is mainly distributed in the middle part of low hill areas with annual average soil erosion modulus being 2000t/km^{-2}. The area with mild water and soil loss is mainly distributed in the transition area from low to high hills with annual average soil erosion modulus being 500t/km^{-2}. According to the *Environmental Impact Assessment Report of Beichuan River Plan*, Xining section of Huangshui River basin is mainly disturbed by mild water and soil loss. Table 6.3-1 gives details of soil erosion modulus of the original earth surface in project area according to *Sustainable Utilization of and Study on Water Resources of Xining City*.

(2) Determination of Erosion Modulus after Disturbance

The soil erosion modulus of the project area after disturbance is determined by multiplying erosion modulus of original landform and accelerated erosion coefficient as per the requirements of specifications. The accelerated erosion coefficient of the project area is determined according to the degree of disturbance on earth surface and vegetation during the project construction process. Based on experience and consultation of relevant experts, the soil erosion modulus of the area after disturbance is generally 3~5 times that of the original earth surface. According to results of special research on erodibility of soil after disturbance of soil body carried out by Inner Mongolia Institute of Water Resources and Hydropower Research in the science and technology key project for national and regional governance, the soil erosion modulus after disturbance is 2~5 times larger than that before disturbance. After project implementation, the currently serious water and soil loss in the proposed project area will be greatly reduced. Based on consultation and comprehensive analysis, average accelerated erosion coefficient after disturbance during the project construction is taken as 1.5-3 on average for calculation, and that during natural restoration is taken as 1-2 for calculation. See Table 6.3-1 for details.

Table 6.3-1 Soil erosion modulus of original landform and after disturbance in project area

Locations	Erosion Modulus of Original Landform ($t/a \cdot km^2$))	Erosion Modulus after Disturbance during Construction ($t/a \cdot km^2$)		Erosion Modulus during Natural Restoration ($t/a \cdot km^2$)		After Restoration Period($t/a \cdot km^2$)
		Accelerated erosion coefficient	Erosion modulus	Accelerated erosion coefficient	Erosion modulus	Erosion modulus
Liujiagou,Shengou	5000	1.5	7500	0.8	4000	2000
Chaoyangdianqu	2300	3	6900	2	4600	500
Beichuan River Area	4600	1.5	6900	0.87	4000	500
South Bank of Xichaun River	2300	3	6900	2	4600	2000
Both Banks of Beichun River	2300	3	6900	2	4600	2000

(3) Prediction of New Water and Soil Loss

The new water and soil loss is calculated with area method by the following formula:

$$L = S \times (m - m') \times n$$

Where *L* represents new water and soil loss (t);

S represents damaged area of earth surface (km^2);

m represents soil erosion modulus after disturbance ($t/a \cdot km^2$);

m' represents original soil erosion modulus ($t/a \cdot km^2$);

n represents calculated time period (a);

See Table 6.3-2 for calculation results.

Table 6.3-2 Prediction of new water and soil loss

Locations	Stages	Calculated Year (a)	Damaged Area of Earth Surface	Original Soil Erosion Modulus ($t/a \cdot km^2$)	Soil Erosion Modulus after Disturbance	New Erosion Amount (t)

			(km²)		(t/a·km²)	
Liujiagou, Shengou	Construction period	2	0.014	5000	7500	70
	Restoration period	2	0.014	5000	4000	-28
	After Restoration Period	30	0.014	5000	2000	-1260
Chaoyangdianqu	Construction Period	2	0.104	2300	6900	956.8
	Restoration Period	2	0.046	2300	4600	211.6
	After Restoration Period	30	0.046	2300	500	-2484
Beichuan River Area	Construction Period	3	1.4	4600	6900	9660
	Restoration Period	2	0.6	4600	4000	-720
	After Restoration Period	30	0.6	4600	500	-73800
South Bank of Xichuan River, Both Banks of Beichuan River	Construction Period	2	0.27	2300	6900	2484
	Restoration Period	2	0.27	2300	4600	1242
	After Restoration Period	30	0.27	2300	2000	-2430
Total					Construction Period	13170.8
					Restoration Period	705.6
					After Operation	-79974

As can be seen from the table, due to disturbance during construction, the proposed project will cause new water and soil loss of about 13,170.8t; after construction of the project is completed, greening of land surface of the construction sites will continue to generate a small amount of soil and water loss of 705.6t during the restoration period; along with greening ratio increase, water and soil loss will reduce year by year, and will finally restore with eco-environment improved and erosion degree greatly reduced. Take 30 years as operation period, the total amount of reduced water and soil loss will be 79974 compared to that before project implementation, or 2665.8t annually on average.

(4) Analysis of Project Impacts on Water and Soil Loss

The impacts on water and soil loss occur in two periods, i. e. the construction period and the operation period after water and soil loss is controlled based on project management.

Impacts during the construction period mainly include the following aspects: (1) the main structure is disturbed during construction, resulting in loss of protective layer of the earth surface and increase of erosion degree due to rainfall; (2) In the excavation section, certain slope grade and slope face are formed, which may cause washout on rainy days; (3) If spoils are hard to be or improperly disposed, the earth surface structure is destroyed and materials for the project is lost during transportation, water and soil loss will be caused on rainy days. As long as management is strengthened and organization and arrangement are reasonable, the impact during the construction of the above-mentioned reconstruction project on the surrounding environment could be reduced to the minimum level and will end with the completion of the project as construction operation lasts for a short period and the impacts caused are temporary and local. If water and soil loss is comprehensively controlled during the construction process, impact in terms of ecological environment could also be reduced.

After restoration during the operation period, the soil erosion modulus of the project area is effectively reduced, being conducive to the conservation of local water and soil.

6.4 Analysis of Prediction Results for Water and Soil Loss

The area of earth surface disturbed during project construction is 1.788km^2.According to the water and soil loss predictions, the amount of new water and soil loss caused by the project is 13,170.8t.The project construction area is an area where serious water and soil loss are caused with large background value. During the construction of the project, it becomes especially important to adopt measures for water and soil conservation. Therefore, for the design of scheme for water and soil conservation in the next stage, regional environment characteristics shall be targeted so as to reasonably design measures for conservation of water and soil and try to reduce disturbance of the earth surface.

After the project is completed, the amount of water and soil loss will be effectively reduced by 2665.8t every year through management and control.

6.5 Water and Soil Conservation Measures

The excavation method of earth and stone work shall be reasonably arranged in construction. Earth and stone work shall not be discarded nearby at random. No waste disposal area is provided for the project. All the earth and stone work shall be reused. The earth and stone work involved in the project must borrowed and stacked at the borrow pit and temporary waste yard specified in the scheme.

(1) Borrow Pit

The borrow pit site was not specified during feasibility study period of the proposed project. Borrowing earth will unavoidably change surface condition, disturb soil structure, and damage vegetation. With respect to the negative impacts caused by the project construction, the following preventive measures must be properly taken to try best to minimize water and soil loss.

① Before excavation of borrow pit of the project, the surface humus soil is stripped and stacked in a centralized manner in proper location near to the site and is used for follow-up greening.

② Rainfall concentrated period shall be avoided as far as possible to borrow earth. In the process of excavation, in order to reduce rainfall runoff intrusion that increases weight of loose soil and leads to gravitational erosion, ditches shall be arranged at two sides of borrow pit to allow the surface runoff to discharge in time.

③ Earth covering shall be carried out in the pit after completion of borrowing and then revegetation is performed. The type of revegetation depends on the original land vegetation. Meanwhile, according to the rock and soil types of back wall after excavation, slope cutting and stepping is carried out for it. Water conservation measures are provided accordingly. With respect to rock slope, slope shall be cut at the grade below 1:1 and wire mesh shall be hung on slope surface to plant grass. With respect to soil slope, slope shall be cut at the grade below 1:1.5 and grass and shrubs shall be planted on slope surface. Intercepting ditch shall be set at slope top of back wall of borrow pit.

(2) Temporary Waste Yard

The surface humus soil of land occupied by project construction is stripped and stacked in a centralized manner in proper location near to the site and is used for follow-up greening. This portion of spoil is stacked at temporary waste yard.

Before stacking earth, stacking scope is strictly divided, simple walls to retain water and wind shall be provided, and drainage ditches shall be dug. The temporary waste bank shall be timely used over implementation of greening to avoid prolonged exposure. After completion of greening, leveling shall be performed, and spontaneous recovery or plant protection shall be carried out depending on local conditions.

Various prevention and control measures adjusted to local conditions shall be taken for the water and soil loss within scope of responsibilities of this project to effectively control newly increased water and soil loss amount and gain effective management of original natural water and soil loss.

After completion of construction, clearance and remediation shall be carried out for land temporarily occupied. Temporary buildings shall be demolished, ground shall be cleaned, the soil compacted after being rolled shall be loosened again, low-lying land shall be filled up by earth covering, and greening shall be performed in time to minimize the level of water and soil loss.

(3) Water and Soil Conservation for Main Works

In order to prevent and control slope erosion and avoid slope runoff, drainage ditches shall be constructed at slope surface on two sides of subgrade of road works or at gully slope of main works such as wastewater treatment and reclamation plant. Slope runoff or water discharged from main works is led to bottom of ditch or low-lying ground to ensure its safety. Sedimentation basin is provided at outlet of drainage ditch by combining topography. Water flow is discharged to natural channels nearby after subsiding in sedimentation basin. Waterproof rain cloth is used to cover embankment slope at rainy season.

(4) Water and Soil Conservation for Temporary Works

a Construction Site

The land temporarily requisited during project construction shall be timely returned to farmers for reclamation after completion of utilization. The contractor shall ensure the conditions for recovery of temporary land to arable land.

b Construction Road

① When the main works are designed, the current roads shall be used to the fullest and be expanded to meet the requirements of construction. Construction roads shall be newly constructed for some road sections. The topography and landscape shall be combined as far as possible and the balance between excavation and filling shall be maintained.

② In order to prevent surface runoff from damaging construction road and reduce water and soil loss resulting from excavation of construction road, drainage ditches are constructed at sides of high slope of construction road to discharge water to natural channels nearby. The construction of drainage ditches and construction roads are simultaneous.

③ Based on subgrade protection engineering of construction road and drainage works, protection is carried out in sections by combining topographic and geological conditions and construction characteristics. According to the different situations of each road section, protection measures for plant are arranged. Based on the principle of “matching species with the site”, consideration is given to the requirements of protection and greening and beautification, local conditions and characteristics of vegetation are combined, and thus local excellent native tree and grass species are selected for roadside greening according to comprehensive analysis of survival ratio and adaptability, so as to realize the purpose of preventing water and soil loss and improving greening environment.

④ If construction roads are unavailable in borrow pit, temporary waste bank and waste disposal area, or road width does not meet the requirements, supplementary design shall be performed for this scheme and road width shall be designed as 4.5m.In construction, construction vehicles shall be strictly required to drive on designed road to avoid random rolling that damages original surface and vegetation and leads to new water and soil loss.

(5) Standard Construction

a During construction period, the damage by the works to aboveground vegetation shall be reduced as far as possible. The selection of construction season shall be adjusted to local conditions and the seasons when plants grow fast shall be avoided. As for construction in wood land, manual work shall be adopted as far as possible to minimize area of operation.

b Efficiency of construction shall be improved to shorten construction time and reduce exposure duration of bare land.

c The operation specifications for excavation in layers, stacking in layers, backfilling according to layers (undersoil is at bottom and topsoil is at top) of soil during construction period shall be strictly implemented. The original survival conditions of plants shall be maintained as far as possible to facilitate the recovery of vegetation. Proper accumulation layer shall be provided during backfilling to prevent surface depression and water and soil loss caused by precipitation.

6.6 Cost Estimate for Water and Soil Conservation

Water and soil conservation measures to be taken for the proposed project are included in the project components of river bank improvement of Beichuan River and integrated gully improvement, implementation of these components will meet the requirements for water and soil conservation. Therefore, costs for water and soil conservation have been taken into count in the overall project cost, overlapping calculation needs to be avoided.

7 Alternative Analysis

7.1 'Without-project' Option

The Qinghai Xining Water Environment Management Project mainly includes: (1) urban wastewater collection pipe network; (2) river bank environmental improvement; (3) Reuse of reclaimed water; (4) integrated gully improvement. See Chapter 2 for details of these project components. In this chapter, 'Without-project' option is compared with the project option from the environment perspective, for the purpose of analyzing whether the proposed project is needed. For details, see Table 7.1-1.

It is clear from the table that implementation of the project can effectively change the current situation in the project area of Xining that can be summarized as: wastewater is discharged directly into river; household wastes are piled up at random; water and soil loss is heavy in gullies and ecological environment is harsh. Therefore, implementation of the project is beneficial to improve urban environment and save water resource in Xining, resulting in obvious and positive environmental benefits. Therefore, the project is feasible from the environment perspective.

7.1-1 Results of With-project and Without-project Comparison

Project Components	Work Contents	Ecological Environment		Water Environment		Atmospheric Environment		Acoustic Environment	
		With-project	Without-project	With-project	Without-project	With-project	Without-project	With-project	Without-project
Urban Wastewater Collection Pipe Netwrok	Wastewater interception main pipes along Xichuan River	Wastewater is collected. It is beneficial to improve ecological environment along the river.	Wastewater is discharged directly into the river, which pollutes the river water and ecological environment near the discharge outlet.	Wastewater is intercepted, collected and sent to No.4 wastewater treatment plant for treatment to reduce pollutants into the river and to improve water quality. Wastewater collected is 43.6 thousand m^3/d.	Wastewater is discharged directly into Xichuan River, which has an impact on water quality.	Discharge outlets along Xichuan River are removed and quality of atmosphere along the River is improved due to wastewater collection.	Currently there are several direct discharge outlets along the river. Odors emit and have an impact on the atmospheric environment along the river.	No significant influence	No significant influence
	Wastewater interception main pipes at along Beichuan River	Wastewater is collected. It is beneficial to improve ecological environment along the river.	Wastewater is discharged directly into the river, which pollutes the river water and ecological environment near the discharge outlet.	Wastewater is intercepted, collected and sent to No.5 wastewater treatment plant for treatment to reduce pollutants into the river and to improve water quality. Wastewater collected is 24.4 thousand m^3/d	Wastewater is discharged directly into Beichuan River, which has an impact on water quality.	Discharge outlets along Beichuan River are removed and quality of atmosphere along the River is improved due to wastewater collection.	Currently there are several direct discharge outlets along the river. Odors are emitted and have an impact on the atmospheric environment along the river.	No significant influence	No significant influence

	Wastewater collection pipes and ancillary roads in Beichuan River area	Combining with planning of Beichuan area, reasonable arrangement of wastewater collection pipe network and road network is to the benefit of orderly development of Beichuan area and maintenance of ecological environment in Beichuan area.	It is inconsistent with planning of Beichuan area. Without ancillary road network and pipe network, wastewater of Beichuan area cannot be collected, due to which Beichuan area still stays in current ecological environment: dirty, random and bad.	Wastewater in Beichuan area is collected reasonably and effectively. It is beneficial to protect quality of water in Beichuan River. Wastewater collected is 11 thousand m^3/d	Wastewater is discharged directly into Beichuan River, which has an impact on the quality of water in Beichuan River.	Construction of road network brings automobile exhaust.	Road network is built for the demand of planning of Beichuan area. Impact of automobile exhaust still exists.	Automobile noise	Automobile noise
Reuse of reclaimed water		Pollutants into surface water are reduced through recycling of wastewater after treatment. It is beneficial to improve ecological environment near discharge outlet of wastewater treatment plant.	Wastewater is discharged directly into surface water after treatment and cause a certain degree of odor at the discharge outlet, influencing the ecological environment nearby.	Pollutants into the river are reduced. Recycling of reclaimed water is beneficial to save water resource. Saved water resources amount to $4800m^3/d$.	Wastewater is discharged directly into surface water after treatment. Pollutants are discharged into the river.	Flow of wastewater discharge outlet is reduced. Impact of odors on the environment is reduced to some extent.	Odors have a certain impact near the discharge outlet of wastewater treatment plant.	No significant influence	No significant influence
Low-impact development and river bank environmental improvement		It will greatly improve ecological environment along the banks of Beichuan River and change the current situation of poor environment and disorderly development in some	Rubbishes on the bank have a strong impact on ecological environment along the bank of Beichuan River. Unreasonable development exists and results in deterioration of ecological environment in the region.	An ecological environment suitable for living can be provided by ecological management, greening and rubbish elimination.	Dumping of rubbish greatly threatens the quality of water in Beichuan River.	No significant influence	Household wastes dumped in some regions emit odors.	No significant influence	No significant influence

	areas of the river.								

(continued) 7.1-1 Results of With-project and Without-project Comparison

Project Component	Work Contents	Ecological Environment		Water Environment		Atmospheric Environment		Acoustic Environment	
		With-project	Without-project	With-project	Without-project	With-project	Without-project	With-project	Without-project
Integrated Gully Improvement	Comprehensive environmental management in Liujiagou and Shengou	Slope protection is built on both sides of the ditch to change current situation of water and soil loss on both sides of the ditch. Silt and household wastes in the ditch are cleaned up and cleaned to change current situation of ditch mouth, i.e. dirty, random and bad, and to improve ecological environment in the ditch.	Water and soil loss is heavy in ditch mouth due to gravitational erosion. Plenty of sediment silts up at bottom of ditches. Loose soil piles up on both sides as well as household wastes, which results in heavy pollution and overflow of wastewater in ditches; torrential flood and debris flow greatly threaten life and property safety of residents on both banks. Depositions of sediment and rubbishes in ditches are discharged directly into the	Household wastes in the ditch are cleaned to avoid the impact on the surface water quality; sediments into the river are reduced and the current situation that the water is turbid is changed by soil and water loss control.	Sediments are gathered at bottom of the ditch and household wastes are dumped by residents on both banks. These sediments and wastes are washed into the river by precipitation, which pollutes the surface water.	The impact of odors is eliminated after cleaning of household wastes.	Household wastes are dumped at random. Impact of odors is significant.	No significant influence	No significant influence

			river after the flood, which increases sediment concentration of river water and has a significant impact on the quality of water in the river.						
	Comprehensive environmental management in Chaoyangdianqu	Household wastes are cleaned. Channels are cleaned up and facilities along channels are rebuilt to improve ecological environment along both sides of the channel.	Wastewater produced by residents on both banks is discharged directly into the ditch, which causes heavy pollution. Rubbishes are piled up in the ditch, which has significant impact on the water environmental quality; besides, the ditch has not been repaired for many years and a large number of wastes are accumulated, which result in poor diversion of the ditch. Therefore, renovation works for the ditch is extremely urgent.	Household wastes in the ditch are cleaned to avoid impact on surface water quality.	Household wastes pile up in the ditch, which has a significant impact on the quality of water in the ditch.	The impact of odors is eliminated after cleaning of household wastes.	Household wastes pollute the water and cause odors.	No significant influence	No significant influence

7.2 Alternative Analysis for LID-based Rainwater Treatment

(1) Processing Options

Option I: distributed processing

Distributed processing system will adopt techniques of ecological road rainwater collection system, biological retention pond and infiltration depressions along the road.

Ecological road rainwater collection system is based on layout of road cross-section, it can collect and drain rainwater on road surface to tree pits and greening belts, so as to use rainwater to replenish urban groundwater and supply water for greening. By doing so, ecological road system that allow for transformation of rainwater into water resources can be established to benefit maximization of greening area, ‘breathing area’ and rainwater intention.

Option II: concentrated processing

Concentrated processing requires installation of processing facilities at outlets of all rainwater collection and discharge systems. After entering the processing facilities, the collected rainwater will go through infiltration, plant root absorption and other procedures for purification, and its flow rate will be reduced by infiltration and retention processes.

(2) Trade-off of Options

See Table 7.2-1 for details.

Table 7.2-1 Comparison of Schemes for Initial Rainwater

Options	**Option I**	**Option 2**
Description of Option	Distributed Processing	Concentrated Processing

Advantages	Simple for installation, less space constraints; Good processing outcomes; Reduction at source; Less investment.	Concentrated facilities for easier management.
Disadvantages	Dispersed facilities and thus complicated operation and management	Impossible to realize reduction at source, big demand of transmission pipes; Occupation of large land area; More investment.
One-time investment	Low	High
Operation cost	Low	High
Utilization ratio of rainwater	Distributed facilities allow for immediate rainwater entering into LID system. Many installation sites make possible for rainwater purification and utilization at the source, resulting in high utilization ratio.	After being collected by pipes, rainwater can enter into LID system at concentrated outlets. Less installation sites make it impossible for rainwater purification and utilization at the source, resulting in low utilization ratio.
Sediment	Sediment evenly distributed in all systems after treatment by distributed LID systems, and go slowly into natural system, without causing siltation.	Concentrated rainwater contains big amount of sediment that will go into LID systems, resulting in siltation in some areas. Accumulated sediment over time will be brought into surface water bodies by runoffs.
Water Environment	Distributed design enables more natural circulation of rainwater after infiltration process. Faster purification via plants and infiltration facilities, resulting in higher utilization ratio and without impacting on surface water quality.	If encountered with strong storm and thus bigger flow collected, processing efficiency of concentrated system will be reduced, not favorable to purification of rainwater.
Eco-environment	Distributed system design makes plant communities along both banks of Beichuan River closer to natural structure, favorable to improvement of eco-environment.	Concentrated processing at far distance between LID systems, prone to isolation of landscapes, inconsistent with natural structure of ecological communities. Installation of big pipes becomes necessary, causing greater ecological impacts during construction.
Energy saving	Reduction at source, less investment.	Impossible for reduction at source, bigger transmission pipes.

From the above table, it is clear that distributed processing system enables effective purification and utilization of initial rainwater on the road, and is closer to natural circulation and favorable to eco-environmental improvement. Meanwhile, after localized sedimentation and filtration, initial rainwater can be recycled for greening and river replenishment, which is favorable to water resources conservation. Therefore, option 1 is hereby recommended.

8 Mitigation Measures for Environmental Impacts

8.1 Environmental Protection Measures at Design Stage

8.1.1 Protective Measures for Social Environment

(1) In selecting site for wastewater reclamation plant and layout of roads and pipeline, comprehensive consideration shall be given to natural and social environment along the alignment, so as to save arable land as much as possible, and pass around some environmentally sensitive areas involving residents, school and hospital, as well as minimize interference on electricity, telecommunication and water conservancy facilities along the line and demolition. The route shall be laid far away from or by bypassing natural scenic spot, cultural relics & historic sites, water source area and national key project facilities.

(2) The routing should allow for use of existing space as much as possible to reduce the damage of new route on environment.

(3) Structures shall be set rationally to reduce inconvenient impact of project construction on production and living of masses along the line.

(4) Construction shall be appropriately organized and designed to minimize impact of the construction on environment.

8.1.2 Protective Measures for Surface Water Environment

Interface between intercepting main sewer and wastewater pipe network on both sides should be properly arranged to ensure that wastewater can be fully collected on both banks of rivers and reduce impacts of domestic wastewater on surface water.

8.1.3 Protective Measures for Ecological Environment

(1) On the premise that technical requirements are met in design, road shall be laid by complying with topographic relief to reduce filling and excavation quantity for subgrade, so as to decrease new water and soil loss caused by road construction.

(2) Transport should be limited within economical haul distances by proper selection of quarry or borrow area, and quantities of excavation and backfilling should be under strict control and the excavated earth shall be reused for backfilling as much as possible, earth borrowing should be conducted in combination with land improvement and reclamation. Wherever condition permits, building waste residue meeting technical standard shall be adopted as much as possible to fill subgrade, so

as to reduce land for soil borrowing.

(3) In construction of pipe network works, excavation scope shall be strictly controlled. Area of excavation shall not be arbitrarily enlarged, and water & soil loss shall be reduced.

(4) In designing low-impact system and environmental restoration works for river banks, the following principles shall be followed:

1) Environmental restoration for river banks shall aim to improve aquatic ecological environment on river banks, upgrate water environmental service, and improve overall water environment in Xining;

2) Rainwater volume shall be reduced at source and treated locally, to decrease pollution of initial rainwater on river course, improve aquatic ecological system, and promote its adjustment and control capacities;

3) Achieve the goal that water ecology is in harmony with environment;

4) Create high-quality regional water-loving life and regional space with sustainable development;

5) Realize the goal of controlling pollution, protecting & stabilizing river banks, adjusting micro-climate and beautifying environment.

6) Achieve ecological benefits and adhere to sustainable development.

8.1.4 Protective Measures for Acoustic Environment

(1) In design of road network in Beichuan area, consideration shall be given to impact of traffic noise on surrounding school and residential area. Besides, the planning of Beichuan area shall be referred to so as to ensure proper layout and classification of the roads, thus reducing future impact of traffic noise on residents and work places.

(2) Site selected for wastewater reclamation plant shall be far away from places with dense population, appropriate protective distance shall be provided to reduce impact of noise and odors on residents.

8.1.5 Protective Measures for Landscape Environment

Specific to the damage of project construction on environment, the following measures shall be taken in design of proposed project:

(1) In designing Beichuan road network, the roads should be harmonized with urban landscape as much as possible to avoid large scale of filling and excavation.

(2) In paving of road subgrade, construction wastes generated by other works of the project shall be used as much as possible to reduce earth borrowing.

(3) Borrow pit shall be specially designed, for which greening and drainage facilities shall be provided to prevent new water and soil loss.

(4) Wastewater reclamation plant shall be far away from downtown area to avoid impact on urban landscape.

(5) For river bank improvement, urban planning and local plant species shall be considered to rationally lay landscape and select locally suitable plants, so as to make such works in harmony with surrounding environment.

8.1.6 Design of Road Traffic Safety Facilities

In order to ensure traffic safety, the road works of proposed project shall be provided with guide sign, indication sign, warning sign and prohibition sign as well as pavement marking.

(1) Pavement Marking

The pavement marking shall be designed based on *Road Traffic Signs and Markings* (GB5768-2009). Marking shall be hot-melt material with good durable performance and light reflecting performance, being labeled with number 2.

Based on different setting positions, markings can be divided into marking of traffic lane (edge line and boundary of traffic lane), marking of pedestrian sidewalk, marking of traffic diversion, indication marking and orientation arrow.

The edge line of traffic lane is white full line with width of 15cm. The boundary of ground traffic lane is white dotted line with width of 15cm. The full line is 6m long with space of 9m and ratio to the dotted line being 2:3. In order to strengthen light reflecting performance in the night, light-reflecting glass beads shall be mixed in advance. Coating thickness of markings: On asphalt pavement, the thickness is 1.8-2.0mm.Marking surface shall be covered by glass beads, which shall be evenly distributed with content of 0.3-0.34kg/m^2.

Markings shall be of equivalent width, equivalent space, regular line shape, neat edge and smooth line.

(2) Traffic Signs

1) Design Principle

Traffic signs shall be laid according to *Road Traffic Signs and Markings* (GB5768-2009), and shall have complete types and perfect functions. The above design is provided for drivers unfamiliar with the route.

In marking layout of main line, important signs shall be repeatedly promoted. It is prohibited to make markings clutter, so as to avoid information overload. At one position, guide signs shall not be more than 3.Guide sign and prohibition sign cannot be set at one position.

For important signs, drivers' reflection time shall be checked to ensure that the signs are laid rationally.

Marking layout for main line shall be designed in such manner that the information on marking can be timely identified by drivers traveling at designed speed. The layout shall be made conspicuous and beautiful as much as possible.

Prohibition sign shall be set at appropriate position in front of the road section in which speed is limited and non-motor vehicle & pedestrian are not allowed to pass through.

The sign of keeping to the right shall be electronically controlled.

2) Layout Design

The text on traffic sign layout shall be Chinese character and with corresponding phonetic letters, According to designed driving speed, on marking of main line, the Chinese character shall be the height of 40cm with width ratio being 1:1, and the phonetic letter (capital letter) shall be the height of 16cm, with a minimum space between Chinese character and phonetic letter being 12cm.

3) Material of Sign Board and Light-reflecting Film

Aluminum plate plus joist or the aluminum plate formed by extrusion shall be adopted for sign board. The width (or length) of sign board shall be modulus times of 15cm and 30cm for convenience of processing and standard unification. Light-reflecting film of sign shall be of Grade 1.In the project, light-reflecting film color of the sign can be differentiated based on different categories. Thereinto, guide sign is of blue background and white words, prohibition sign is of white background and black words circled by red line, and indication sign is of blue background and white words.

4) Structural Design

Based on different ways being supported, sign structure includes column-type structure, cantilevered structure and attached-type structure, which are adopted in design according to traffic composition, layout size and laying position.

In the preliminary design, according to actual road traffic conditions, traffic signs are set at different sections and positions, to ensure driving safety of vehicles and reduce & prevent traffic accident.

(3) Design of Safety Facilities at Level Crossing

Design of main level crossing is included in the design of works. Relatively complete safety facilities and pavement canalization facilities shall be provided for main level crossing. Advance signs including sign for level crossing entry ahead shall be provided at intersection.

Lines shall be set at level crossing including boundary line of traffic lane, edge line of traffic lane, orientation arrow & traffic diversion line, crosswalk line, advance marking sign line of crosswalk, deceleration line for letting other vehicles pass through, stop line and guide lane line, etc.

Level crossing is the most dangerous place where traffic conflict occurs. In design of traffic works, traffic management measures are taken to reduce danger at level crossing. When sign, marking and traffic signal system are set, electronic police system and safety monitoring system shall also be set.

8.2 Environmental Protection during Construction Period

Given the common features of construction activities under the project, this section describes the common environmental protection measures for them during construction period. The specific measures for environmental protection are detailized in Attachments 3, 4, 5, 6, 7 of this EIA.

8.2.1 Regulations on Social Environmental Protection

(1) Management on Land Acquisition and Demolition

① Permanent and temporary land occupation results in reduction of arable land, decline of output and decrease of income, for which the owner should give corresponding economic compensation in a timely manner to reduce impact on lives of residents along the line. For young crops and crops, compensation shall be given based on current-season yield. If no young crops are involved, compensation shall be given based on actual investment of current season. Land compensation and resettlement fees shall be given strictly according to relevant provisions as specified in *Land Administration Law of the People's Republic of China*, *Land Administration Method in Qinghai Province* and *Tentative Method for Lump Sum Fees for Unified Land Acquisition in Qinghai Province.*

② Land acquisition and resettlement involved in the project shall be under the charge of local government, and shall be undertaken through negotiation between state-owned land and resource administrative departments of all levels and villages & towns along the line. The project ower shall, before construction, prepare rational plans for land acquisition, demolition, and resettlement as well as execution schedule. Besides, the owner shall pay fees for land acquisition and demolition according to relevant policies.

③ Compensation fees shall be earmarked for specified purposes, and shall be distributed in a timely manner to villages and individuals concerned as per relevant provisions. In addition, effective publicity means shall be adopted to vigorously publicize national policies involving economic resettlement compensation.

④ Farmers with land being occupied can use compensation fees to adjust planting structure or engage in the tertiary industry or go to work outside home. At the same time, training, education and management for people turning to other industries shall be strengthened, so as to prevent new environmental problems. During construction, farms with land being occupied can be employed firstly, so as to provide them with income for living in short term.

(2) Management Measures for Influence on Irrigation and Water Conservancy along the Line

① Parallel operation method shall be adopted in borrowing soil for construction, i.e., excavation, leveling and protection shall be simultaneously conducted so as to recover landscape in a timely manner.

② In order to guarantee smooth flow of water in farmland canal and prevent water and soil loss, works involving change of farmland canal, small bridge and culvert shall not be conducted during irrigation period as much as possible. What' more, after completion of such works, dirt in the culvert shall be cleaned in a timely manner to ensure smooth flow of water in river and canal during irrigation period.

③ In case of inevitable removal or alteration, the existing irrigation canal or water conservancy facility must be removed after alternative irrigation canal is constructed and can be put into service.

(3) Management Measures for Impact on Infrastructures like Current Traffic Facilities

① For all public utilities and structures affected by or under influence of proposed project, the contractor shall, during construction period of the proposed project, take all appropriate measures for protection.

② Before commencement of construction, local roads bearing main transportation tasks shall be reinforced. When local roads are blocked due to project construction, temporary access shall be set to connect with original roads, so as to guarantee smooth flow of traffic.

③ Infrastructures within the scope of subgrade including road, communication, electricity and pipe network shall be removed or reconstructed in advance with the coordination of relevant departments, so as to avoid many adverse effects.

④ During construction period, transportation of raw and auxiliary materials or bulky machine may damage local roads, therefore, such roads shall be repaired in a timely manner in the course of and after construction, and alternatively, compensation fees shall be given to local road administration departments for repairing.

⑤ The owner shall fully negotiate with local traffic departments and public security departments to strengthen management of traffic transportation and reduce interference of road construction & pipeline layout on existing traffic facilities. The owner is also required to work out transportation plan. Transportation of road building materials shall not be carried out in rush hour of traffic, so as to avoid traffic jam and reduce traffic accidents.

⑥ For excavation near public utilities, the contractor shall notify relevant departments and invite their representatives to come to the site when the excavation is carried out. The contractor shall submit copies of the above notice and invitation to supervision engineer for future reference.

(4) Regulations on Traffic Environment Protection

The project has longer construction period and generates relatively obvious impact on traffic, besides, layout of wastewater interception pipe network and reclaimed water pipe involves many main traffic lines. Therefore, a series of feasible construction measures and traffic improvement measures shall be prepared to improve traffic conditions during project construction.

① Since the construction will inevitably lead to interaction with some existing roads, excavation of road will seriously affect traffic conditions in the whole area. The owner shall giver full consideration to the above factor. For road section with busy traffic, bicycle lane can be used as temporary passageway to reduce traffic pressure.

② Construction of the works shall be conducted section by section as much as possible. Excavation, pipe burying and backfilling shall be completed in possible shortest period. In road section with extremely busy traffic, construction is required to avoid rush hour.

③ Surface asphalt waste residues excavated during construction shall be timely cleaned & transported, and collected & recycled in specified point, as well as delivered to appointed place for site leveling. Strict control shall be provided for road acquisition by stacked soil in construction and greenbelt & road acquisition & rolling by vehicles, to guarantee a certain traffic capacity of road.

④ Pipes shall be laid in combination with urban construction. Negotiation shall be conducted with planning department, so as to avoid separate construction of pipes. Giving important consideration to pipe layout in annual pavement renovation plan of urban construction departments, can not only reduce damage on pavement, but also lower construction costs.

⑤ Construction method shall be determined section by section combining contents and scale of works, to reduce investment and ensure quality of works. The construction method combining project schedule and excavation shall be implemented to avoid traffic interruption and traffic jam.

⑥ Specific to impact on traveling of target population caused during construction, sign board shall be appropriately set around construction point. Besides, negotiation shall be conducted with relevant traffic departments, and the owner shall appoint relevant personnel to disperse traffic at busy sections and entrances of walking streets, so as to ensure safety of pedestrians.

⑦ The contractor shall post notice in project construction area one week prior to implementation of the project, to let citizens understand impact caused by construction ahead of time so as to obtain their pardon.

⑧ When smooth traffic of road needs to be maintained all the time in special sections including hospital, construction scheme shall be appropriately prepared. Traffic corridor shall be reserved and normal traffic road in the section shall not be completely occupied due to implementation of the project, so as to ensure that patients can go to the hospital without delay.

(5) Analysis of Impact on Appearance and Landscapes of the City

During construction of the project, certain impact may be caused on urban landscapes, therefore, the contractor shall take such measures as protection & greening of side slope of subgrade, restoration of residue field, removal of temporary works and cleaning of construction site, so as to recover landscapes along roads and add new landscape belt for the city.

(6) Social Impacts and Environmental Mitigation Measures

Social impacts of the proposed project and environmental mitigation measures are shown in the following table (Table 8.2-1).

Table 8.2-1 Summary of Social Impacts of the Project & Environmental Mitigation Measures

Subproject Name	Project Impact	Mitigation Measures	Implementation Time
Pipe Network Works for Wastewater Collection	①Risk caused by affordability of population of lowest life guarantee; ②Risk caused by that part of wastewater treatment fees cannot be charged; ③Risk from pipe network connecting fee; ④Risk from operation and maintenance of pipe network; ⑤Road operation & drainage and road safety.	①Before operation of the project, the owner and relevant government departments commit to prepare water fee reduction policy or provide fee subsidies for population of lowest life guarantee; ②Charge wastewater treatment fees against residents who do not use tap water as source of domestic water; ③Based on full negotiation with residents and in combination with economic income of local residents, determine the construction and installation fees of branch pipe network acceptable to the residents; ④Establish emergency maintenance mechanism and publicize special telephone number of wastewater pipe network maintenance. ⑤Regularly maintain drainage pipe network in road area to ensure smooth discharge of water; strengthen traffic management and set warning sign and safety barriers.	①Construction period ②Construction period and operation period ③Construction period and operation period ④Operation period Operation period
Reclaimed Water Reuse Works	Rick caused by water quality and quantity;	Establish standard self-inspection system to regularly or irregularly inspect water quality produced by reclaimed water treatment pant; build buffering tank for water users to ensure stable water supply.	Operation period
Environmental Renovation Works for Beichuan River Bank	①Risk caused by poor environmental awareness of residents;	①Strengthen publicity of environmental protection knowledge to enhance masses' environmental awareness; strengthen supervision on pollution discharge of enterprises and residents along both banks of rivers, and	①Construction period and operation period ②Operation period

	②Risk of later-stage maintenance of the project; ③Risk caused by citizens' living habits; ④Impact on landscape facilities including toilet, garbage can, scenic road and greening	depend on administrative forces to ensure water in rivers is clean and tidy. ②Make clear responsibilities of environmental protection departments, urban management personnel, water conservancy departments and municipal administrative authorities; conduct scientific management; and encourage all citizens to participate and supervise the works; ③Set notice board at dangerous area. ④Strengthen management of scenic road, regularly clean garbage can, build clean-type toilet, avoid constructing toilet besides major landscape, adopt suitable plants for greening and ensure their survival rate;	③Operation period ④Construction period and operation period
Comprehensive Management Works for Ditch	①Risk caused by poor environmental awareness of residents; ②Risk of later-stage maintenance of the project;	①Publicize by various means to improve masses' environmental awareness; ②Establish and perfect sanitation system;	①Operation period; ②Construction period and operation period

8.2.2 Protection and Management Measures for Cultural Relics and Historic Sites

If cultural relics and historic sites are found or suspected during construction period, the contractor shall immediately protect the site according to *Law of the People's Republic of China on the Protection of Cultural Relics* (December 29, 2007) and requirements as stated in material culture and resource policies of the World Bank, report to local Cultural Relics Bureau for handling, and carry out construction again after the handling by Cultural Relics Bureau. Report procedure for cultural relics is shown in Fig.8.2-1.

When cultural relics and historic sites are found or suspected in the course of construction, the contractor shall:

(1) Stop construction at position where cultural relics are found and strengthen protection for the site;

(2) Report in a timely manner to police department and competent department of cultural relics for identification and handling;

(3) Delimit protection range immediately once cultural relics are determined by experts;

(4) Conduct rescue excavation for cultural relics in case of tight construction period or natural damage risk;

(5) Let professional personnel to conduct rescue excavation for cultural relics by using special equipment, and do not excavate them randomly;

(6) Conduct demonstration about whether alternative site shall be selected for continuous construction once major cultural relics are identified.

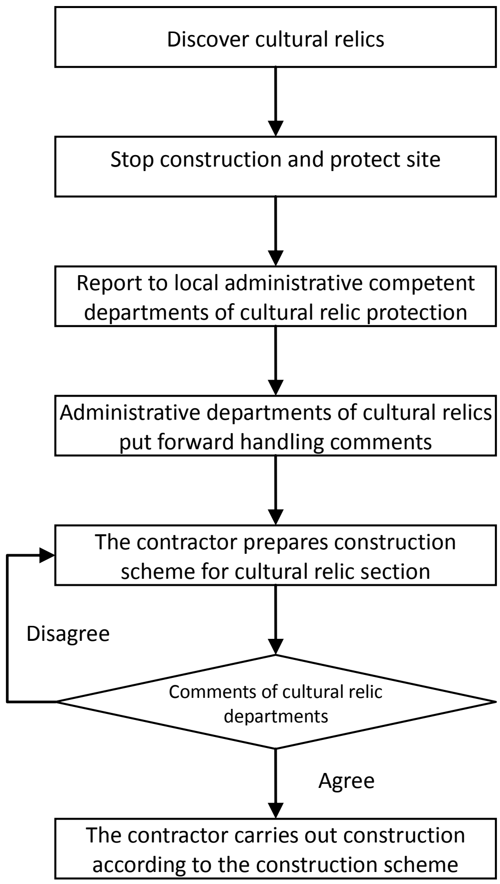


Fig. 8.2-1 Handling Procedure for Cultural Relics Found During Construction Period

8.2.3 Environmental Protection Measures for Noise Pollution Prevention

During construction period, the major source of noise is mechanical noise generated by such construction equipment as excavators, cutting machines and transport vehicles, with sound level being more than 85dB(A). Whether shield is provided or not, areas within 30m, 80m and even 150m of construction site will be affected by construction noise at different levels. The following measures are taken to improve acoustic environment quality of the said main protection objects.

(1) Environmental management on construction site shall be strengthened, and *Noise Limits for Construction Site* shall be strictly followed. In order to reduce impact of construction on surrounding residents, when route reconstruction is conducted near acoustic environmental sensitive objects listed in environment assessment and residential area, it is prohibited to carry out construction during 22:00 PM to 6:00 AM of the next day in noise sensitive points near to the route. Except for protection objects at noise sensitive point, for other routes to be reconstructed, construction time can be arranged according to project schedule and impact on traffic.

(2) In main traffic road, residential area and site of wastewater treatment and

reclamation plant involved in layout of pipe and route, a notice to reassure the public can be posted, in which construction period shall be indicated. This can not only reassure the masses and get their understandings, but also supervise the contractor, which is conducive to completing construction on schedule.

(3) In school and other sensitive points, high-noise equipment shall not operate during school hours. In residential area, high-noise equipment shall not operate during lunch time. In hospital and government office and other sensitive areas, operation time of high-noise equipment shall be shortened as much as possible. As for construction equipment and method, low-noise machine shall be adopted as far as possible, e.g., small machine.

(4) The construction method of "concentrate efforts and carry out construction section by section" shall be adopted to shorten construction period and relieve impact of construction noise on acoustic environment in local sections. Except in busy sections, joint calking for pipe connection in other sections shall be carried out simultaneously in different batches.

(5) Preventive measures for noise pollution shall be taken when route construction is carried out at sensitive points. Guardrail with a height of 1.5-2.0m can be used to shield construction noise at construction site.

(6) In partial intensive residential areas and teaching areas, pipeline may be laid by man, so as to minimize impact of construction noise on residents and schools.

(7) Isolating and protective measures shall be appropriately taken for construction site, so as to achieve good effect of noise reduction.

(8) During road construction, noise is mainly generated by construction machines and transport vehicles. In order to ensure health of construction personnel, according to *Sanitary Standard for Noise of Industrial Enterprise*, it is recommended that the contractor shall rationally arrange schedule for workers and let them operate high-radiation strong-noise construction machines in turn to reduce their time of receiving high-noise. At the same time, the contractor shall pay attention to maintain machines and operate them correctly, so as to maintain the noise of road building machines at minimum sound level. It is recommended that operators and relevant personnel shall ware personnel protective articles, such as earplug and helmet.

8.2.4 Environmental Protection Measures for Air Pollution Prevention during Construction

During construction, main pollution factors for impact of proposed project on ambient air are construction waste gas and dust nuisance, for which, the waste gas mainly includes the exhausts from various construction machineries and transport vehicles; during construction, the dust nuisance is mainly produced from subgrade excavation, site excavation and backfill, discarding of soil and stone, and loading, transportation of knocked-down construction garbage, transportation, loading and unloading of construction materials, and construction. And, few dust nuisance is also generated by site leveling, and the main pollutant is TSP.

(1) Preventive Measures for Dust Nuisance Pollution

From pavement excavation, pipe trench excavation, foundation excavation for structures on site to backfilling and covering, in order to prevent dust nuisance, construction site shall be embosomed (in the environment assessment, closed embosoming or semi-closed embosoming with color plate is recommended). If there is successive sound weather and wind during construction of pipe network, temporary storage area of excavated earth shall be watered or covered with green covering screen, to prevent dust nuisance.

The contractor shall dispose spoiled soil timely as per plans, cover the compartment of vehicle transporting residual soil (keep the vehicle closed during transportation) during transportation and spray water on transportation route containing non-soil pavement. Besides, the contractor shall avoid excavating earth and handling materials under wind. The transport vehicles shall not be overloaded. Relevant measures shall be taken to prevent dropping of residual soil being transported during transportation. Before departure, soil attached on wheels of vehicles shall be swept out with broom to prevent falling off of spoiled soil to affect environmental cleanness. Besides, clean-keeping system shall be implemented for road under construction, to ensure spoiled soil can be timely cleaned up once being found.

During construction, the major impact on ambient air is from dust. Dust is generated during excavation on dry ground surface and hole drilling, part of which will suspend in the air and other part will drift with wind and down to nearby ground and surface of buildings. In case of strong wind, dust will fly during pile-up of excavated soil, part of which will fly and fall off during handling & transportation of such excavated soil. The soil entrained by rushing rainwater is scattered on ground surface, and will generate dust nuisance due to movement of vehicles or wind after being dried. Backfilling of excavation earth will also generate a large amount of dust nuisance. Handling, transportation and stacking of construction materials will inevitably cause falling off and flying of dust.

Hazard of dust pollution during construction shall not be neglected. If construction personnel and surrounding residents imbibe dust floating in the air, various respiratory diseases will be caused. What’s more, since dust contains lots of pathogenic bacteria infecting various diseases, health of construction personnel and surrounding residents will be seriously influenced. In addition, because flying dust will reduce visibility, traffic accident will be easily caused. Dust drifts down to buildings and trees and their leaves, affecting landscape. Therefore, the owner shall strengthen management and take appropriate measures to strictly control dust generated during construction. In order to minimize impact of project construction on surrounding environment, the following preventive measures are recommended:

1) Special personnel shall be allocated to be responsible for constriction site, so as to realize scientific management and civilized construction. During construction of foundation, relevant measures shall be taken as much as possible to accelerate project schedule, and earth-rock shall be transported out to specified place to shorten hazardous period of stacking.

2) Floor of construction site must be hardened, and concrete floor may be adopted if conditions permit.

3) During excavation, hole drilling and demolition, water shall be sprayed to keep construction site wet in a certain degree. Specifically, loosen and dry surface soil on construction site shall be watered regularly to prevent dust; when soil is backfilled, dry surface soil shall be watered appropriately to prevent dust from flying.

4) To strengthen management for stacking yard of soil to be backfilled, measures for compacting, regular watering and covering of earth surface shall be prepared. Needless soil and construction materials shall be carried away in a timely manner, and should not be stacked for a long time.

5) Anti-spraying equipment shall be provided for truck transporting soil and transport vehicle of construction materials, and the load should not be too full, so as to ensure soil and materials will not be scattered during transportation. Running route and schedule shall be planned appropriately to avoid driving in such sensitive areas as busy area, intensive traffic area and residential area. In section with high environmental requirement, transportation shall be conducted at night based on actual conditions, so as to reduce impact of dust on environment.

6) Top of transport vehicle shall be covered, and handling site shall be washed cleanly before handling to prevent soil carried by wheel and chassis from falling on road surface.

7) Soil scattered on pavement during transportation shall be swept timely to reduce dust during running of transport vehicles.

8) Sand and cement, which are stacked outdoor and will easily generate dust nuisance, shall be covered with canvas and plastic cloth to prevent dust from spreading.

9) During construction, it is prohibited to use discarded construction materials as fuel.

10) Fence on demolition construction site shall be complete.

11) After completion of construction, road and vegetation on the land occupied by construction shall be restored timely.

12) Demolition and road construction sites shall be embosomed with color steel plate.

13) Transportation shall be rationally arranged. Bulky members and massive materials as well as spoiled soil required during construction shall not be transported in rush hours, so as to relieve traffic pressure and minimize automotive emission.

(2) Preventive Measures for Tail Gas Pollution Caused by Construction Machines and Transport Vehicles

Construction machines & equipment and transport vehicles conforming to national health and protection standards shall be adopted so that the gas emissions can meet relevant national standards. Overload limit, speed limit, exhaust purifier installation, and other measures can be taken to reduce impact of the exhaust from transport vehicles and construction machines on the surrounding residential area.

8.2.5 Environmental Protection Measures for Water Environment Impact

(1) Stacking of construction materials including asphalt, cement, oil fuel and chemicals shall be managed properly, and coverings shall be added during stacking. Such construction materials shall not stacked besides rivers, when necessary, fence shall be provided to prevent such materials form being rushed into rivers along rainwater runoff to cause pollution in case of rainy season or rainstorm.

(2) During construction of pipes along or crossing rivers, it is prohibited to dump waste from pipe installation into the rivers nearby. Such waste shall be transported to specified filling position of subgrade or to specified location for disposal.

(3) Intercepting ditch shall be provided around machine storage yard within maintenance area, to prevent mechanical grease dirt form being rushed into surrounding environment along rainwater to cause pollution. Wastewater collected in the intercepting ditch shall be naturally evaporated after oil and precipitation treatment. Household waste generated shall be managed properly, and collected regularly and transported to specified location for disposal. Machines in maintenance area shall be maintained to prevent pollution by mechanical grease dirt.

(4) Heavy grease leakage from construction machines shall be prevented. It is prohibited to discharge oily water produced during running of machines into nearby water bodies. It is also prohibited to discharge oily water produced during maintenance of construction machines into water bodies.

(5) In addition, the proposed project is municipal construction project, folk houses, unused plant and warehouse can be rented and used as construction camp. During construction, household wastewater generated by construction personnel can be discharged into municipal wastewater pipe network, and finally delivered to wastewater treatment plant to be treated until standard is met, and then discharged, so as to reduce pollution on environment.

(6) Without prior written consent of supervision engineer, the contractor shall not, for any purpose, interfere natural flowing of river course, water channel or existing irrigation system or drainage system, so as to avoid occurrence of flushing and deposition.

8.2.6 Environmental Protection Measures for Solid Waste Disposal

The solid wastes produced during construction period of the project mainly include construction waste, household waste, and waste from the environmental management of river bank and the ditch clearance and transportation, and sludge from ditch clearance.

Most construction wastes generated during construction period are inorganic wastes which mainly compose of offcut in construction such as discarded mound, tiles, concrete blocks, etc. There are also a small number of organic wastes which mainly include various packing materials such as discarded old plastics, plastic foams, discarded paint and coatings, etc. Surrounding landscape and environmental quality will be affected if these wastes are not disposed properly as they are non-perishable and insoluble. In order to avoid these problems, it is suggested in the EIA that construction wastes generated during construction period shall be transported at any time to the Yinjiagou domestic solid waste landfill for unified disposal or comprehensive utilization. Discarded earth and stone work excavated in construction shall be returned to nature by means of disposal on the spot and be properly filled and compacted.

The household waste mainly composes of organic waste including leftovers and feces. If being piled in construction site without timely and effective disposal, these solid wastes will rot, stink and breed flies, and even trigger infectious diseases when it becomes worse, affecting the health of construction personnel. The household waste during construction period of the proposed project is disposed in a unified manner by stacking in specified places and transporting to Yinjiagou landfill in a timely manner.

The waste from the river bank environmental improvement and gully clearance includes mainly construction waste and household waste, both being ordinary solid waste and can be transported to Yinjiagou Landfill after being collected.

Canal clean-up will be done for Chaoyangdianqu canal as part of gully improvement component. Chaoyangdianqu canal used to be a water channel with function of power generation, now it is mainly for agricultural irrigation. It is surrounded by villages and farmer households, without industrial enterprises. The wastes discharged into the canal are mainly domestic wastewater and household waste. The sludge in the canal is of general composition, which will be delivered to Yinjiagou Landfill in Xining.

During clearance and transportation of solid waste, management shall be strengthened to avoid secondary pollution in the process.

(1) The Owner and relevant departments should jointly formulate proper spoil disposal and transportation plan. Transportation of waste slag at peak traffic times shall be avoided. The transportation of soil residue in bustling downtown sections is prohibited and such transportation should be arranged at night as far as possible.

(2) The contractor of the project shall timely carry away waste slag according to spoil disposal plan. Overload shall not occur. Loader carrying slag shall be slow during driving to reduce spill and leak and keep the city clean.

(3) The Owner shall go hand in hand with the relevant departments undertaking transportation to properly educate drivers about professional ethics, and urge proper waste transport according to the specified route, places and time. Non-scheduled inspection shall also be made.

8.2.7 Measures for Ecological Environmental Protection

(1) Protection Measures for Vegetation

① The current farmland and trees shall be properly protected. It is recommended that construction personnel should receive relevant training before temporary land is used. Civilized operation without damage except the works shall be emphasized. Management shall be strengthened. Strict protection of the trees and vegetation within the temporary land is required to reduce damage to the ecological environment along the project as far as possible.

② The construction of the project, landscape engineering, slope protection, and drainage ditch shall be performed at the same time. It is best to simultaneously carry out utilization, leveling, greening and reclamation. But in view of feasibility, leveling and greening shall remain to be the focus after completion of the works.

③ The land temporarily occupied shall be leveled and reclaimed or greened and renovated in time after completion of the works.

④ The green vegetation outside the land in use shall be protected to the greatest extent. If the current green vegetation is damaged due to construction of temporary works, reclamation shall be undertaken when temporary works are demolished.

⑤ The area of vegetation damaged by the works during construction period shall be strictly controlled. No human destruction shall take place other than inevitable land occupation and tree cutting for the works.

⑥ The education about protection of natural resources and wild animals shall be strengthened among construction personnel. Cutting trees at random is prohibited in employment contract.

(2) Protection Measures for Cultivated Land

① Since the proposed project is located in Xining Municipality and its surrounding area, the construction of pipe network and road is bound to have certain impacts on agricultural development along the project. The unnecessary land shall be occupied as little as possible or not occupied in construction. Operations shall be performed within reach of land used for the project according to greening design requirements.

② The cultivated land shall be occupied as little as possible. The process of taking and removing soil shall be combined with the agricultural development and planning design and the farmland capital construction to provide convenience for developing local economy and solving local practical problems.

③ The requirements of relevant policies shall be carefully implemented for greening of the project. The width of greenbelt shall be strictly controlled if the project is surrounded by cultivated land.

(3) Greening Measures

① Greening measures for main road: Certain amount of vegetation is damaged by slope surface of the proposed highway, temporary land occupation, etc. The vegetation damaged thereby is mainly restored by revegetation. When greening tree and grass species are selected, the basic principle of “matching species with the site” shall be followed to determine the species of trees and grass. Priority shall be given to native trees and grass. Secondary are the introduced trees (grass) that have become accustomed to the local natural environment after being planted for many years. According to the conditions of areas passed through by the proposed highway, the selected trees shall be hardy variety with high survival rate and be characterized by cold resistance, drought resistance, tolerance to barren soil, developed root system, and strong ability in stabilize soil. The grass shall be local grass variety easy to survive. The leanness-resistant hardy grass prone to humus shall be selected.

② Plant measures for areas directly impacted: The areas directly impacted include several types, i.e. cultivated land, barren slope (wasteland), and grassland. The principle for greening of areas directly impacted is to restore the original land use types after completion of the main works. Therefore, land remediation and reclamation to farmland are carried out for cultivated land after completion of the works. Land remediation is carried out for barren slope and grassland after completion of the works to create mixed woodland of arbor and shrub, or plant grass of quality.

③ Greening measures for other occupied land: mainly for restoring the farmland and vegetation damaged by borrow pit.

8.3 Environmental Protection Measures during Operation Period

8.3.1 Environmental Protection Regulations on Road and Pipe Network Works during Operation Period

(1) Protective measures for social environment

1) Before completion and operation of construction, complete the connection with relevant road and setting of safety signs.

2) Perform regular maintenance for the road, so as to ensure the normal traffic.

3) Clean and transport the waste residue removed from road maintenance and other solid waste immediately, and send to the designated location for landfill treatment.

4) Enhance traffic safety management, and play the full functions of road, so as to reduce traffic accident.

5) Provide a reasonable number of waste bins along the road, for convenience of pedestrian littering, so as to maintain urban environmental health.

6) After construction of wastewater pipe network along Xichuan River and Beichuan River, recover the occupied sandstone road.

(2) Protective measures for ecological environment

1) After road construction, perform soil conservation, control and beautification in the area affected by road, and recover the destroyed vegetation, so as to reach harmony and unity in soil erosion control and road greening and beautification. Plant measures layout of road shall conform to soil conservation, reasonable layout, each characteristic, and combination of point, line and plane, so as to form a complete greening system.

2) Pack the household waste along the road in bags by classification for centralized treatment.

3) During operation period, try best to avoid destroying original landform for road maintenance.

(3) Protective measures for acoustic environment

1) Strengthen traffic management, and reduce noise source.

The traffic noise is one of the main sources of urban noises, so further enhance motor vehicles and road traffic management in the whole urban area. Perform strict quality control for annual vehicle audit, to eliminate tricycles. Meanwhile, set speed limit and no horn signs in the road section near the important sensitive points (for example, school, and village close to the road), so as to mitigate the effect of noise. Remove roadblocks immediately to ensure carriageway and sidewalk clear. Maintain the evenness of road surface, to avoid the traffic noise increased by pitching of vehicle for poor road conditions. For motor vehicles, perform civilized driving, reduce number of honking, and decrease the intensity of mobile noise, so as to decrease the impact of traffic noise.

2) Make the public participant in the environmental noise pollution prevention consciously through publicity.

Environmental protection department shall vigorously promote Noise Pollution Prevention Law, Environmental Quality Standard for Noise, relevant regulations and systems, and support the public participant in the environmental noise pollution prevention with the help of social opinion. Improve the citizen’s awareness on noise pollution hazard through publicity, so as to reduce or resist strong noise pollution source.

3) Enhance urban landscape engineering, in combined with urban renovation, enhance urban landscape engineering, and choose suitable seeds of trees, plant density and width of vegetation, so as to absorb sound waves and reduce noise. Plant street trees on both side of the road timely, and carry out effective maintenance and management, so as to form a green screen, which can effectively reduce the noise pollution and beautify the environment.

4) When planning house building on both side along the road, consideration shall be given to the impact of traffic noise of the proposed project. It is suggested that the residential area faxing the road directly shall not be planned within 35m away from the red line of road, and the construction of school shall be 150m away from the center of road, so as to ensure that the traffic noise of the Project will not affect he people’s life along the line.

According to the specific environmental characteristics and functions of Beichuan area, in combined with the future economic development characteristics, it is suggested to strengthen the monitoring on the road sections near residential district, office building, school, hospital, etc. to be built in the area. And necessary protective measures for acoustic environment shall be taken, according to monitoring results and impact degrees.

5) Sound proof wall shall be set up surrounding the Kunlun College of Qinghai University and No.4 High School of Xining City to reduce impact of construction under the project on teaching activities of the college and school. Details of the planned sound proof walls are shown in Table 8.3-1 and location of the walls are shown in Figure 8.3-1 and Figure 8.3-2.

Table 8.3-1 Details of the Planned Sound Proof Walls

Sensitive Receptors	Location of the Sound Proof Walls	Type of the Wall	Height	Noise Abatement Capacity	Cost (yuan/m)	Length
Kunlun College of Qinghai University	Northeastern corner of the college site North side	Upright	3m	6～8dB(A)	1300	100m
	Northeastern corner of the college site Eastern side	Upright	3m	6～8dB(A)	1300	100
No.4 High School of Xining	Northern side of the school, teaching area	Upright	3m	6～8dB(A)	1300	200
Total					Length	400m
					Cost	520 thousand yuan

Figure 8.3-1 Location of the Sound Proof Wall for Kunlun College of Qinghai University

Figure 8.3-2 Location of the Sound Proof Wall for No.4 High School of Xining

(4) Protection measures for water environment

1) Forbid various vehicles with leakage and overload in bulk on the road, to avoid water pollution caused by loss of goods on the road; try best to collect the oil leaked for traffic accidents, so as to reduce the pollution of ground water, natural vegetation and crops.

2) Check and maintain the facilities for soil conservation works and drainage works along the line regularly, and repair immediately in case of damage. Check the sediment deposition in the culvert along the line regularly, and desilt timely.

3) In case of heavy wind, heavy fog, icy pavement and other serious conditions, remind the drivers to slow down, so as to reduce the rate of the traffic accidents.

4) According to the requirements for bridge maintenance in *Technical Specification of Highway Maintenance* JTJ073-96, enhance the safety inspection and monitoring for bridge project, and ensure the safety of the section in important water areas.

5) Perform water quality monitoring plan, and take additional environmental protection measures according to the water quality monitoring results. The measures are as follows:

① The water drained from bridge surface is introduced to wastewater pipe network, and do not enter the river directly. Warning board shall be set to remind the driver of carefully driving.

② Engineering protection measures, such as, guard rail reinforcement, shall be taken on both sides of the crossing bridge, so as to avoid the vehicles falling into river for sudden accidents and pollute the water.

③ For hazardous materials transportation, strict management measures shall be taken, and the vehicles shall be equipped with complete certificates, and qualified for hazardous materials transportation. Obvious signs of vehicle for hazardous goods shall be marked on the vehicles. In special weather, such as, snow and fog, vehicle for hazardous goods shall be forbidden on the road.

(5) Ambient air protection measures

1) Enhance vehicle management. Environmental protection and traffic police department shall enhance supervision and monitoring, strictly enforce the inspection system for vehicle emission, and forbidden the vehicles with the discharge of pollutants exceeding the current vehicle emissions standards according to relevant regulation on the road or specify its drive route.

2) Enhance management for transport vehicles, and forbid the vehicles without covering on the road which may cause raising dust during transportation.

3) Enhance road management and road surface maintenance, and maintain good operation of road, so as to reduce traffic jam.

4) Plant more trees and grasses on both sides of the road, which can not only absorb and purify the pollutants in the vehicle emissions, but also beautify the environment and improve landscape along the road.

5) Carry out the ambient air monitoring program, and take corresponding environmental protection measures according to monitoring results.

(6) Measures on solid waste disposal

1) Develop and promote laws and regulations to forbid the passengers and pedestrians littering on the road, so as to ensure traffic safety and cleanliness on both sides of the road.

2) Set trash container or garbage can on bus stop and both sides of the road for convenience of passengers. Forbid to build an exposed dump of refuse.

3) Enhance management, clean and transport waste timely, transport the stacked waste to Yinjiagou household waste landfill in Xining for centralized treatment, and forbid littering at random.

8.3.2 Regulations on Environmental Protection of Reclaimed Water Plant during Operation Period

(1) Ambient air protection measures

1) Carry out greening in and around the site, try to expand the area of green land and plant evergreen arbor and shrub, and flowers and plants which have certain function of absorbing the stench.

2) The greening area in the site shall be more than 30% of the total area of plant area in the feasibility study design.

(2) Protective measures for acoustic environment

1) Use low speed water pump;

2) Provide a cover for recycled water basin.

(3) Protection measures for water environment

Daily maintenance of water reclamation plant shall be carried out during the operation period to ensure normal operation of the plant and reclaimed water treatment equipment and reduce possibility of abnormal discharge. Meanwhile, supervision of the quality of water shall be strengthened. Special emergency response scheme shall be prepared for the reclaimed water treatment plant and there shall be special personnel in charge. In case of abnormalities, handling measures shall be taken immediately to ensure that the effluent quality reaches the standards for discharge.

(4) Measures for mitigation of impact on ecological environment

After construction of water reclamation plant, greening will be carried out in the plant area. According to the preliminary scheme of feasibility study, the greening area in the plant area shall not be 30% smaller that that of the plant area. Meanwhile, greening will be carried out within the protection range of atmospheric environment of the wastewater treatment plant. Therefore, the construction of water reclamation plant will improve the surrounding ecological environment at the plant site.

8.3.3 Control and Prevention Measures against Environmental Risk Accident of Wastewater Interception Pipe Network

According to the relevant information, accidental discharge of wastewater pipe network is mainly caused by the following reasons:

(1) Spillover of wastewater caused by pipe rupture.

(2) Pump house accident, i. e. spillover of wastewater caused by suspension of operation.

(3) Blockage of discharge outlet caused by breakage of discharge pipe;

Generally, in the first situation, spillover of wastewater in the pipe is caused by excavation of other works. The amount of spillover is related to the wastewater volume transported by pipe, and repair schedule. In case of such accidents, first-aid repair shall be organized timely to reduce the wastewater spillover and the impact on surrounding environment as far as possible.

In the second situation, precaution shall be considered during the design. Standby power shall be provided in the wastewater pump station (power shall be supplied by double return circuit), so as to avoid shutdown of pump station because of power failure. Besides, standby units shall be provided in the pump station, to deal with the repair and mechanical failure of water pump.

In the third situation, generally flotsam collision for non-human factors and storms cause breakage of discharge pipe, blockage of discharge outlet or weaken diffusion effect, thus polluting the water quality around the discharge outlet.

Therefore, relevant departments shall strengthen management of wastewater pipe network. In case of breakage of pipe network, emergency measures shall be taken immediately to repair and maintain, so as to avoid the accidental spillover of wastewater causing relatively large environmental impact.

8.3.4 Control and Precaution Measures for Road Environmental Risk Accident

Since the transportation risk of hazardous substances is caused by sudden traffic accidents, certain management means can be taken for prevention. With regards to the environmental impact that might be caused by traffic accident of vehicles for transporting hazardous substances, in order to avoid the occurrence of hazardous accidents, control the range and degree of influence after accident and mitigate the losses caused by accident, the following measures are hereby put forward:

(1) The vehicles without certificate, signs, or with leakage, overload of dangerous chemicals in bulk is forbidden on the road;

(2) Consigner must submit to relevant departments of public security organ timely for application, approval and supervision of public security organ.

(3) The unit delivering the cargo shall be qualified for transportation of hazardous substances. Driver delivering the cargo and supercargo shall be qualified to perform duties, and improve skill of driver, enhance education on safe driving and courteous driving. Carrier vehicles and vessels shall conform to relevant national standards.

(4) In case of transportation of highly toxic chemical, transportation shall be performed according to "Road Transport Pass for Highly Toxic Chemical" approved and issued by public security organ;

(5) Under adverse weather conditions, such as, heavy fog and heavy wind, vehicles for hazard transportation shall be forbidden on the road;

(6) Visible signs shall be provided on the road close to river, so as to draw the attention of drivers for hazardous substance transportation. Speed limit signs and speed bumps shall be provided, so as to reduce accident rate;

(7) After accident, drivers and carriers shall report immediately and indicate all important related matters.

(8) After receiving the report, the traffic administration and highway management department shall report to municipal government, and start emergency plan for emergency treatment of accident;

(9) For the drivers for transporting hazardous substances, relevant department shall carry out business training for eliminating traffic accident of vehicles for transporting hazardous substances regularly, so as to enhance awareness of unexpected development of employees, and minimize the accident risk for transporting hazardous substances.

8.3.5 Emergency Preparedness Plan for Transportation Risk of Dangerous Goods

In recent years, with the increasing volume of dangerous goods year by year, road and bridge shoulder a hard transportation task of vehicles transporting such dangerous goods as fuels and chemicals. The probability of leakage and explosion of dangerous goods during transportation is greatly increased. *Emergency Plan for Transportation Risk of Dangerous Goods* is prepared to strengthen effective control on transportation accident of dangerous goods, reduce accident hazard at the most extent, ensure people's safety of lives and properties, and protect environment.

(1) Guiding thought and principle of emergency rescue plan

The guiding thought of emergency rescue plant is to reflect the people-oriented idea and to implement the policy of "safety first, precaution crucial". Once traffic accident occurs that is harmful to environment, rescue can be carried out at the fastest speed to the best effect orderly, so as to reduce casualties and property losses to the largest extent, minimize the accident hazard, and safeguard the living safety and stability of the masses along the line.

The principle of emergency rescue for risk and accident is to respond rapidly, obey unified command, realize graded responsibility, and achieve the combination of unit self-help and social rescue.

(2) Establishment and responsibility of discipline group for site rescue

It is recommended that the local government should establish rescue command department for traffic accident, and establish the following rescue discipline groups based on actual situations:

1) Danger source control group: be responsible for site rescue work under emergency and timely control of danger source, as well as immediate organization of special protective equipment and tools according to the nature of dangerous goods.

2) Rescue group for the injured: be responsible for setting up temporary medical assistance station in a safe area near the site, conducting emergency treatment for the injured and escorting the heavy injured to hospital for further treatment.

3) Fire-fighting rescue group: be responsible for fire-fighting on site, research and rescue of the injured on site, cooling of equipment and vessels, rescue of the injured and post-accident decontamination of contaminated area.

4) Safety evacuation group: be responsible for protection and guiding of people on site and around, evacuation of people, transfer of surrounding materials and the like.

5) Safety alert group: be responsible for laying out safety alert line, forbidding irrelevant personnel and vehicles to enter dangerous area, performing security patrol in evacuation area of personnel.

6) Material supply group: be responsible for organizing the supply of emergency materials and arranging vehicles to transport.

7) Environment monitoring group: be responsible for monitoring such environments as atmosphere, water and soil in real time, determining the composition and concentration of hazardous substances, confirming area and range of contamination, assessing environmental impact caused by accidents, formulating environmental restoration scheme and organizing implementation. The group consists of environmental monitoring mechanism and chemical detection mechanism, and is under the charge of Environmental Protection Agency.

8) Expert consultation group: be responsible for putting forward emergency rescue scheme and safety measure for accidents, and providing technical advice for site command and rescue work.

8.4 Cost Estimate for Environmental Protection

Total investment of the proposed project is RMB 1,524.1771 million, including investment for environmental protection of RMB 10.81 million, accounting for 0.71% of the total project investment.

Breakdowns of environmental protection investment are included in the cost estimate of *Environmental Management Plan*.

9 Analysis of Rationality of the Project Implementation

9.1 Conformity to Industrial Policy

The proposed project fits in with Item 3 '*Urban public transport construction*', Item 9 '*Urban water supply and drainage pipe networks*', Item 13 '*Urban landscaping and eco-community development*', Item 16 '*Application of key technologies to urban ecological system*', and Item 19 '*Technologies and construction for reclaimed water utilization*' of Article 22 '*Urban Infrastructure Construction'* Class I (Encouraged Projects) included in No.10 Order - *Guiding Catalogue for Industrial Structure Adjustment (2011 edition)* issued by the National Development and Reform Commission. It also meets requirements on utilization and recycling of reclaimed water stipulated in the national law on promoting circular economy. Therefore, implementation of the project is in line with requirements of current industrial policy of China.

9.2 Compliance with Integrated Water Environment Management Plan of Huangshui River Basin

The project objective to improve coverage of urban drainage pipe network meets the following requirements stated in the *Integrated Water Environment Management Plan of Huangshui River Basin* as: '*give priority to wastewater collection pipe network, fully improve wastewater treatment rate, realize "full collection and full treatment", complete as soon as possible comprehensive renovation of discharge outlets in city territory, realize the objective that the load rate of wastewater treatment plants is not less than 80%'.*

The project objective to improve river bank environment meets the following requirements stated in the *Integrated Water Environment Management Plan of Huangshui River Basin* as: '*fully promote the river regulation works, perform comprehensive management of river bank environment, mainly including flood prevention, road, greening, lighting, waterscape etc., enhance efforts in controlling sand excavation in river and rubbish dumping'.*

The project objective using recycled wastewater as replacement for municipal water uses and reducing pollutants discharged into the river meets the following requirements in the *Integrated Water Environment Management Plan of Huangshui River Basin*: *'conduct overall planning for construction of reclaimed water recycling works, vigorously push forward reclaimed water utilization in water shortage areas, such as Haidong area of Xining, expand scope of reclaimed water utilization, realize the objective that reclaimed water utilization rate reaches 30% and above in Xining Municipality'.*

The objective to improve flood gully ecological environment meets the following requirements in the *Integrated Water Environment Management Plan of Huangshui River Basin*: *'improve flood gully eco-environment by strengthening efforts in eco-environmental construction of Huangshui River Basin, further increase forest and grass coverage, continue to implement water and soil conservation and ecological restoration works, such as watershed improvement in urban area of Xining, so as to reduce quantities of sediment and pollutants entering into rivers'*.

9.3 Compliance of Reclaimed Water Reuse Component Included in the Project with the Master Plan of Xining Urban Development

According to Master Plan of Xining Urban Development, reclaimed water recycling system should be established in combination with wastewater treatment plant, and wastewater is to be locally recycled for uses by industrial zone, urban greening, road watering, dust laying and ecological water compensation for rivers and lakes.

Arrangement of wastewater treatment plants should be based on the principal of combing central and distributed systems. Wastewater treatment rate is planned to reach 90% and above. Six wastewater treatment plants are planned to be completed. The total scale of treatment is planned to reach 440 thousand ton/day at the end of the planning period. Reclaimed water recycling system shall be established by taking the effluent of wastewater treatment plant as water source and reaching reclaimed water recycling rate of 31%.

Table 9.1-1 List of Reclaimed Water Plants Planned

Reclaimed Water Works	No.3 Reclaimed Water Plant	35,000 m^3/d	New
	No.4 Reclaimed Water Plant	36,000 m^3/d	New
	No.5 Reclaimed Water Plant	16,000 m^3/d	New
	No.6 Reclaimed Water Plant	32,000 m^3/d	New
	Chengnan Reclaimed Water Plant	18,000 m^3/d	New

The demonstrative reclaimed water plant included in the proposed project meets requirements in the Master Plan of Xining Urban Development, and the plant is reasonably located at the periphery of the city, having few impacts on lives of residents.

9.4 Compliance of Project Activities in Beichuan Area with Beichuan (Core Area) Development Plan

(1) Road Design

1) Road planning for Beichuan River (Core Area)

Design of road framework for the area is based on requirements on roadway network development stipulated in the city's master plan, and functional zoning and topographic conditions are considered in designing the grids of roads for the area to form a road system with distinct functions for trunk road and branch roads.

A road network structure featured by "three horizontal and three vertical roads and cluster road development" is planned for the Beichuan core area as per the city master plan, including:

Three horizontal roads: Xining-Zhangye Highway, two secondary trunk roads on the both sides of existing railway. Recently, because of railway impact, road traffic should not across the railway. After removal of remote railway, it is suggested that these two secondary trunk roads are merged to be one major trunk road, and ecological green gallery should be maintained; and a arc secondary trunk road along the Xining-Datong Expressway crosses the whole place, mostly acts as a tourism landscape channel.

Three vertical road: extension of Qinghai University Road, Weier Road and Tianjun Road.

Extension of Qinghai University Road: it is located in north of the place, runs from east to west, and is the east extended line of Qinghai University Road (urban trunk road). It is convenient to connect each development unit in the north, so as to enhance functional connection of all zones.

Weier Road: it is an urban trunk road, located in core zone. And the urban core function will be deployed along the road.

Tianjun Road: it is a trunk road in the south. The flyover exit of Xining-Datong Expressway is in the east. It is convenient to connect each functional group in the south.

Cluster road development: the land for road development is narrow and separated by rivers and railway as many pieces. Roads need to be planned based on such natural zoning by river, gully and railway, and by taking into consideration the multilayers of terraces existing in the area, so as to form a cluster of branch roads.

2) Road Design for Beichuan Area

In the area, the road structure is chessboard-shaped, consisting of main framework of five horizontal and one vertical trunk road, secondary road, and tertiary (branch) roads, for which, the five horizontal and one vertical of trunk road including five horizontal (extension part of Beiyuan Road, extension part of Liujiagou, extension part of Erwei Road, extension part of Sanwei Road and extension part of Siwei Road) and one vertical (Tiedong Road). One highway entrance connected with Xining-Datong Expressway is added (extension part of Liujiagou intersects with Xining-Datong Expressway).

Set highway entrance depending on general regulation, break through the external traffic bottleneck; break through the channel connected to Xining urban area to the south; and extend the East Chaoyang Road and Beichuan River West Road as the effective supplementary traffic facilities for connecting the site with the municipality, so as to improve the constitution of internal road traffic network in the area.

3) Conformance Analysis

Based on understanding of the planned road traffic system in Beichuan River Area (Core Area) included in the Design for Comprehensive Improvement of Beichuan Core Area in Xining (under preparation) and actual situation in the area, adjustment is made under the proposed project for road development in the area. Number of trunk roads is changed from three horizontal and three vertical ones to five horizontal and one vertical. But the regional road functions are still the same, that is, Road network construction in Beichuan Area. The functions are traffic infrastructure in Beichuan area and regional traffic circulation. The proposed project construction is consistent with planning layout, and the basic functions aren't changed, and conform to the planning.

(2) Conformance with Municipal Drainage Design

1) Wastewater Pipe Network Planning of Beichuan River (Core Area)

The principle for wastewater pipe network layout is that by making full use of the terrain, the wastewater shall flow by gravity, and the terrain in the planning zone shall be lower in the south and higher in the north, so as to determine main drainage in the planning zone is from north to south. In combined with the terrain in planning zone, it can be determined that two wastewater main pipes is provided in the planning zone, one is laid along the east side of railway, and the other one is laid along the east side of Beichuan River, which is connected to the wastewater main pipe in Tianjun Road.

According to terrain conditions and road vertical planning, wastewater pipe diameter calculation is based on the maximum wastewater volume. The wastewater pipe is laid along the water collection side of the planning road, which is in west and north direction in principle. The pipe diameter shall be no less than 300mm. the minimum slope is 3. In the vertical layout, the wastewater pipe is located below the rainwater pipe and the wastewater pipe network construction and the road construction is synchronous.

2) Conformance Analysis

In the planning area, wastewater interception main pipes are designed to be installed along the east side of Tiedong Road, and the wastewater collection pipes are all designed to be installed along the designed roads, all conforms to the plan.

(3) In conclusion, design of roads and drainage works under the proposed project conform to the Beichuan River (core area) plan.

9.5 Feasibility of Site Selection of the Reclaimed Water Recycling Plangt

The proposed reclaimed water plant is located in the south-east corner of the No.5 WWTP, land there is still a vacant lot, vast, flat and immediate to No.5 WWTP.

According to conclusions in EIA of No.5 WWTP, the wastewater treatment plant has a buffer distance of 50m for sanitary protection, within which no sensitive receptors to environmental impacts are found. Based on field investigation, in the surrounding area of No.5 WWTP, sensitive receptors include mainly Shuangsubao Village, which is situated in north-eastern side and south-eastern side of the plant. Prevailing wind direction in Xining is southeast wind, so the wastewater treatment plant is at the downwind direction of the prevailing wind of the village.

After completion of the reclaimed water plant, reclaimed water storage pond will be the main structure that may generate odors. The pond has a dimension of 15.9x15.9x4.5m as designed, contact area of the water body and air is as small as 252.8m^2, and water in the pond is treated water from No.5 WWTP, with little odors. Therefore, construction of the reclaimed water plant won’t greatly increase concentration of odor pollutants within the area. Besides, the reclaimed water plant is located in the west of No.5 WWTP and at the downwind direction of prevailing wind direction of Shuangsubao village. The closest house is about 100m away from the reclaimed water plant, far from the residential area. After being put into operation, the reclaimed water plant has very little impact on lives of surrounding residents.

To summarize, site selection of the reclaimed water plant is feasible.

10 Environmental Risk Assessment

Environmental risks of the project are analyzed according to the *Technical Guidelines for Environmental Risk Assessment on Projects* (HJ/T169-2004).

10.1 Risk Source Analysis

For types of potential accident risks, refer to table 10.1-1.

Project Activities	Risk Factors	Types of Potential Accidents
Wastewater interception pipe network	COD, BOD5, ammonia nitrogen, etc. in wastewater	Pipe blockage, pipe rupture, etc., result in overflow of a lot of wastewater from the wastewater interception pipes, causing pollution to surface water and groundwater.
Reclaimed water recycling pipe network		Pipe blockage, pipe rupture, etc., result in overflow of a lot of wastewater from the reclaimed water recycling pipes, causing pollution to surface water and groundwater. But quality of reclaimed water is better than that of wastewater, so such accidents of reclaimed water pipes have smaller environmental risk for surface water and groundwater.
Roads	Transport of hazardous articles	Accidental release, explosion, burning, etc. occur during transportation of hazardous articles.

10.2 Environmental Impact Analysis of Risk Accident

10.2.1 Environmental Impact Analysis of Risk Accident of Wastewater Interception Pipe

If an accident occurs with wastewater interception pipe, a lot of wastewater will overflow to pollute surface water and groundwater. Beichuan River and Huangshui River are close to the pipes, overflow from the pipes may go directly into the rivers instead of being collected, which will cause deterioration of downstream water quality.

10.2.2 Environmental Impact Analysis of Road Accident

For road construction activities, the protected objects of environmental risk shall be analyzed according to environmental elements. Generally, such protected objects include water environment, atmospheric environment and ecological environment.

(1) Water Environmental Risk

In the Project, water pollution accidents for road construction activities mainly include the following three conditions: (1) Accidental release, explosion, burning, etc. occur during transportation of hazardous articles along the river, and the accidental wastewater flows into the nearby water bodies. (2) The traffic accident of vehicles for hazardous substance transportation might directly cause fire or explosion, damage structure, cause temporary traffic jam. But the situation is locally, and the duration is short. (3) Dangerous substances leak and are discharged into water bodies, which will pollute farmland seriously, affecting agriculture and reducing farmer's economic income. And this will directly or indirectly affect the survival of fishes and aquatic organisms in the river. Thus, it can be seen that, when risk accident occurs for road and bridge works, the leaked hazardous substances will pose a great threat to the surrounding water environment and people's life.

(2) Atmospheric Environmental Risk

In the Project, the accidental air environmental risk for road works mainly comes from transportation of poisonous, hazardous and volatile substances at normal temperatures and pressures, and mostly are liquefied gases, mainly including liquefied petroleum gas, chloroethylene, butadiene, propylene, liquid chlorine, etc. The biggest potential risk of this substance is that it spreads around in a gaseous form, coupled with suitable meteorological conditions (air temperature, air pressure, air direction, air speed, etc.), the negative effects of accident will be amplified rapidly. In this way, when the hazardous substances is close to various sensitive points, once serious traffic accident occurs, the people's production order and life security along the line will be treated severely.

(3) Ecological Environmental Risk

The protected targets for ecological environmental risk mainly includes the aquatic organisms in the river, wildlife in riverbank and farmland vegetation, and the leakage of hazardous substances will pollute the groundwater through soil medium. Therefore, during operation, the project road works has potential risk in groundwater environment, and necessary precautions must be taken, such as, setting of road rainwater runoff collection and discharge system.

(4) Life Safety Risk

After the traffic accident of vehicles for transporting hazardous, poisonous and hazardous substances, leakage will be caused, and will threat the surrounding pedestrians' lives.

It can be seen from the above analysis that, for risk of road accident, the source mainly comes from the vehicles for transporting hazardous chemicals and poisonous and hazardous substances. They leak in case of emergency, so as to threat the surrounding environment and pedestrians' safety.

The proposed project is located in Xining Municipality. According to the management requirements for transport vehicles of hazardous substances in Xining Municipality, the vehicles carrying above substances are not allowed to enter the municipality, thus, the incidence of accidental risk is small with the enhanced management of vehicles.

10.3 Countermeasures for Environmental Risk Accident

10.3.1 Control and Protective Measures for Environmental Risk Accident of Wastewater Cut-off Pipe Network

According to relevant information, accidental discharge of wastewater pipe network is caused by the reasons as below:

(1) Wastewater overflow caused by pipe rupture.

(2) Pump house accident, wastewater spillover caused by stopping operation.

(3) Blockage of discharge outlet caused by breakage of discharge pipe.

Generally, the first condition is wastewater spillover caused by excavation of other works. Its amount of spillover is related to the wastewater volume transported by pipe, and repair schedule. In case of such accident, first-aid repair shall be organized timely, try best to reduce the wastewater spillover and reduce the impact on surrounding environment.

In the second situation, precaution shall be performed during design. Standby power shall be provided in the wastewater pump station (power shall be supplied by double return circuit), so as to avoid shutdown of pump station because of power failure. Besides, standby units shall be provided in the pump station, to deal with the repair and mechanical failure of water pump.

In the third situation, flotsam striking for non-human factors and storms cause breakage of discharge outlet, blockage of discharge outlet, or weaken diffusion effect, so as to pollute water quality around the discharge outlet. Therefore, relevant departments shall strengthen management on wastewater pipe network. In case of breakage of pipe network, emergency measures shall be taken immediately to repair and maintain, so as to avoid the accidental spillover of wastewater causing major environmental impact.

10.3.2 Control and Precaution Measures for Road Environmental Risk Accident

The transportation risk of hazardous substances is caused by sudden traffic accidents, so management shall be enhanced from the source, and the vehicles for transporting hazardous substances shall not be allowed to enter the urban area. With regards to the environmental impact might be caused by traffic accident of vehicles for transporting hazardous substances, in order to avoid the occurrence of hazardous accidents, and control the range and degree of influence after accident, mitigate the losses caused by accident, the following measures shall be put forward:

(1) The vehicles without certificate, signs, or with leakage, overload of dangerous chemicals in bulk are forbidden on the road;

(2) The consigner must submit to relevant departments of public security organ timely for application, approval and supervision of public security organ.

(3) The carrier shall be qualified for transportation of hazardous substances. Carriage driver and supercargo shall be qualified to perform duties, and improve skill of driver, enhance education on safe driving and courteous driving. Carrier vehicles and vessels shall conform to relevant national standards.

(4) In case of transportation of highly toxic chemical, transportation shall be performed according to "Road Transportation Pass for Highly Toxic Chemical" approved and issued by public security organ;

(5) Under adverse weather conditions, such as, heavy fog and heavy wind, vehicles for hazardous substance transportation shall be forbidden on the road;

(6) Visible signs shall be provided on the road close to river, so as to draw the attention of drivers for hazardous substance transportation. Speed limit signs and speed bumps shall be provided, so as to reduce accident rate;

(7) After accident, drivers and carriers shall report immediately and indicate all important related matters.

(8) After receiving the report, the traffic administration and highway management department shall report to municipal government, and start emergency plan for emergency treatment of accident;

(9) For the drivers for transporting hazardous substances, relevant department shall carry out training for eliminating traffic accident of vehicles for transporting

hazardous substances regularly, so as to enhance awareness of unexpected development of employees, and minimize the accident risk for transporting hazardous substances.

Emergency measure for environmental risk and accident

In recent years, with the increasing volume of dangerous goods year by year, road and bridge shoulder a hard transportation task of vehicles transporting such dangerous goods as fuels and chemicals. The probability of leakage and explosion of dangerous goods during transportation is greatly increased. Emergency Plan for Transportation Risk of Dangerous Goods is prepared to strengthen effective control on transportation accident of dangerous goods, reduce accident hazard at the most extent, ensure people's safety of lives and properties, and protect environment.

(1) Guiding Thought and Principle of Emergency Rescue Plan

The guiding thought of emergency rescue plant is to reflect the people-oriented idea and to implement the policy of "safety first, precaution crucial". Once traffic accident occurs that is harmful to environment, rescue can be carried out at the fastest speed to the best effect orderly, so as to reduce casualties and property losses to the largest extent, minimize the accident hazard, and safeguard the living safety and stability of the masses along the line.

The principle of emergency rescue for risk and accident is to respond rapidly, obey unified command, realize graded responsibility, and achieve the combination of unit self-help and social rescue.

(2) Establishment and Responsibility of Discipline Group for Site Rescue

It is recommended that the local government should establish rescue command department for traffic accident, and establish the following rescue discipline groups based on actual situations:

1) Danger source control group: be responsible for site rescue work under emergency and timely control of danger source, as well as immediate organization of special protective equipment and tools according to the nature of dangerous goods.

2) Rescue group for the injured: be responsible for setting up temporary medical assistance station in a safe area near the site, conducting emergency treatment for the injured and escorting the heavy injured to hospital for further treatment.

3) Fire fighting rescue group: be responsible for fire fighting on site, research and rescue of the injured on site, cooling of equipment and vessels, rescue of the

injured and post-accident decontamination of contaminated area.

4) Safety evacuation group: be responsible for protection and guiding of people on site and around, evacuation of people, transfer of surrounding materials and the like.

5) Safety alert group: be responsible for laying out safety alert line, forbidding irrelevant personnel and vehicles to enter dangerous area, performing security patrol in evacuation area of personnel.

6) Material supply group: be responsible for organizing the supply of emergency materials and arranging vehicles to transport.

7) Environment monitoring group: be responsible for monitoring such environments as atmosphere, water and soil in real time, determining the composition and concentration of hazardous substances, confirming area and range of contamination, assessing environmental impact caused by accidents, formulating environmental restoration scheme and organizing implementation. The group consists of environmental monitoring mechanism and chemical detection mechanism, and is under the charge of Environmental Protection Agency.

8) Expert consultation group: be responsible for putting forward emergency rescue scheme and safety measure for accidents, and providing technical advice for site command and rescue work.

10.4 Conclusion of Risk Analysis

The analysis on the proposed project shows that, the main risk sources are wastewater overflow from the main wastewater interception pipe and wastewater regeneration pipe network due to some reasons, and sudden leakage & explosion of dangerous articles during transportation. There is no major source of danger in the project. By taking corresponding preventive measures and emergency measures, the environmental risk of the proposed project can be minimal and acceptable.

11 Public Consultation

11.1 Purposes and Significance of Public Consultation

Public consultation in the process of environmental impact assessment is for quality improvement of EIA and for more information and suggestions to be incorporated into the assessment process to make it a democratic and public process. By enabling people directly or indirectly related to the project to participate in the assessment process to air their opinions and views, transparency and reliability of the assessment results can be ensured and thus a thorough and fair environmental impact assessment can be achieved.

As an integral part of environmental impact assessment, public consultation is an effective approach towards scientific decision-making and also an important means of improved mutual communication and exchange between the project construction unit, environmental assessment unit and the public, since extensive public consultation enables full understanding of the public that may be impacted directly or indirectly by the project construction of the possible environmental impacts caused by the project, the mitigation measures and social and economic benefits of the project, and it makes it possible for their opinions and suggestions to be heard and their supported and active contributions of new and better ways to be solicited, so that solutions can be found to reduce adverse environmental impacts to minimal level and avoid disputes due to pollution during construction or operation stage and therefore the harmony of development and environmental protection can be achieved.

The purposes of public consultation include mainly:

(1) To have comprehensive analysis of public opinions and incorporate them into environmental protection supervision measures designed for the project and also take them as guidance to work and actions for construction under the project;

(2) To link up the public with construction unit by introducing to the public in detail project overview, possible pollution impacts and the prevention and control measures, prediction results of environmental assessment while feeding back to the construction unit public opinions and suggestions with adjustment proposals, that is, acting as a bridge of understanding between the public and construction unit;

(3) To understand various opinions and suggestions from the public and hereby provide reference for protecting vital interests of the public. Through public consultation in environmental assessment, feasible suggestions from the public can be fully incorporated in the project design to reduce as far as possible

adverse impacts on the public and ensure proper compensations to them, thus easing their concerns;

(4) To rely on public supervision in evaluation of environmental management after the impact assessment. Active public consultation is an important component of environmental management mechanism that favors eco-environmental protection, improved environmental and economic benefits and upgraded environmental quality, and guarantees implementation of sustainable development strategy.

11.2 Principle of Public Consultation

Public consultation under this EIA adheres to the principle of ‘openness, equality, extensiveness and facilitation’ and follows the approach and procedures defined based on considerations of timeliness requirement of the task and availability of human, material and financial resources.

11.3 Approach and Steps for Public Consultation

11.3.1 Approach

Two rounds of public consultation and investigation were conducted during the process of environmental assessment for comprehensive and accurate reflection of public opinions and suggestions.

The first round of public consultation was conducted at the early stage of environmental assessment by means of newspaper publicity, posters, interviews and questionnaires and meetings for discussion, so that project information and the potential environmental impacts during construction and operation periods were conveyed to people who might be impacted by the project, they could thus understand the potential impacts of the project on environment and on their lives. Their opinions were taken as findings of environmental assessment and fed back to project implementing entity and designers for use as important reference for the next step project design.

After EIA had come to preliminary conclusions, the second round of public consultation was conducted in the forms of website disclosure, posters and public meetings with project affected people, aiming at enabling the public to clearly understand what environmental impacts the project might cause, how the project would impact on environment, the specific mitigation measures to address those environmental impacts, and positive and negative impacts the project construction might impose on their lives. By doing so, timely understanding of public opinions was achieved and used as important reference for this EIA to come up with corresponding measures.

Details on the questionnaires, posters, newspapers, websites and meetings for the purpose of public consultation are enclosed in the Attachments 4, 5 and 6.

11.3.2 Steps for Public Consultation

During public consultation, the task team members went to the environmentally sensitive sites to interview local people, directly distribute to them questionnaires, put up posters of project information, with assistance and cooperation from local environmental monitoring departments, environmental protection organization, local township governmental departments or villages. Local websites and city level newspapers were also used to disclose project information. Meetings with local people and local departments, phone calls and emails were all used to collect feedback, and the task team and project implementing entity both arranged staff on duty to attend phone calls and keep records of public opinions during the public disclosure period.

After completion of the public consultation, statistical analysis of the findings was conducted to truly reflect opinions of the public and relevant local departments in the project areas and summarize their concerns. Results of such analysis were fed back to the project implementing entity and incorporated into this EIA, together with recommendations on measures to be taken to address the concerns for reference by the project designer and implementing entity.

The steps of public consultation are summarized in the following figure (Figure 11.3-1).

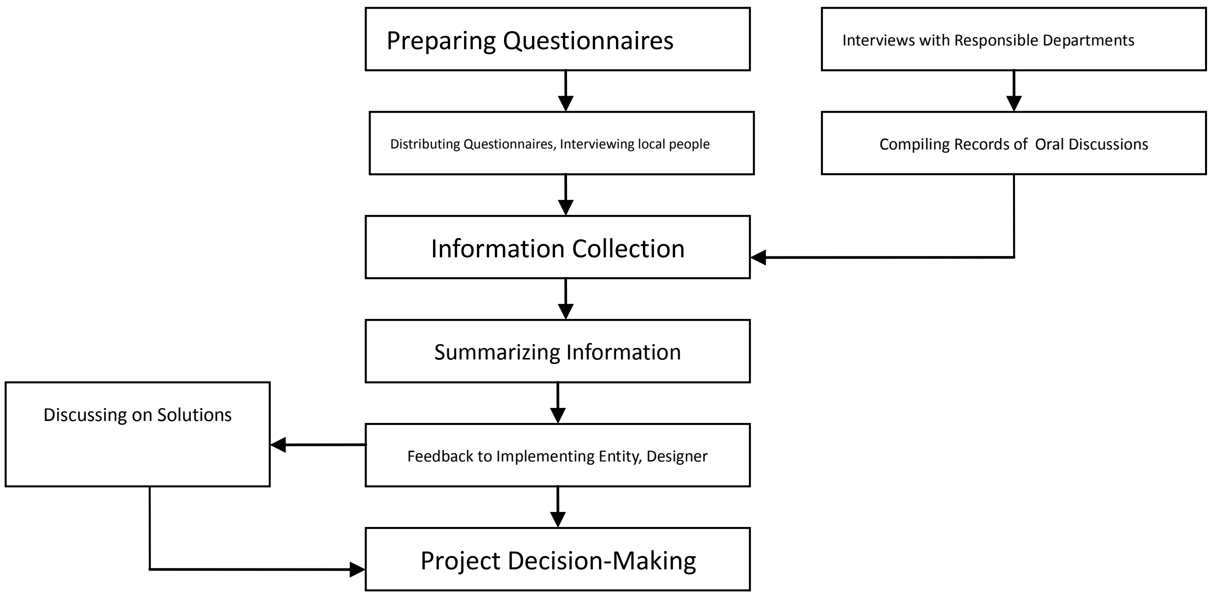


Figure 11.3-1 Steps of Public Consultation

11.4 First Round of Public Consultation

11.4.1 Questionnaires

(1) Targeted group: people living in the project affected areas and households to be relocated. Sampling interviews with adequate representativeness were conducted in the project affected areas.

(2) Contents of questionnaires (see the attachment for details): design of the questionnaires follows principles of 'being simple, using plain and clear-cut language, being easy to understand', and the distribution covers the same scope as the project affected areas. Picture 11.4-1 shows the process of interviews and contents of the questionnaires are shown in the attachment.

(3) Analysis of Results from Questionnaires

Basic information of the interviewees: Questionnaire based interviews were conducted in May 2013 and involved people of different age groups, ethnic groups and of various levels of education, with proper proportion of men and women participation taken into account to ensure representation of women's rights and interests. Totally 49 questionnaires were distributed and all were collected, of which 48 were found valid, accounting for 98%.

Figure 11.4-1 First Round of Public Consultation

Figure 11.5-1 Second Round of Public Consultation

Compositions of interviewees for questionnaires-based consultation are shown in the following table.

Table 11.4-1 Compositions of Interviewees for Public Consultation

No.	Groups		No. of People	Percentage（%）
1	Gender	Male	31	64
		Female	17	36
2	Ethnic Group	Han	39	81
		Minorities	9	19
3	Education	Undergraduate and above	2	4.2
		Junior College	6	12.5
		Senior High School	13	27.1
		Junior High School	17	35.4
		Primary School and Below	10	20.8
4	Age	18-30	7	14.6
		30-50	36	75
		50 and above	5	10.4

Statistics and analysis of the results:

a. After detailed introduction, only a few people (12.5%) indicated incomprehension of the project, 87.5% of them indicated understanding about the project;
b. From the interviews it is clear that local people (87.5%) are fairly satisfied with local environmental quality, they considered major local environmental problem(s) as water pollution (41%), solid waste (27%), air pollution (22%), ecological deterioration (12.5%) and noise pollution (10%);
c. When asked whether the project construction would favor local infrastructure improvement, most answers were 'yes', a few indicated 'not certain'(3%). 96% of the interviewed considered impacts of the project on local economy as positive, 4% indicated the impacts were unfavorable or being not certain about the impacts;
d. When asked about compensation for dismantling and resettlement because of the project, 92% of the interviewees indicated economic compensation measures should be adopted, while 8% said that other compensation methods should be applied;
e. Through introduction by the staff of the task team, the interviewees understood that certain environmental impacts might be caused by the project during construction and operation periods. Regarding urban sewage interception works, most of them (45%) thought the most serious impact during construction period would be ecological deterioration, while others took soil and water erosion (43%), noise (35%), air pollution (17%), and other 10%, respectively; and they took water pollution (37%), noise (22%), air pollution (16%) and other (8%), respectively, as the most serious impact during its operation period. For the subproject for reuse of reclaimed water, the interviewees took air pollution (43%), noise (43%), soil and water erosion (31%), ecological damage (25%) and

other (12), respectively, as the most serious impact during its construction period; and took ecological damage (44%), air pollution (39%), noise (31%), solid waste pollution (27%) and other (8%) as the most serious impact during operation period. For integrated river bank environmental improvement subproject, they thought the most serious impact during construction period would be soil and water erosion (43%), air pollution (29%), ecological damage (18%) and other (14%); for its operation period, the most serious impact was taken as noise (39%), solid waste pollution (33%), ecological damage (29%), air pollution (25%) and other (22%). For the integrated gully improvement subproject, soil and water erosion (50%), noise (35%), air pollution (25%) and other (22%) were taken by the interviewees as the most serious impact during construction period, while noise (43%), air pollution (33%), solid waste pollution(25%), ecological damage (22%) and other (28%) taken as the most serious impact during its operation period.

f. After introduction by the task team members, all interviewees agreed upon the layout of the sewage collection pipelines, alignment of roads, and site of the reclaimed water plant; they all considered it necessary to conduct the river bank environmental improvement and the integrated gully improvement subprojects and expressed their support to implementation of the project. Because of public awareness raising of environmental protection, 88% of all interviewees indicated their willingness to perform supervision on pollution control under the project, while 12% expressed unwillingness or 'don't care' attitude.

Statistics of results from the interviews are shown in the following table.

Table 11.4-2 Results of Questionnaire-based Interviews

Questions	Answers	No. of People Choosing the answer	%
1.Do you know about the project?	A. Yes	42	87.5
	B. No	6	12.5
2.Are you satisfied with current local environmental quality?	A. Yes	42	87.5
	B. No	6	12.5
	C. Not Sure	0	0
3.What do you think is the main environmental problem existing in the local area? *	A. Air Pollution	11	22
	B. Noise Pollution	5	10
	C. Solid Waste Pollution	13	27
	D. Water Pollution	20	41
	E. Ecological Damage	6	12.5
4.Do you think the project is favorable to local infrastructure improvement or not?	A. Favorable	47	97
	B Unfavorable	0	0
	C. Not Sure	1	3
5. What impact do you think the project implementation will have on local economy?	A. Promotion	46	96
	B. Obstruction	1	2
	C. Not Sure	1	2
6. What is your take if the project implementation involves resettlement?	A. Opposition	0	6
	B. Economic Compensation	44	86
	C. Other Compensation	4	8

Questions		Answers	No. of People Choosing the answer	%
7. What environmental impact(s) do you think the subprojects will cause during construction？*	Urban Sewage Interception Pipeline	A. Ecological Damage	22	45
		B. Air Pollution	12	25
		C. Noise Pollution	17	35
		D. Soil & Water Erosion	21	43
		E. Other	5	10
	Reuse of Reclaimed Water	A. Ecological Damage	12	25
		B. Air Pollution	21	43
		C. Noise Pollution	16	33
		D. Soil & Water Erosion	15	31
		E. Other	6	12
	Integrated River Bank Environmental Improvement	A. Ecological Damage	9	18
		B. Air Pollution	14	29
		C. Noise Pollution	11	22
		D. Soil & Water Erosion	21	43
		E. Other	7	14
	Integrated Gully Improvement	A. Ecological Damage	8	16
		B. Air Pollution	12	25
		C. Noise Pollution	17	35
		D. Soil & Water Erosion	24	50
		E. Other	11	22
8. What environmental impact(s) do you think the subprojects will cause during operation?*	Urban Sewage Interception Pipeline	A. Air Pollution	8	16
		B. Noise Pollution	11	22
		C. Water Pollution	18	37
		D. Solid Waste Pollution	6	12
		E. Ecological Damage	4	8
		F. Other	0	0
	Reuse of Reclaimed Water	A. Air Pollution	23	44
		B. Noise Pollution	19	39
		C. Water Pollution	15	31
		D. Solid Waste Pollution	13	27
		E. Ecological Damage	4	8
		F. Other	0	0
	Integrated River Bank Environmental Improvement	A. Air Pollution	14	29
		B. Noise Pollution	12	25
		C. Water Pollution	19	39
		D. Solid Waste Pollution	16	33
		E. Ecological Pollution	11	22
		F . Other	0	0
	Integrated Gully Improvement	A. Air Pollution	11	22
		B. Noise Pollution	16	33
		C. Water Pollution	21	43
		D. Solid Waste Pollution	12	25
		E. Ecological Damage	9	18
		F. Other	0	0
9. Do you think the layout of sewage collection pipeline and alignment of roads proper or not？		A. Proper	48	100
		B. Improper	0	0
		C. Not Sure	0	0
10. Do you think the site of reclaimed water plant proper or not？		A. Proper	48	100
		B. Improper	0	0
		C. Not Sure	0	0

Questions	Answers	No. of People Choosing the answer	%
11. Do you think river bank environmental improvement necessary or not？	A. Necessary	48	100
	B. Unnecessary	0	0
	C. Not Sure	0	0
12.Do you think gully improvement necessary or not？	A. Necessary	48	100
	B. Unnecessary	0	0
	C. Not Sure	0	0
13. Based on above, what is your take on implementation of the project？	A. Support	48	100
	B. Objection	0	0
	C. Don't Care	0	0
14. Are you willing to supervise as a volunteer environmental protection under the project？	A. Yes	40	88
	B. No	2	4
	C. Not Sure	4	8

11.4.2 Discussion Meeting

Time: PM, May 28, 2013

Venue: Huangshui River Basin (Xining Section) Integrated Management Committee

Hosted by: Xu Jin

Participants: 29 representatives from Cultural Relics Bureau, Forestry Bureau, Land Resources Bureau, Water Resources Bureau and other relevant departments of Xining Municipality, Shitoulei Village, Beixingyuan Village, Taojiazhai Village, Shuangsubao Village, Guojiata Village, Zhangjiawan Village, Yuejiawan Village, Xin Village, and Yuhong Community of Shuidiansiju Living Quarter and etc.

Picture of the meeting is included in Picture 11.4-1 and the follow is the record of main points of the meeting:

The meeting began with an introduction by Mr. Xu Jin, general engineer of the World Bank Funded Project Management Office, of the project overview and scope, locations and layout of activities, schedule and necessities. EIA task team then explained to the participants its analytical results of project implementation and relevant policies, potential environmental impacts of the project during construction and operation periods, corresponding environmental protection and pollution mitigation measures. And then the project design institute, residents/ farmers raised questions of their concerns and interests, including mainly:

a. How to protection ambient environment and ensure the water demands of ambient and downstream environment after project construction?
b. Dose the project include implementation of environmental protection measures during its construction period to reduce impacts on lives of villagers living in the surrounding areas of the construction sites?
c. What are the impacts of road construction on lives of villagers during construction period?

Project management office and EIA task team answered each of the questions from the participants to remove their doubts. Through thorough discussion, representatives at the meeting all indicated positive significance of the project implementation to improvement of both living environment of local people and river water environment, reduction of pollution in Huangshui River, promotion of sustainable economic development, and to realization of comprehensive social, economic and ecological environmental benefits.

Replies to the questions raised by people at the meeting:

① Purpose of project construction is to improve the urban water environmental infrastructure and environmental service level of Xining Municipality. The project itself is characterized by environmental protection. After completion, the current scattered discharge of wastewater can be effectively collected; direct discharge of pollutants into Huangshui River can be reduced; and the water quality of Xining section of Huangshui River can be improved. Meanwhile, water resource can be effectively conserved via construction of reclaimed water reuse works.

After completion of the project, road and reclaimed water reuse works will somewhat impact surrounding environment and none of the other works will have much impact. So the detailed environmental impact prediction analysis aims at road works and reclaimed water reuse works in this project construction. The mitigation measures are proposed based on prediction conclusions to avoid or reduce the impact of the project construction on the environment.

② No increase of water intake is involved in this project construction; on the contrary, the implementation of reclaimed water reuse works will play a role in water resource conservation and reduce the water intake of upstream users from Huangshui River or other water sources. So the implementation of this project will not impact the water resources of surrounding and downstream users.

③ The major impact of this project construction mainly involves construction period. During specific construction, the works will be supervised and all the environmental protection measures put forward at EIA stage will be implemented strictly according to the requirements of the World Bank.

④ Such road works are mainly centered on Beichuan area. At present, all the demolitions have been completed without any residents within such area. The impact during road construction is minor. After completion of the project, the construction will be implemented according to Beichuan planning. In the process of construction, the planning and the road red lines required by this environmental impact assessment will be strictly enforced with functional zones rationally arranged to reduce the impact of noise and tail gas on the residents within the area. After completion of road, the traffic condition and capacity of Beichuan area will be greatly improved, bringing convenience to the life of residents.

⑤ Construction of the project will occupy a small amount of cultivated land, but involving no demolition or relocation of people. The project management office entrusted a working group of Hoihai University to conduct relevant investigation. Compensation will be arranged in accordance with national policies on land acquisition. Social Assessment and Resettlement Action Plan will be prepared to address issues in this regard.

At the meeting, consultation was conducted with relevant departments on issues the project may involve during construction, including water source, cultural relics protection, whether basic farm land will be occupied and etc. According to the feedback, the project won't involve cultural relics protection sites, or water source, or basic farm land.

Besides, at the meeting, participants raised questions on issues the project construction may involve during construction, such as environmental impacts during construction, temporary land occupation during construction, protection of water bodies along the line of construction in the construction process, etc. The EIA task team recorded the questions and responded accordingly. The requirements raised at the meeting were incorporated in the preparation of this EIA and EMP.

11.5 Public Disclosure of EIA Outline on Newspaper

An announcement titled *Invitation to the Public for Participation in Environmental Impact Assessment of Qinghai Xining Water Environment Management Project* was issued on Xining Evening Paper on April 13th, 2013. The name of and brief introduction to the project and the main contents of EIA of the project were included in the announcement. It was pointed out that *Environment Impact Assessment Outline* had been placed in the headquarters for Comprehensive Treatment of Xining Beichuan River and the public could go to consult the document at any time. No suggestion or opinion from the public on project construction was received during publicity period.

11.6 Second Round of Public Consultation

11.6.1 Questionnaire

(1) Respondent: people and the relocated households in the area affected by the project. Interview investigation method is adopted to select respondents by sampling in different project areas. The selected respondents are universal and representative.

(2) Questionnaire content: The questionnaire is prepared in simple, common, clear and understandable manners. The scope of questionnaire distribution is identical to that influenced by the project.

See Attachment 6 and Figure 11.5-1 for details of the questionnaire.

(3) Analysis on Questionnaire Result

1) Statistics on basic information of respondents: The public participation in the questionnaire was carried out in September 2013. During the questionnaire, full consideration is given to the comments and suggestions on the proposed road from people in different age groups, in various ethnic groups and with diversified education degrees. Besides, women's rights and interests are also taken into account, and emphasis is placed on a rational male/female ratio in the questionnaire. In this questionnaire participated by the public, 75 personal questionnaires in total were distributed, of which 73 questionnaires were withdrawn, including 72 valid questionnaires. The recovery rate is 97% and pass rate is 99%.The composition of respondents participating in this personal questionnaire is shown in Table 11.6-1.

Table 11.6-1 Composition of Respondents Participating in Public Investigation for Xining Water Environment Management Project

No.	Item		Number of People	Proportion (%)
1	Gender	Male	55	77
		Female	17	23
2	Ethnic group	Han	60	83
		Minority	12	17
3	Education level	Above bachelor degree	1	1
		Above college degree	2	3
		Graduate from high school	22	31
		Graduate form junior high school	31	43
		Below primary school	16	22
4	Age	18-30	7	14.6
		30-50	36	75
		More than 50	5	10.4

2) Statistics and Analysis on Survey Result

(I) Opinions on the current situation of environment where construction project is located:

2) The results of this survey show that 15% of local people are much concerned with the environmental conditions in this region, 61% relatively concerned, 24% ordinarily concerned, none not concerned.

3) The results of this survey show that only 8% of local people think the environmental conditions in this region excellent, 23% good, 58% ordinary, 11% not good.

4) The results of this survey show that 23% of people think the first and foremost environmental problem in this region is air pollution; 38% of them think it is water pollution; 23% of them think it is noise pollution, and 16% of them think it is

solid waste pollution.

(II) Expectation for Construction of the Project

1) The survey results show that only 7% of respondent are unfamiliar with the construction of this project, 62% of them are not very familiar, and 31% of them are familiar.

2) The survey results show that 19% of local people express that the environmental problem likely to cause big impact on project area after implementation of the project is air pollution, 23% of them express it is water pollution, 27% of them express it is noise pollution, 31% of them express it is solid waste pollution.

3) The survey results show that 88% of local people express that the project construction is helpful for improving the infrastructure in this region, 4% of them express it is harmful, 8% of them express it is uncertain.

4) The survey results show that none of local people think that this project has great impact on farm irrigation along Chaoyangdianqu, 39% of them think it has ordinary impact, 61% of them think it has basically no impact.

5) The survey results show that 96% of local people support the project construction, 4% do not care, and none opposes it.

(III) Opinions and Suggestions on Environmental Protection Measures

1) The survey results show that 100% of people express that the environmental protection measures proposed for this project are reasonable, none expresses the measures are unreasonable.

2) The survey results show that 100% of people express that the negative impacts of the project on the environment can be accepted after the environmental protection measures are taken for the proposed project.

Statistical results of public consultation for the proposed project are shown in Table 11.6-2.

Table 11.6-2 Statistical Results of Personal Questionnaire

Question	Answer	Number of People	Proportion (%)
(I) Opinions on the current situation of environment where construction project is located			
1. What is your level of concern with the environment in this region?	A Much concerned	11	15
	B Relatively concerned	44	61
	C Ordinarily concerned	17	24
	D Not concerned	0	0
2. What do you think of the current environmental situation of project area?	A Excellent	6	8
	B Good	17	23
	C Ordinary	42	58
	D Bad	7	11

3. What do you think is the first and foremost environmental problem in the project area?	A. Air pollution	17	23
	B Water pollution	28	38
	C. Noise pollution	17	23
	D. Solid waste pollution	10	16
(II) Prediction for Construction Project			
4. Are you familiar with the project construction:	A. Familiar	22	31
	B. Not very familiar	44	62
	B. Unfamiliar	6	7
5. What do you think is the environmental problem likely to cause big impact on project area after implementation of the project?	A. Air pollution	14	19
	B Water pollution	17	23
	C. Noise pollution	19	27
	D. Solid waste pollution	22	31
6. Do you think the project construction is helpful for improving the infrastructure in this region?	A. Yes	64	88
	B. No	3	4
	C. Not sure	5	8
7. What do you think is the level of impact of this project on the farm irrigation along Chaoyangdianqu?	A Great impact	0	0
	B Ordinary impact	28	39
	C No impact	44	61
8. What is your overall opinion on this project?	A. Support	69	96
	B Not care	3	4
	C Oppose	0	0
(III) Opinions and Suggestions on Environmental Protection Measures			
9. Do you think the environmental protection measures proposed for this project are reasonable?	A. Yes	72	100
	B No idea	0	0
	C No	0	0
10. Do you think you can accept the negative impacts of the project on the environment after the environmental protection measures are taken for the proposed project?	A Yes	72	100
	B Wait and see	0	0
	C No	0	0

11.6.2 Discussion Meeting

Time: afternoon, September 10th, 2013

Place: Huangshui River Basin (Xining Section) Integrated Management Committee

Host: Xu Jin

Participants: 23 villager representatives from Zhanjiawan, Xiaozhai Village, Duoba Town, Shuangsubao Village, Wangjiazhuang Village, Jiujiawan Village.

The main content of meeting is summed up as follows (also see Figure 11.5-1 for picture of the meeting):

The meeting began with an introduction made by Xu Jin, Chief Engineer of World Bank Project Office, who introduced the latest basic information such as project overview, building location, plane arrangement and scope as well as the adjustments of project engineering content based on the actual situation during design, and gave explanations on the necessity of project construction and the schedule of the project. And then, assessment unit introduced the possible environmental impacts according to the classification based on project construction content, accordingly put forward relevant measures, and provided the participants with the first draft of environmental impact assessment report and that of environmental management plan. At the meeting, construction unit, environmental impact assessment unit and other participants had discussions on the environmental impacts of the project. The villagers within affected areas were consulted for their opinions on project construction. Via communication with Project Office and environmental impact assessment unit, all the villagers expressed that the project was a public welfare project helpful for improving people's living standards and infrastructure and environmental conditions, believed that the environmental impacts caused by the project were temporary and acceptable, and thus consent to and support the project construction.

Questions raised at the meeting are mainly the following:

① How to guarantee irrigation water supply along the line of construction during improvement of Chaoyangdianqu canal;

② Whether there will be odors when reclaimed water is used for greening;

③ Whether daily life of people will be impacted by construction of the reclaimed water plant;

④ Whether cultivated land will be occupied during construction of wastewater pipes along banks of Beichuan and Xichuan rivers, and if yes, what will be the compensation policy;

⑤ Whether amounts of cultivated land occupations have been calculated;

⑥Whether there will be impact on traffic when pipes are installed resulting in damage to some sections of sand and gravel road pavement.

Answers to the above questions:

① Construction relating to Chaoyangdianqu canal will be scheduled in non-irrigation season as much as possible to avoid impact on irrigation at the downstream of the canal and, if necessary, temporary water diversion channel will be arranged to guarantee water level in the canal meeting irrigation needs.

② The reclaimed water to be used for greeing purpose meets national standard Quality Standard for Reuse of Reclaimed Water as Urban Miscellaneous Water and, after having been sterilized, the reclaimed water has little smell and thus won't impact on ambient environment.

③ The reclaimed water plant is to be located within No.5 WWTP at its south-west corner, far from the surrounding residential area. Main facilities of the plant include one reclaimed water storage pond and two submerged pumps, with little noise and odor and thus without impact on daily life of people.

④ Statistics of cultivated land occupation has been done and, due to the fact that the project design is still at initial stage, the results may be adjusted along with revisions to specific designs of construction, but detail statistics of final results of cultivated land occupation will be available. Compensations will be made according to national policy, as shown in detail in Section 2.9.1 of this EIA.

⑤ Pipe installation will only occupy some part of sand and gravel road sections during construction period, and half of the roadway will be reserved for traffic. Phased construction will be adopted, and each of phases will last short time. After completion of the construction, recovery of road pavement will be undertaken. Therefore, pipe installation won't cause big impact on traffic.

11.7 Public Disclosure of EIA Draft

(1) Newpaper Disclosure

An announcement titled *The Invitation to the Public for Second Time Participation in Environmental Impact Assessment of Qinghai Xining Water Environment Management Project* was issued on Xining Evening Paper on September 17, 2013. The name of and brief introduction to the project and the main conclusions of environmental impact assessment of the project were included in the announcement. It was indicated that *Environment Impact Assessment* and *Environmental Management Plan* had been placed in Huangshui River Basin (Xining Section) Integrated Management Committee of Qinghai Xining Water Environment Management Project, headquarters for Comprehensive Treatment of Xining Beichuan River, and Village Committees and etc. in the project area, and that people could go to consult them at any time. No suggestion or opinion from the public on project construction was received during publicity period.

See Attachment 3 for details.

(2) Website Disclosure

Based on disclosure in September and considering adjustments made to project activities, on December 5, 2013, EIA and EMP were released on Xining government website and on-line download of the whole text of the documents were available for the public.

Website: http://www.xining.gov.cn/html/56/319812.html

11.8 Summary of Results of Public Consultation

The following table includes the details.

Table 11.8-1 Summary of Results of Public Consultation

Time	Location	Form	Document Offered for Consultation	People Consulted	Question/ Opinions	Responses
Questionnaire						
May 29-30, 2013	Interviews in project affected areas	Questionnaire survey	EIA Outline	49 affected people	See Section 11.4.1	See Section 11.4.1
Sept.10-12, 2013	Interviews in project affected areas	Questionnaire survey	EIA and EMP drafts	75 affected people	See Section 11.6.1	See Section 11.6.1
Discussion Meeting						
May 28, 2013	Huangshui River Basin (Xining Section) Integrated Management Committee	Discussion Meeting	EIA Outline Drafts	29 affected people	See Section 11.4.2	See Section 11.4.2
Sept.10, 2013	Huangshui River Basin (Xining Section) Integrated Management Committee	Discussion Meeting	EIA and EMP Drafts	23 affected people	See Section 11.6.2	See Section 11.6.2
Information Disclosure						
April 13, 2013	Xining Evening Paper		EIA whole text disclosed and placed in PMO and village committes along construction line for the public to consult			
Sept.17, 2013	Xining Evening Paper		EIA and EMP whole texts disclosed and placed in PMO and village committees along construction line for the public to consult			
Dec.5, 2013	Xining Governmental Website		Access for EIA and EMP whole texts download provided			

12 Environmental Management Plan

See a standalone report *Environmental Management Plan* for details.

13 Economic Benefit Evaluation

13.1 Economic Benefit Evaluation

Economic benefit evaluation is one of the important conditions for project feasibility analysis, aiming at understanding economic feasibility of a project via scientific calculation, analysis and justification. Based on comparison of technical and economic options, this chapter measures and calculates financial status and economic benefits of the project according to relevant national provisions, and analyzes its net benefits to national economy. With technical and economic feasibility and rationality of the project expounded in macro and micro aspects, this chapter provides economic references for decision-making of the project.

13.1.1 Evaluation Basis

(1) *Methods and Parameters for Economic Evaluation of Construction Projects* (the 3rd version) issued by NDRC;

(2) *The Guideline for Feasibility Study of lnvestment Projects* (trial version) issued by the State Planning Commission;

(3) Other relevant laws and regulations and policies, and relevant basic information provided by project implementation organizations.

13.1.2 Financial Evaluation

Analysis of profitability is to reflect profit-making capability of the project using various evaluation indicators calculated based on profit distribution, cash flow of both project investment and capital funds during the calculation period. The results of calculation of financial parameters of the project are shown in Table 13.1-1.

Table 13.1-1 Financial Indicators of Demonstrative Reuse of Reclaimed Water under the Project

No.	Indicators	Value	Benchmark Value
1	FIRR (Project Investment)	6.24%	5%
2	FIRR(Capital Funds)	9.55%	5%
3	FNPV(Project Investment)	1.84 mil.yuan	≥0
4	FNPV(Capital Funds)	2.45 mil.yuan	≥0
5	Payback Period(Project Investment)	16.06 yrs	＜18 年

5	Profit ratio of investment	4.45%	≥2.5%
6	Profit and tax investment ratio	5.34%	≥2.5%

From the above table, it can be seen that FIRR of the project is up to the benchmark value, and FNPV of the project is bigger than 0, indicating that the project is profitable according to miminal profitability requirement. Paybaci period of the project meeting the benchmark value indicates that investment of the project can be recovered on time. Other financial indicators of the project are all up to the benchmark levels. Therefore, the proposed project is financially viable.

13.1.3 National Economic Evaluation

The project is a social welfare project related to water environment renovation, and the value (economic benefit) created by the project is far more than financial benefit created. However, except for partial benefits which can be calculated in quantitative manner, the other often is represented as social benefit and environmental benefit which are difficult to be quantized with currency. The national economic evaluation is performed by means of cost and benefit analysis method. In addition, economic parameters such as shadow price, shadow exchange rate, shadow wage and social discount rate are used for calculating and analyzing the cost to be paid by country for the project and the economic contribution to the country and society. By investigating the economic rationality and macro feasibility of investment, the decision-making department can make the choice for the project according to the conclusion of national economic evaluation, and perform national economic evaluation for the overall project.

It can be seen from above table that, though comparison of benefit created by society with the cost paid by society, economic internal rate of return (EIRR) of total investment is 17.56% which is larger than social discount rate (i.e 8%), and net present value of national economy is RMB 1,703.53 million which is above zero. Each national economic evaluation indicator meets requirements and has good national economic benefit, so the project is economically feasible.

13.1.4 Evaluation Conclusion

As per conclusion from financial analysis, internal rate of return pre-tax and after-tax and payback period of the project are consistent with and above benchmark values.

The source of domestic counterpart funds is workable, and repayment schedule is practicable, so that the project is financially feasible.

The national economic evaluation of the project is conducted by analyzing and calculating external benefits of the project after relevant expenses are adjusted. The calculated economic internal rate of return of total investment is beyond social discount rate, which shows that net contribution of investment occupied by the project on national economy is remarkable. Meanwhile, the environmental and social benefits created by the project are far more than those calculated with currency in national economic evaluation. Therefore, in the perspective of overall national evaluation, the implementation of the project plays an important role in promoting the long-term economic development, social progress and improvement of people’s living quality within the region. Therefore, the implementation of the project is totally feasible, and the implementation shall be actively prepared to make the economic benefit, social benefit and environmental benefit brought into play as soon as possible.

13.2Analysis of Comprehensive Benefits

(1) Water Supply Benefits

The proposed project will support reuse of reclaimed water in Beichuan Area to replace tap water that is currently used for urban miscellaneous purposes. According to calculation, daily use of urban miscellaneous water in Xining totals 4964 m^3/day in Beichuan Area for 217 days from March through to October every year, or 1.077 million m^3 a year. By replacing this amount of tap water supply with reclaimed water, tap water saving will be 1.077 million m^3/year.

Based on survey on water use cost, tap water is 2.2 yuan/ton, reclaimed water is 1.2 yuan/ton, then cost saving for miscellaneous water uses will be 1.077 million yuan a year.

(2) Environmental Benefits

Environmental benefits measure environmental consequences of human activities. Human living and production activities will inevitably cause various changes to environment, such environmental changes react differently to human subsistence and social sustainability. Therefore, there is a need to conduct comprehensive evaluation and measurement of environmental changes caused by human activities from natural, economic and humane point of view.

Implementation of reclaimed water reuse, improvement of local investment environment and control and management of environmental pollution are critical to local economic development. Improvement of environmental quality will bring in tremendous economic and social benefits.

Economic effects of project investment in reclaimed water reuse are reflected by project investment and the benefits generated in the fields beyond the project itself. In terms of social effects, the project investment functions to meet living and social needs of urban residents. Such effects, though impossible to be economically measured, relate to improvement of urban investment environment and social impact that are determinant to urban physical and social activities. Environmental effects of the project investment are embodied in reduction of pollution to natural environment, improvement of ecological quality of living space of urban residents, and the resulted reduction of losses of industry, agriculture, human health and resources. Such indirect economic benefits are mostly nonquantifiable in monetary terms except for a small proportion, while this proportion of indirect economic benefits that can be expressed in monetary terms are mainly reflected by reduced economic losses of the society by reducing impact of environmental pollution. Such economic losses generally can be categorized as industrial, agricultural, animal husbandry, fishery losses; human health losses; water resources losses; land value losses caused by environmental pollution; tourism losses and etc.

Through calculation it can be concluded that, by constructing wastewater collection pipe networks and implementing river bank environmental improvement, wastewater collected totals 22.70 million m^3/year, and rainwater collected totals 390 thousand m^3/year, garbage cleaned totals 3,000 m^3. Because of resulted reduction of pollutants in the area, cost saving for ing of environmental treatment and protection totals 2 million yuan a year.

Meanwhile, after implementation of improvement activities under the project, greening area will increase from 0 to about 600 thousand m2, reaching greening area ratio of 40%, and collection and treatment of sewage and household garbage from local residents will be undertaken to change the current situation of arbitrary sewage and garbage dumping, local environmental quality will be upgraded. Construction of large greening area is helpful to air purification, moisture conservation and environmental improvement. All of these will help to give a full play to ecological functions of the area, including air purification, oxygen production, carbon sequestration and maintaining biodiversity. By calculating economic values of these ecological service functions, incremental value of ecological service functions of the area can be derived. Environmental improvement is favorable to diversification of eco-environment and landscape.

(3) Landscaping Benefits

Under the proposed project, a total of 600 m^2 of river bank environmental improvement of Beichuan River will be implemented, together with ancillary facilities. The planned landscaping area of 600 m^2 along Beichuan River is from Chaoyangdianqu canal inlet in the north and to Tianjun Road in the south, from Binshui Road in the west and to Xining-Datong highway in the east, covering a total distance of 9.3 km along the river. Landscaping development will combine water surface, greening area, flower and plant, environmental and urban functions of the riverbank, and arrange sport and fitness machines, leisure square and fountain along the river bank, so as to provide a relaxing and enjoyable space for people.

(4) Eco-environmental Benefits

Change to land uses resulted from project compoments including urban wastewater collection pipes and riverbank environmental improvement, reuse of reclaimed water, integrated gully and canal improvement activities will impact on structure and functions of eco-systems, and thus cause changes of values of ecological services. Table 13.2-1 includes calculated values of ecological services.

Table 13.2-1 Unit Area Values of Ecological Service of Various Terrestrial Eco-systems in China **Unit**：yuan/hm^{2}a

Types	Forest	Grassland	Farmland	Wetland	Water body	Desert
Gas regulation	3097.0	707.9	442.4	1592.7	0.0	0.0
Climatic regulation	2389.1	796.4	787.5	15130.9	407.0	0.0
Water source conservation	2831.5	707.9	530.9	13715.2	18033.2	26.5
Soil formation and protection	3450.9	1725.5	1291.9	1513.1	8.8	17.7
Waste treatment	1159.2	1159.2	1451.2	16086.6	16086.6	8.8
Bio-diversity protection	2884.6	964.5	628.2	2212.2	2203.3	300.8
Food production	88.5	265.5	884.9	265.5	88.5	8.8
Raw Material	2300.6	44.2	88.5	61.9	8.8	0.0
Entertainment culture	1132.6	35.4	8.8	4910.9	3840.2	8.8
Total	19334.0	6406.5	6114.3	55489.0	40676.4	371.4

Source: Natural Resources Journal, Volume 2, Series 18, March 2003

Based on the above table, value of ecological services produced by the proposed project is calculated as average of that of forest and grassland, the two main constitutions of the eco-system improved under the project area, and the result of calculation shows that eco-environmental benefits of the proposed project total 1.544 million yuan.

(5) Benefits of Incremental Land Value Resulted from Eco-environmental Improvement

Changes to land uses because of implementation of the proposed project will result in change to value of land function. Beichuan riverbank environmental improvement and eco-environmental improvement under the project will increase value of 240 ha of land in the surrounding area, and the land value increase is from 200 thousand yuan/mu to 400 thousand yuan/mu, which will result in a total of 720 million yuan of incremental benefits.

14 Conclusions and Suggestions

14.1 Conclusions

14.1.1 Project Overview

The proposed project mainly includes four components, such as urban wastewater collection pipe network, reuse of reclaimed water, low-impact development and river bank environmental improvement and integrated gully improvement. Under the project components urban wastewater collection pipe network and river bank improvement, 84 km of wastewater collection pipes and 44km of rainwater pipes will be installed, 27 km of new urban roads will be constructed, and 8 bridges will be built, as well as 600 m^2 of river bank improvement and ancillary facilities along Beichuan River. After implementation of the project, the current situation of direct and arbitrary wastewater discharge, serious river and environmental pollution along Xichuan River (Yangjiawan-Duoba section), both banks of Beichuan River (Datong Tollgate –Datong WWTP section) and Beichuan Area will be reversed fundamentally, and living condition of local people in those areas will be effectively improved. In the meantime, river bank and the surrounding areas will see improved eco-environment, promoted economic development and rapid development of tertiary sector, manufacturing industry, agricultural, animal husbandry, fishery and other relevant industries, forming gigantic driving force to urban development. The project will generate great benefits, including mainly water supply benefits, environmental benefits, landscaping benefits and eco-environmental benefits.

Construction period is the main pollution period of the project, and impacts are mainly dust, noise and social impacts. Road noise is the main environmental impact of the project during operation period.

Total investment of the proposed project is 1,524.1771 million yuan, including the World Bank loan of USD 150 million, an equivalent of 915.00 million yuan and accounting for 60% of the total investment, and self-raised counterpart funds of 609.1771 million yuan, accounting for 40% of the total investment.

Total investment for environmental protection under the proposed project is 10.815 million yuan, accounting for 0.71% of the project total investment.

The project was listed in 2012 in the World Bank pipeline project for FY 2013-2015. Preparation and appraisal of the project will be accomplished at the end of 2013 or early 2014, and implementation of the project is scheduled in 2014 through to 2018.

14.1.2 Present Environmental Quality

During this EIA, environmental quality of the project sites and Xining was analyzed based on existing data and supplementary monitoring data. The results of such analysis are:

(1) Quality of air environment is generally good. TSP is the primary pollutant, and monitoring in the project sites shows that the concentration of conventional monitoring indicators, such as SO2, NOX and TSP, meet the limit value of second level standard of *Ambient Air Quality Standard* (GB3095—2012). H_2S and NH3 monitored on boundary of No.3 WWTP, which is now in operation, meets the one-time limit value for concentration defined in Sanitary Standard for the Design of Industrial Enterprise (TJ36-79), indicating that operation of WWTP has relatively big impact on

air quality for the surrounding environment.

(2) Quality of surface water environment is not optimistic. Monitored rivers are classified as either Class-III or Class-IV in terms of water environmental function zoning. Monitoring data show that BOD, COD, NH_4-N, TP and fecal coliform group are exceeding the standards to various degrees, being multiple times of the standards. This is due to lack of a complete wastewater collection system in Xining, which results in direct sewage discharge into rivers, and household garbage piled up along the river banks and the resulted serous non-point pollution.

(3) Monitoring of acoustic environment indicates that noise at all monitoring sites are all within the standard, thus the acoustic environmental quality is good.

(4) Groundwater quality data used in this EIA come from No.4 Water Plant of Xining and Duoba Water Plant, two representative water plants for groundwater quality in north or west part of the city. Water quality surveys conducted in February, June and August for two years show that groundwater quality in Xining is good and consistent with class III standard in *Quality Standard for Ground Water* (GB/T14848-93).

14.1.3 Conclusions of Environmental Impact Assesment for Construction Period

(1) During construction, main pollution factors for environmental impacts of proposed project on ambient air quality are construction waste gas and raising dust, for which, the waste gas mainly includes the exhausts from various construction machineries and transport vehicles; during construction, the dust mainly generated from subgrade excavation, site excavation and backfill, discarding of soil and stone, and loading, transportation of knocked-down construction garbage, transportation, loading and unloading of construction materials, and construction process. Also a little dust may be raised by site leveling, and the main pollutant is TSP. These impacts can be mitigated by strengthening construction management and taking measures such as site watering during construction, use of apron, tarpaulin to avoid raising dust from temporary earth pileups, timely hardening of compacted road surface, and concentrated construction sequenced from one zone to another and reduction of construction working hours, and etc.

(2) Noise during construction includes mainly noise from construction machines. Analysis indicates that when the distance from one place to construction site is more than 200m, noise impact of construction on the place will abate greatly. In order to ensure normal life of surrounding residents, the contractor shall strictly execute the relevant national regulations for construction, and arrange the construction line reasonably. Effective noise control measures shall be taken, such as, sound proof walls shall be constructed in the sensitive area with serious noise pollution, and construction is forbidden within 200m of residential area during 22:00 - 6:00. With the end of construction, the effect of construction noise ends.

(3) Household rubbish in the project area that needs to be cleaned amounts to 12,951m^3, which will be transported to Yinjiagou landfill for disposal. Earth and stone

excavated by the project amounts to 973,000 m^3, the total earth and stone filling is 3,056,000 m^3, the total borrowed earth and stone is 2,083,000 m^3 and total amount of dispatched and utilized earth and stone is 181,000 m^3. Therefore, earth and stone that needs to be leveled or utilized in this project totals 181,000 m^3. In addition, solid wastes that are generated during project construction, mainly including construction wastes, household rubbish generated by constructors, and other household rubbish within the project site, should also be cleaned.

(4) Water-crossing bridge construction may cause bigger impact on water environment during construction, thus strict compliance with requirements defined in EMP formulated during this EIA process should be imposed to reduce impact on river water. Wastewater produced during construction also includes household wastewater from construction workers, for which wastewater disposal facilities can be installed to effectively avoid the impact. Additionally, after being properly handled, the very limited wastewater from waste residue and oily sewage produced during construction will have only small impact on water environment.

(5) One of the major content of the project is to improve and recovery eco-environment in the project area. Although certain disturbance might be caused to some individual areas during construction of the project, the purpose is to cleaning rubbish and leveling land, without causing eco-environmental deterioration. Through timely recovery of construction sites, the negative impact of the project construction can be minimalized.

14.1.4 Conclusions of Environmental Impacts of the Project during Operation

(1) Positive Impacts

1) Implementation of the project will produce markedly environmental benefits. Analytical results show that after project completion, the total amount of wastewater collected will be 80,800 m^3/d in the long term. Implementation of the project can significantly enhance wastewater collection capacity in Xining Municipality and improve water environment. Reuse of reclaimed water will help to save tap water use by 4,800 m^3/d, with significant water resources conservation benefits.

2) Implementation of LID program, every year totally 390 thousand m^3 of rainwater can be treated and purified, and then partially used for greening in Beichuan Area, and the rest for replenishment of Beichuan River.

3) Environmental recovery under the project will effectively reduce water and soil loss by 2665.8 tons per year after recovery period.

4) Implementation of the project will also greatly improve eco-environment in Beichuan Area, which is helpful to water source conservation, micro-climate regulation, improvement of water quality at the river downstream, improvement of habitability in the new urban development area and thus improvement of living condition of local residents.

5) Implementation of the project will greatly improve environmental condition of the project area and further improve image of the city, thus optimizing investment environment, upgrading quality and quantity of investments and businesses that can be attracted, promoting regional cooperation and exchange, and facilitating regional social and economic development and harmonious society building.

6) Implementation period of the project is long, which will contribute to increase of job opportunities, such as material transport to construction sites, cooking for construction workers by women; during operation period, local residents in the project area can be employed to work for pipe maintenance, greening and cleaning.

(2) Negative Impacts

While bringing in positive impacts, the project construction will produce some negative impacts as well. These impacts mainly come from the project activities of road construction, pipe installation and construction of reclaimed water plant.

1) Road construction may cause noise impact. Considering that the construction sites are located in areas that are still in initial stage of development, neither residential area of office buildings are established there, recommendation on noise control distance from road is put forward based on noise impact prediction during this EIA, so as to provide guidance for future development planning of the Beichuan Area. Beside, recommendation on individual EIA for future constructions is aldo put forward.

2) Road construction benefits regional development while bringing with it potential safety hazards, including traffic safety hazards, pedestrian safety hazards. Therefore, pedestrian crosswalks or tunnels should be arranged at crossings of the roads, and traffic lights and fences should be installed to ensure conveniences and safety for pedestrians.

3) After road construction, vehicle exhausts will also cause certain pollution to urban ambient air quality.

4) Maintenance of pipes and road may cause temporary block of traffic and inconvenience to pedestrians. Prior-notification and proper timing of such maintenance activities can greatly reduce such impacts.

5) After construction of the reclaimed water plant, little odor or noise will be produced. By covering reclaimed water storage tank, no obvious impact will be caused on residents in the surrounding area.

14.1.5 Conclusions of Environmental Risk Analysis

The analysis on the proposed project shows that, the main risk sources are wastewater overflow from the main wastewater interception pipe and wastewater regeneration pipe network due to some reasons, and sudden leakage & explosion of dangerous articles during transportation. There is no major source of danger in the project. By taking corresponding preventive and emergency measures, the environmental risk of the proposed project can be minimal and acceptable.

14.1.6 Conclusions of Environmental Impact Assessment

(1) Roads and Pipe Network Works

The adverse impacts of road and pipe network works mainly occur in construction period. The construction will have impacts on social environment, ecological environment etc. to some extent.

The noise, atmospheric pollution, water pollution and the like caused in construction period have different levels of effects on residents along certain range. The road noise will bring inconvenience for resident along the line. Large number of road construction material needed in construction period is transported by vehicle, which will increase the vehicle flow on existing road, and will interfere normal traffic order of existing road. The vehicle transporting loose-packed road construction material maybe inevitably lead to leakage or scattering, which will increase the dust of road and make the air quality of local environment reduced. Furthermore, with the increase of traffic flow, the traffic noise pollution will become serious, even the normal rest (at night) of resident on both sides of existing road will be affected.

The ecological effects in construction period are represented as effects of land permanently occupied by the project on ecological environment and water and soil loss along the line.The construction of the project can inevitably cause the excavation of earth and rock, and the damage of vegetation and scenery on both sides of the line.Meanwhile, the bad location of borrow pit maybe cause serious water and soil loss, damage of farmland and silting of water body.The temporary borrow pit, construction camp, construction road, material yard and the like maybe occupy grassland, cultivated land, passageway and the like, which will destroy farmland, grassland resources, and cause traffic inconvenience.Meanwhile ,the excavation of construction road will cause water and soil loss.

Therefore, project entity shall strengthen construction management, strictly execute each of the preventive measures to mitigate environmental pollution and damage mentioned in this report, minimize adverse environmental impacts caused by construction of the project, and fully realize social and environmental benefits of the project.

(2) Reclaimed Water Plant

The environmental impact of reclaimed water plant during construction period is the same as that for pipe network and road works. The main impacts in operation period are odor from reclaimed water storage tank and pump noise. It can be seen from analysis that environmental impacts of the reclaimed water are relatively small.

(3) Integrated River Bank Environmental Improvement

During construction, the impacts on flora and fauna during construction is small. Meanwhile, new ecological structure formed in the course of the project can improve the ecological environment. Therefore, the environmental impacts of this project component are acceptable.

(4) Integrated Gully Improvement

This project component will greatly improve current environmental status and people's living environment. Its environmental impacts are small and mainly in construction period.

14.1.7 Conclusions of Public Consultation

To fully and accurately reflect public opinions and suggestions, two rounds of public consultations were conducted during this EIA. Through public participation, residents, enterprises and public institutions within the proposed project area all have gained some understanding of the project, and all indicated their support and no objection to construction of the project.

It is known from public feedbacks that part of the public think that the construction of the project may cause some adverse environmental impacts, such as dust pollution during road construction, vegetation damage caused by excavation of pipe network and construction of new road works, air pollution by reclaimed water plant. To prevent and mitigate adverse environmental impacts by the project, project entity shall strictly carry out each of the pollution control measures to minimize the adverse environmental impacts of the project during construction and operation periods, so as to realize maximum social, economic and environmental benefits of the project.

14.2 Suggestions

(1) When signing contract with a contractor, all relevant requirements as defined in the EMP should be incorporated into the contract, so as to supervise and urge standardized construction and compliance by the contractor to reduce potential environmental problems brought by construction.

(2) Prior to construction commencement, construction workers and managers should be trained to establish environmental awareness.

(3) Construction supervision should be well performed.

(4) Regular maintenance, check and repair of pollution control and prevention facilities should be conducted during construction and operation periods, so as to ensure proper operation of such facilities, especially wastewater treatment facilities. To ensure discharge of pollutants as per standards, regular monitoring should be conducted. Direct discharge of wastewater without treatment to meet requirements should be strictly banned.

(5) In order to prevent odor pollution from the reclaimed water plant, cover should be added to reclaimed water storage tank, and air quality monitoring during operation of the reclaimed water plant should be enhanced.

(6) Project entity should make proper arrangements to address land acquisition and resettlement issues and make proper compensations, so as to avoid dispute over land acquisition and resettlement impacting on project progress.

(7) After completion of project implementation, water and soil conservation should be implemented in a timely and adequate manner.