Environmental Monitoring Report

Project Number: 33177
February 2006

PRC: Harbin Water Supply Project

Prepared by Black and Veatch

PRC

For Harbin Municipal Government
Harbin Municipal Water Supply Construction Company

Asian Development Bank

HARBIN MUNICIPAL WATER SUPPLY
CONSTRUCTION COMPANY

ASIAN DEVELOPMENT BANK

HARBIN WATER SUPPLY PROJECT

ADB Loan No. 1995-PRC

ANNUAL ENVIRONMENTAL REPORT: 2005

for construction period up to the end 2005

February 2006

PREPARED BY:
HARBIN MUNICIPAL WATER SUPPLY CONSTRUCTION COMPANY
WITH ASSISTANCE OF
BLACK & VEATCH

EXECUTIVE SUMMARY

This Annual Environmental Report (AER) describes the environmental monitoring and mitigation measures undertaken with regard to the Environmental Impact Assessment (EIA) and the Summary Environmental Impact Assessment (SEIA) provisions during the construction period from January to the end 2005 of the Harbin Water Supply Project ("the Project").

In this report we briefly provide (i) documentation review and compliance with environmental regulations, (ii) environmental institutional structure and responsibility, (iii) mitigation measures undertaken to minimize adverse environmental impacts arising from the construction of the Project facilities, (iv) environmental monitoring and status of ambient environmental quality, and (v) conclusions and recommendations.

As of the end of 2005, the Project is assessed to be some 73% complete overall, and the reservoir impoundment took place on 25 Sep 2005. In 2005, the mitigation measures and monitoring program were generally carried out satisfactorily. Attention has been paid on reservoir bed clearance and sanitation disinfection, heritage and archaeological sites protection, as well as wastewater treatment, air protection and noise control etc. Through the implementation of these measures, the destruction to the environment has been lowered to a minimum level possible during construction.

The water quality of both the upper reaches of the Lalin River and the tributaries flowing into the reservoir has been monitored periodically in 2005, which showing the water quality at the dam site is somewhat polluted.

However, to some certain extent there were still unavoidable impacts on the environment. Some recommendations are put forward to make improvement on environmental protection in next stage. Particularly, more efforts are required on water and soil conservation to reduce soil erosion.

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ABBREVIATION

AER	-	Annual environmental report
B&V	-	Black & Veatch Company
EIA	-	Environmental impact assessment
EMLG	-	Environmental Management Leading Group
EMO	-	Environmental Management Office
FB	-	Forestry Bureau
HDPCC	-	Harbin Disease Prevention and Control Centre
HMWSCC	-	Harbin Municipal Water Supply Construction Company
HWCHPIDRI	-	Heilongjiang Water Conservancy and Hydroelectric Power Investigation, Design, and Research Institute
IER	-	Initial environmental review
NCMEDRI	-	Northeast China Municipal Engineering Design and Research Institute
RO	-	Resettlement offices
SEIA	-	Summary environmental impact assessment
SEPA	-	State Environmental Protection Administration

1. Introduction

1.1 General Introduction

This report is the Annual Environmental Report (AER) to describe the implementation of the mitigation measures and monitoring recommended in the Environmental Impact Assessment (EIA) and the Summary Environmental Impact Assessment (SEIA) for the Harbin Water Supply Project ("the Project") and conducted during the construction phase from January to the end of 2005.

The full EIA report in the Chinese language was prepared by the Northeast China Municipal Engineering Design and Research Institute (NCMEDRI) in association with Heilongjiang Water Conservancy and Hydroelectric Power Investigation, Design, and Research Institute (HWCHPIDRI), and submitted to the State Environmental Protection Administration (SEPA) on 2 February, 2002 for approval. The SEIA was prepared in accordance with the requirements of the Government of the People's Republic of China (PRC) and the Asian Development Bank (ADB) by the project preparatory technical assistance (PPTA) Consultants CDM International Inc. (CDM) of the USA in July 2002. These reports described the potential effects of the Project and the measures proposed to mitigate any adverse impacts.

Under a contract entered into dated March 2005, Black & Veatch (B&V) is providing consulting services to the Harbin Municipal Water Supply Construction Company (HMWSCC) who is the Executing Agency of the Project in relation to the implementation of the Project. The contract provides details of the B&V scope of work.

The Terms of Reference (TOR) for the consultancy services for project implementation (TOR), as included in the Request for Proposals (RFP), includes advising upon tasks to monitor the environmental impact of the Project with a view to mitigating the effects of the Project upon the environment. The TOR was reviewed by B&V in the Inception Report (IR) of May 2005 and a course of action proposed in order to satisfy the requirements of the TOR.

B&V mobilized the Environmental Expert for the works to commence in Harbin on 31 May 2005. In order to review all information related to the environmental issues associated with the Project, an Initial Environmental Review (IER) document and the Annual Environmental Report (AER) for 2004 have been prepared by B&V.

In this AER we briefly provide (i) documentation review and compliance with environmental regulations, (ii) environmental institutional structure and responsibility, (iii) mitigation measures undertaken to minimize adverse environmental impacts arising from the construction of the Project facilities, (iv) environmental monitoring and status of ambient environmental quality, and (v) conclusions and recommendations.

1.2 Brief Description of the Project

Harbin is the provincial capital and largest city of Heilongjiang Province, PRC with an urban population of more than 3 million people. Harbin is forecast to have a shortage in water supply capacity of at least 450,000 m^3/day in 2010, increasing to at least 950,000 m^3/day by 2020. The Songhua River passes through the city, and is the current major raw water source for about 1 million m^3/day of water used in Harbin. The Songhua River basin covers about 400,000 km^2 of drainage area upstream from Harbin, and receives pollution from several major upstream cities – Jilin, Changchun,

Daqing and Qiqihar. Major industrial pollution sources include a large scale chemical plant and other petrochemical waste generators in Jilin, and other industries located in the provinces of Heilongjiang, Jilin and Inner Mongolia. The river has experienced deterioration in water quality and the river water quality falls below the required PRC standards. To address the urgent needs of Harbin for increased water supply and improved water quality, a new water source is being developed under the Harbin Water Supply Project (the Project).

The general objectives of the Project are to improve the existing inadequate water supplies to the urban communities of Harbin, and assist towards poverty alleviation, health improvements and the economic development of the region as a whole. The proposed Project will be developed in two phases, in order to reduce the initial cost. The Asian Development Bank (ADB) Loan 1995-PRC provides US$ 100 million of the total estimated cost of US$ 399.48 million for the first phase Project. The remainder, i.e. US$ 299.48 million equivalent, is being provided from local counterpart funds. The first phase of the Project consists of the construction of the following principal components:

- a multi-purpose dam at Mopanshan on the Lalin River, having a total storage volume of approximately 523 million m^3.
- a raw water pipeline of 2200/2400 mm diameter and approximately 175.5 km in length from Mopanshan Dam to Harbin.
- a potable water treatment plant in the suburb of Harbin of approximately 450,000 m^3/day capacity.
- expansion and rehabilitation of some 112 km of the water distribution network.

A planned Phase 2 will provide a second parallel raw water pipeline and increase the water treatment capacity to 900,000m^3/day, and the distribution system would be improved by installing 53.2km of trunk mains and 11km of small water pipes.

1.3 Brief Description of the Environment

Harbin City is located in south-central Heilongjiang Province, southeast of the Songnen Plain. The Mopanshan Reservoir site is located in Wuchang County, which is under the administration of Harbin Municipal Government.

The reservoir area is mountainous with peaks of 278 to 1600 m and the ground gradient of 1/3000 to 1/5000. The general gradient within the proposed inundated area is 0.0036. Soils are 5-33 cm thick, and in the more fertile agricultural areas they are 40 – 60 cm deep. From the dam site the terrain descends northwards toward Harbin. There was an earthquake with an intensity of 5.8 on the Richter scale in 1960, at a site 50 km away from the proposed dam site. According to the latest seismological classification by the State Earthquake Bureau, the project area is classified as 6 on the PRC earthquake intensity scale.

The Lalin River, originating from Changbai Mountain, Zhangguangcai Mountain Range, has a catchment area of 19,200 km^2. Upstream from the proposed dam site, the catchment area is 1,151 km^2, with an annual average stream flow of 561 million m^3 of water. Further downstream from the dam site, there are three major tributaries (Mangniu River, Xilang River and Kacha River) with a total catchment area of 11,800 km^2 that join the Lalin River, which eventually flows to the Songhua River.

The project area is in the northern temperate continental climate zone. Winter is very cold and dry, while the short summer is hot and humid. The annual average temperature is about 3.5^{o}C. The ground is frozen from November through March, to a maximum depth of 2 m. The annual average precipitation is about 650 mm, with more than 70 % of which falling in the June to August period. The prevailing wind is south, with average and maximum speeds of 2.8 m/s and 28m/s respectively.

The Lalin River plain is mainly used for agriculture purposes. The highland area around the ongoing reservoir is mostly covered by forests and used for limited scale timber production. There are no rare or endangered species within the project construction area. The average annual soil erosion modulus is 30.7 tons/km^2 per year.

2. Project Construction Progress

With the original physical completion expected to by 30 June 2007 the period for the loan utilization was/is until 30 June 2008. As of the end 2005, the Project was assessed to be some 73% complete overall, with the construction of the major components estimated to be as follows, i.e.

Mopanshan Dam	85%
Raw Water Pipelines	95%
Water Treatment Works	70%
Distribution System	52%

The more specific progress by component is described as follows:

2.1 Mopanshan Dam

Construction of the dam has continued during the year, the filling works associated with the dam are to a level 322.5 m, which didn't complete the plan in the year of 2005 with two meters left. The impoundment took place on 25 Sep 2005.

The civil works of the spillway, division tunnel and installation of the mental structure basically were finished. The clearance work of the water supply tunnel and the archway installation of the division tunnel and screen of water in-take tower were completed. And the transformer can be used now. Construction of the dam, the status of water storage and the construction of the water supply tunnel can been seen in the attached Photo A2-1, Photo A2-2 and Photo A2-3 respectively.

The water and soil conservation and re-cultivation will start early in the spring of 2006. It is expected that the construction of the water supply tunnel will be finished by the end of Aug 2006 and the work concerned with the dam will be finished by the mid Oct.

2.2 Raw Water Transmission Pipelines

As of end 2005, overall some 174 km of pipe work has been installed of the 182 km overall to be laid. Three contracts including . railway crossing works are considered to be of a high priority and critical to overall progress, and they, were awarded at an early stage of the Project and are now complete. The remaining works, representing significant lengths of pipeline, have been divided into 10 contracts to ensure early completion by distributing, and fully utilizing, all available resources. The actual installation length has exceeded the contract length, because some of the installation route has been changed. Construction of the pipeline can be seen in the attached Photo A2-4.

2.3 Water Treatment Plant

The plan of 2005 is to complete the civil works and install the equipment and also have the commission of some equipment. But the fund is not available and the equipment didn't arrive in site on time, the progress is slowed down by these factors. So the plan was redrafted in late August.

The installation of technical pipes, optical cable trench, chlorine trench, sampling trench and fire protection pipes is almost finished. The major civil works is plasterer for the purification chamber and sedimentation tank. The equipment for dosing room and chlorine room almost arrived. The automatic absorption equipment in Chlorine room was finished installation on Oct, 24th. The chlorine machine and Liquid chlorine evaporator had been finished installation. The transformers arrived in the plant already.

Most of the equipments arrived in the plant in December of 2005, so 2006 will be a busy year to have the equipment installation work. Also the road building, landscaping, excavation-fill balancing remains to do. Current appearance of the plant is shown in the attached Photo A2-5.

2.4 Treated Water Distribution Network

It is currently anticipated that all works on the distribution network, as included in the Project, will be complete by the end of August 2006. It has been decided that the works will be awarded as ten contracts, the current status and progress of each is as given below, and construction of water distribution network at Hongxing Village is shown in the attached Photo A2-6.

Contract Number	Description (diameter)	Length (km) Contract	Installed	Complete %	Comment
1	1400	14.0	13.96	99.71	Land acquisition & resettlement have proved to be difficult & have slowed progress
2	1400	8.7	8.18	94.02	As for 1)above, progress has also been hampered by the existing services & the need to ensure free flow of traffic
3	1000—1200	13.0	12.49	96.07	As for 3) above
4	1000—1200	9.8	9.8	100	As for 3) above
5	1600	5.7	3.65	64.03	As for 3) above
6	1600	4.9	1.37	27.96	As for 3) above
7	1400	4.0	2.5	62.5	As for 3) above
8	1200 —1400	5.9	2.2	37.29	As for 3) above
9	800 —1000	2.2	1.56	70.90	As for 3) above
10	200 —500	44	2.8	6.3	As for 3) above
TOTAL		**112.2**	**58.51**	**65.88**	

3. Environmental Procedure Review

3.1 Legal Requirements

Table 3-1 provides a list of the applicable environmental laws and regulations of the PRC and environmental policies and regulations of ADB with which design, construction, and operation of all project facilities will comply.

Table 3-1: Relevant Environmental Laws, Standards and Regulations

Subject	Environmental Laws, Standards and Regulations
General Environmental Protection	• Environmental Protection Law of the PRC (26 Dec 1989) • Environmental Impact Assessment Law of PRC (1 Sep 2003) • Environmental Protection Management Regulations for Construction Projects (29 Nov 1998) • Notice to Strengthen the Environmental Impact Assessment and Management of Construction Projects Financed by Loan from International Financial Organizations (21 Jun 1993) • Environmental Impact Assessment Technical Guideline (HJ/T2.1-2.3-93, HJ/T2.4-1995, HJ/T19-1997)
Water Resources	• Water Law of the PRC (1 Oct 2002) • Environmental Quality Standards for Surface Water (GB3838-2002)
Forestry Resources	• Forests Law of the PRC (29 Apr 1998)
Protection of Grasslands	• Grassland Law of the PRC (1 Mar 2003)
Protection of Wildlife	• Wildlife Protection Law of the PRC (1 Mar 1989)
General Land Use and Management	• Land Management Law of the PRC (1 Jan 1999)
Soil Erosion Control	• Conservation of Water and Soil Law of the PRC (29 Jun 1991)
Solid Waste Management	• Solid Waste Environmental Pollution Prevention and Control Law of the PRC (1 Apr 2005)
General Water Pollution	• Water Pollution Prevention and Control Law of the PRC (15 May 1996) • Integrated Wastewater Discharge Standard (GB8978-1996)
General Air Pollution	• Air Pollution Prevention and Control Law of the PRC (1 Sep 2000) • Ambient Air Quality Standard (GB3095-1996) • Integrated Emission Standard of Air Pollutants (GB16297-1996)
Noise in Urban Areas	• Standard of Environmental Noise of Urban Areas (GB3096-93) • Standard of Noise at Boundary of Industrial Enterprises (GB12348-90)
ADB guidelines and regulations	• Environmental Assessment Guidelines (ADB, May 2003) • Environmental Policy (ADB, Nov 2002)

Some other relevant documents have been reviewed. They contain information and/or requirements with respect to environmental impacts, mitigation measures and monitoring and should also be complied with during project implementation. These documents include:

- issues relating to environmental matters as included in the Loan Agreement (LA) and the Project Administration Memorandum (PAM) including the Loan Covenants
- the Report and Recommendations by the President
- the SEIA dated July 2002
- EIA report
- approval comments on EIA report issued by the SPEA on July 19, 2002
- Water and Soil Conservation Program
- the TOR as provided in the RFP as supplied by the Client
- Preliminary Design Report
- the Inception Report by B&V
- samples of construction tender document, bidding document and contract

3.2 Compliance with Environmental Regulations

It is noted through documentation review as well as site visits that the implementation of the Project had been compliant with relevant environmental laws, regulations and standards, and the environmental protection measures or facilities had been designed and constructed concurrently with the main construction works.

Since there was no environmental management plan (EMP) prepared for the Project which is normally required by ADB environmental assessment guidelines, during the construction period of 2005, adverse environmental impacts arising from the construction of the Project facilities had been minimized by implementing the mitigation measures, environmental monitoring program, and other recommendations presented in the EIA and SEIA for the Project.

4. Environmental Organization and Management

4.1 Structure and Responsibilities

HMWSCC was set up in 2002 for the specific purpose of implementing and managing the Project. Various agencies and departments of Harbin Municipal Government are also actively involved in different aspects of project implementation, including the Water, Finance and Environmental Bureaus.

Initially, the Engineering Department was assigned within the HMWSCC to hold part-time position of environmental management, in charge of the overall environmental management related to the Project.

In 2005, a project Environmental Management Leading Group (EMLG) and a project Environmental Management Office (EMO) were formally established within the HMWSCC with major responsibilities for implementing the mitigation measures, environmental monitoring program and other recommendations as agreed with ADB, including the planning, coordination, and monitoring of the various activities, reporting to ADB, and ensuring the overall environmental targets are achieved and that the environmental responsibilities and obligations of HMWSCC are satisfied.

Construction of the Project was undertaken by contractors, supervised by construction supervision companies and managed by the HMWSCC. The EMO on behalf of the HMWSCC with the assistance of the supervision companies is responsible for monitoring the contractor's activities to ensure compliance with the mitigation

measures, environmental monitoring program and other recommendations as agreed with ADB.

Each of the contractors and construction supervision companies designated staff from the site management team is responsible for environmental monitoring and supervision. The responsibilities of these staff include day to day site environmental monitoring of their own contract sections, implementation of environmental action plan mitigation measures, and report the site environmental performance of the contract sections, which is mainly a self inspection and self monitoring and based mostly on visual observations.

B&V, being the implementation consultant which was appointed for the Project, assist the EMO as well as the HMWSCC in the environmental management in accordance with the requirements of the contract dated March 2005 between the HMWSCC and B&V.

4.2 Reporting

In quarterly reports, the implementation status of environmental mitigation measures and environmental monitoring has been included. In order to meet ADB's requirements, the first AER for the construction period up to the end 2004 has been finished in December 2005, and this report for the period up to the end 2005 is prepared and to be submitted for ADB review. Besides, the following environmental reports have been prepared by HMWSCC in 2005 for the project implementation:

- Water and Soil Conservation Monitoring Report (No.3, Jun 2005)
- Water and Soil Conservation Monitoring Report (No.4, Sep 2005)
- Reservoir Bed Clearance and Sanitation Report (Nov 2005)
- 2005 Water Quality Monitoring Report

5. Implementation Status of Mitigation Measures

Environmental mitigation measures carried out during construction period up to the end 2005 of the Project have been done well as described below.

5.1 Raw Water Source Protection

5.1.1 Regulation Establishment

Mopanshan Reservoir is the water source for the Harbin Water Supply Project which is being implemented in order to ensure the health of the people and improve their quality of life. In 2003, the Harbin Municipal Legal System Office drafted a water source protection regulation for the reservoir; in early 2005, HMWSCC drafted another small-scaled plan entitled "Harbin Mopanshan Reservoir Water Source Protection Regulation" and has been submitted to the authority concerned. Both of the regulations are awaiting approval now.

5.1.2 Reservoir Bed Clearance

During the construction period before the reservoir impoundment in Sep 2005, reservoir bed clearance activities including structure demolition, forest land clearance and sanitation clearance have been done well. Four villages and three tree plantations, under the domination of Shahezi Town and Shanhetun FB have been involved in the area of clearance.

A. Structure demolition

Two resettlement offices (ROs) are in charge of structure demolition within the reservoir bed. They are the Wuchang RO and the Shanhetun RO. The structures demolition and clearance involved three villages and one tree plantation was finished by the end June 2005. In total, approximately 50,000 m^2 structures have been demolished, including dwelling houses, store houses, livestock barns, vegetable cellars, toilets, tombs and so on. About 57% took place in 2005 with two villages and one tree plantation involved. As for the effect of the structure demolition at Sanrenban Village, see the attached Photo A2-7.

B. Forest land clearance

Two forestry bureaus (FBs) are in charge of the work on forest clearance within the reservoir bed, including the Wuchang FB and the Shanhetun FB. According to the feasibility study reports on forest land acquisition, there would be a total 1087ha forest land within the reservoir area to be acquired by the Project, 3.8% by the Wuchang FB and 96.2% by the Shanhetun FB. The work was commenced early in 2003 by Shanhetun FB and terminated by the end Jun 2005 by Wuchang FB. Actually, total 1031 ha forest land has been cleared, of which 96% took place in the area under the domination of Shanhetun FB.

C. Sanitation clearance

Respectively, sanitation clearance was carried out twice, once in 2004 and once in 2005 by the Harbin Disease Prevention and Control Centre (HDPCC) which was entrusted by HMWSCC within the reservoir impoundment area of about 29km^2, including innocent treatment of pollution sources, pest (rat) control, and environmental quality monitoring. Major achievements are shown in the following Table 5-1.

Table 5-1: Summary of Sanitation Clearance Conducted by the end of 2005

Description	Unit	2004	2005	Total up to end 2005
Pollution sources cleared	Number	2,150	1,304	3,454
Disinfection area	m^2	44,713.7	12,236	56,950
Pest control (number of rats caught)	km^2/number	4.1526/478	1/369	5.1526/846
Residential health survey	Household/person	51/187	179/1,066	230/1253

In 2005 before the reservoir impoundment, there are two main kinds of pollution sources with a total number of 3545 cleared out from the reservoir bed. One of the 2 sources includes household toilets, public toilets, rubbish bin centers, cellars, cesspits and tombs etc., and the other is infective pollution sources such as clinics, veterinary stations, slaughterhouse, infection patients' tombs, etc. Disinfection was carried after clearance of the pollution sources of 56950m^2. Both rat clamps and raticide were used, and 1253 rats were eliminated.

It was demonstrated through sampling, examination and evaluation that both environmental quality and disinfection effects satisfy requirements of relevant standards and regulations. As for the effect of clearance, see the attached Photo A2-8.

5.2 Heritage and Archaeological Sites Protection

33 heritages have been discovered within the project area in the course of construction, of which 18 heritages were discovered within the construction area of the raw water transmission pipeline and 9 heritages were discovered within the impoundment area of the Mopanshan Reservoir. Generally, when a heritage is discovered by a contractor during construction, the contractor would suspend construction work at once and report to the related cultural department which would carriy out further investigation, excavation and protection. Only after these jobs are finished, could the contractor continue the construction work.

Archeological excavation has begun since 2004 and to date two concentrated excavation activities have been conducted, once in the period from June to November 2004 and once in July 2005. By the end of 2004, 22 heritages have been excavated, of which 15 heritages were excavated within the construction area of the pipeline and 9 within the impoundment area of the reservoir. Therefore, 11 heritages are left for excavation in 2005.

The heritages excavated in 2005 within the two component construction areas are summarized in the following Table 5-2. All of the heritage and archaeological sites discovered and excavated have been protected and allocated appropriately. At present, no historic cultural relic has been discovered in the construction sites of the water treatment plant and the distribution network.

Table 5-2: List of Heritages Excavated in 2005

	Name of Heritage	Exposed Area (m^2)
	In the impoundment area of the Reservoir	
1	No.1 historic site of Bronze Age at Shenjiaying	800
2	No.2 historic site of Bronze Age at Shenjiaying	400
3	Historic site of Jin Dynasty at 2nd gravel borrow	1000
4	No.1 historic site of Jin Dynasty at Dagui	800
5	No.2 historic site of Jin Dynasty at Dagui	200
6	Historic site of Jin Dynasty at Laomiaozuozi	5000
7	Historic site of Jin/Ming/Qing Dynasty at Xishan	400
8	Historic site of Bronze Age at Wangjiajie	600
	In construction areas of raw water pipeline	
9	Historic site of Jin/Ming/Qing Dynasty at Galehezi	500
10	No.2 historic site of Jin/Ming/Qing Dynasty at Dongxin	500
11	Historic site of Jin/Ming/Qing Dynasty at Dawaizi	500

5.3 Wastewater Treatment

Mopanshan Dam

Gravel processing wastewater treatment: The process of gravel involves firstly cleaning the gravel of unwanted materials, storing the gravel in the stock yard, and consolidating the unwanted materials in order to prevent the mud and ballast from being washed into the farm fields nearby. In the process, significant amount of wastewater is generated. A sedimentation tank in the low-lying land has been built, and the settled sand together with other waste materials is returned to the stock yard. The settled wastewater is then drained to the river. This procedure is being followed and the sedimentation process is observed to be satisfactory.

Concrete processing wastewater treatment: The concrete processing plants are situated at various locations throughout the construction site. Each has a low production capacity. Quantity of the alkaline wastewater produced from washing a plant is less than 0.1 m^3. At each plant, there is a simple water collecting pool to contain the wastewater and acts as a soak-away. The water filters into the ground, and periodically the waste mud, etc is dredged and moved to the area allocated for stockpiling wastes. This procedure is being followed and the wastewater handling process is observed to be satisfactory.

Workers' living wastewater treatment: There is a water collection well in the living quarters for construction workers. After the sedimentation/settlement of the living wastewater the settled wastewater is drained to the Lalin River. This task is being carried out satisfactorily by the contractor responsible for construction and maintenance of the workers' quarters.

Raw Water Transmission Pipelines

Concrete processing wastewater treatment: Concrete is cast in situ for building wells, and outer protection layer of steel pipe etc. The construction is not concentrated and only small volume of wastewater is produced from concrete processing. The wastewater is settled before discharge.

Workers' living wastewater treatment: The workers come from local farmers or lodged in local farmers' houses nearby, so wastewater is collected and disposed of in local existing facilities.

Water Treatment Plant

Workers' living wastewater treatment: In 2005, most civil works have been finished in last year, therefore only a few workers work in the plant for equipment installation. There is no sewerage system in the Water Treatment Plant area and temporary toilet and septic tank are provided for wastewater collection. The wastewater is then transported away and treated by special agencies.

Wastewater treatment facilities for operation period: Treatment of wastewater produced by nearly 142 staff of the Plant in operation phase has been considered and designed. For no municipal sewer system built in this area, a set of integrative wastewater treatment facility, namely MMBR membrane biological reactor is installed inside the Plant. The special house is shown in the attached Photo A2-15. The design capacity is 1-1.2 tons/d and the facility is set indoor to ensure normal operation in winter. The treated wastewater should meet GB8978-1996 Class II standard and then be discharged into the Hejiagou Channel. In future, the wastewater will be discharged directly into the local municipal sewer once it is completed.

5.4 Air Protection

Mopanshan Dam

Dust control: During the construction of the access road to the earth dam, a water spray vehicle was used to help suppress the dust problem. The cost was RMB 15,000 per year.

Raw Water Transmission Pipelines

Dust control: Water is sprayed when necessary on the construction roads and the construction sites. Dusty materials are enclosed or covered during transportation to reduce air pollution.

Exhaust gas control: In order to control machinery and vehicles' exhaust gas, construction machinery and vehicles are kept in good condition and only good quality fuel and oil are used. The vehicles are also installed with purification apparatus to treat exhaust gases.

Water Treatment Plant

Heating and air pollution control facilities: Two boilers have been installed in the boiler house and been in operation since 2003. Two sets of humid desulfuration dust catchers with efficiency of 95% have been provided and one chimney with 40m in height and 1.2m in upper caliber has been constructed. At the same time, a designated coal house has been constructed for coal deposit. These facilities are shown in the attached Photo A2-16, Photo A2-17 and Photo A2-18 respectively.

Water Distribution Network

Dust control: Water is sprayed periodically to control the dust produced from roads or construction sites. Earth is covered during transportation to prevent dust.

Exhaust gas control: All vehicles used have been inspected and approved by the traffic department. The construction machinery and vehicles were maintained in good condition and also installed with purification apparatus to treat exhaust gases..Only good quality fuel and oil are used.

5.5 Noise Control

Mopanshan Dam

When construction vehicles pass by or through residential areas, they are required to reduce their speed, refrain from sounding the horn and to avoid excessive noise. To further reduce noise impact on residential areas, transport routes for large vehicles was selected and the access road to the stock yard was reconstructed. All construction machinery and vehicles are kept in good maintenance and proper operation to minimize noise generation.

Raw Water Transmission Pipelines

In order to minimize construction machinery and vehicles noise, when construction vehicles pass by or through residential areas, they are required to reduce their speed, refrain from sounding the horn and to avoid excessive noise. The contractors are required to use construction machinery with lower noise emission. All construction machinery and vehicles are kept in good maintenance and proper operation to minimize noise generation. Some noisy construction equipment is installed with sound elimination system. Night-time construction using heavy machinery from 22:00 to 6:00 is forbidden near residential areas. Workers for manufacturing the PCCP pipe work on shorter shifts and are provided with ear mufflers to prevent from noise impact.

Water Treatment Plant

The area surrounding the water treatment plant is very open with the nearest residential area at least 300m away. The noise created during the construction of the treatment plant has little impact on the residents.

Water Distribution Network

Machinery and vehicles noise control: Construction activities are forbidden between 22:00 hrs to the next 06:00 hrs. Noise reduction equipments (silencers) were installed to all potential noisy machines and hooting is forbidden for vehicles when passing through residential areas.

Protect workers from noise: For noisy activities, construction workers wear ear mufflers and work in shorter shifts to reduce potential risks.

5.6 Solid Waste Disposal

Mopanshan Dam

Construction waste disposal: There are in total three temporary disposal areas designated for construction waste produced from the construction of dam, spillway and water supply tunnel etc. The construction waste is used to backfill the construction pits or borrow areas and then to replant vegetation. As of the end 2005, the status of the waste disposal areas is presented in the following Table 5-3. One of the temporary disposal areas for the dam construction is shown in the attached Photo A2-9 and that for the water tunnel excavation in Photo A2-10.

Table 5-3: Waste Disposal Areas for Dam Construction

No.	Location	Source of Waste	Storage (m^3)		Explanation and proposed final disposal
			To end 2004	To end 2005	
1	Outlet of water supply tunnel	From excavation of the tunnel	>80,000 most produced in 2003	80,000-90,000	about 50% is to be backfilled to the outlet of the tunnel, and the others is for filling clay borrow area
2	In Mopanshan Village on the right bank 2km downstream the dam	From excavation of the spillway and dam foundation clearance	80,000-90,000	80,000-90,000	to be used for filling sand and gravel borrow areas
3	Stone intermediate depot on the left bank 400m downstream the dam	From excavation of the spillway	50,000	30,000	total 100,000m^3 came from the spillway, of which 50% has been used to fill the coffer dam and for slope protection downstream the dam in 2004 and 20% in 2005

Workers' refuse disposal: Dustbins are set in all living quarters for workers to collect living solid wastes. Some wastes pits are excavated near the existing waste disposal areas downstream. Periodically the living solid wastes are transported to the pits for incineration and subsequently buried. This task is being carried out by the contractor responsible for construction and maintenance of the workers' living quarters.

Raw Water Transmission Pipelines

Construction waste disposal: In 2005, installation of 98 km raw water pipes was finished with most pipes of 2200 mm in diameter. During construction, normally some 5 m deep and more than 4 m wide trenches are excavated to lay the pipes. Before excavation, about 40 cm thick top soil was stripped and stacked to the designated places in this year. Approximately 4 m^3 earth was excavated by laying 1m long pipe and stored on the 30m wide land temporarily occupied along the trenches. All of the excavated earth is refilled after pipe installation with the topsoil replaced on the surface for re-cultivation. Consequentially, within the 30m wide land temporarily occupied along the pipeline, the earth's surface appears about 10cm higher than before for the sake of the pipe laying, which is thought not impacting on farming and has been accepted by the land owners.

Workers' living waste disposal: There are 10 contracts for the construction of the raw water pipelines. The workers come from local farmers or lodged in local farmers' houses nearby, so domestic solid wastes produced by workers are collected and disposed using local existing facilities.

Water Distribution Network

Construction waste disposal: In 2005, installation of 26.6 km treated water pipes was finished, of which most took place on urban roads. Pipe diameter varies between 1000mm and 1600mm. During construction, normally some 4m deep and 2 to 6m wide trenches are excavated to lay the pipes. Approximately 10 m^3 of earth is excavated for laying 1m long pipe and stored temporarily along the trenches. For the construction sections in urban area, the excavated earth is forbidden to be refilled beneath the urban roads, and sand is required to be filled the trenches for the sake of road foundation stability. Therefore, all of the excavated earth from the urban construction sections was used for other purpose or disposed to the designated locations as waste. For the construction sections in rural area, all of the excavated earth has been refilled into the trenches after pipe installation with topsoil recovered on surface for re-cultivation. Similar to the cases of raw water pipeline, within the land temporarily occupied along the pipeline, the earth's surface appears a little higher than before, which is thought not impacting on farming and has been accepted by the land owners.

Workers' waste disposal: Most construction sections of this component occur in urban area. Workers come from urban or rural area and dwelt nearby. They travel daily between the construction site and home, so minimal domestic waste is produced by the workers on sites.

5.7 Ecological Protection

Mopanshan Dam

Forest protection and relocation: As of the end 2005, totally 1031 ha of forest has been cleared within the reservoir impoundment area. In order to protect the forest, two measures are adopted to protect local forest. One is to replant the same amount of trees in some other places as the fell ones originally growing within the land acquisition area with elevation lower than 318m (normal high water level of the Mopanshan Reservoir). The other one is to protect trees not

fell but growing within the acquisition area with elevation upper than 318m with appropriate compensation.

Vegetation resources protection during construction: Within the reservoir impoundment area, major species include broad-leaved mixed forest, larch, conifer mixed forest, white birch, Chinese linden, Dragon spruce, poplar, etc. with seven kinds of rare national protected trees including Korean pine, Fraxinus mandshurica, Manchurian walnut, cork tree, pinus sylvestris var. mongolica etc. In the construction period, efforts have been made in avoiding to fall these protected trees. The protected young trees have been transplanted to appropriate places within the permanent and temporary acquisition area.

Wild animals' protection: It was known through survey that there were many kinds of national and provincial protected wild animals appearing in the reservoir area. In order to prevent the animals from harm or being disturbed, investigation has been carried out for proper relocation of birds' eggs, roosts and lairs. It is forbidden to catch or kill the wild animals illegally, especially during reservoir bed clearance. Propaganda on the national wild animal protection law and environmental protection were conducted, and the workers' and local residents' awareness of animal protection has been improved consequently.

Raw Water Transmission Pipelines

Every effort has been made to keep the removal of trees along the temporary construction roads to a minimum. Where it is unavoidable and trees are felled, planting of replacement trees is carried out to reduce the impact on the environment.

5.8 Water and Soil Conservation

Mopanshan Dam

As of 2005, the water and soil conservation works completed for the reservoir construction include 200m long retaining walls, 200m long water drainage ditches, 380m long water closure ditches, 6450m^2 landscaping and planting 1692 trees.

Borrow areas

There are one clay borrow area and two gravel quarry areas used for the construction of the Mopanshan dam. In 2005, the status of the borrow areas is as given below:

Table 5-4: Borrow Areas for Dam Construction

No.	Category	Location	Excavated Volume (m^3)	Status
1	Clay	In Mopanshan Village on the right bank 1.5km down-stream the dam	60,000	Further 2,000-3,000m^3 to be excavated in 2006
2	Sand and gravel	on the left bank 2km down-stream the dam	few	Located in reservoir area and already been inundated in 2005
3	Sand and gravel	In Mopanshan Village on the right bank 3.5km down-stream the dam	350,000	Further 30,000m^3 to be excavated in 2006

Before excavation of clay, the top humus soil was stripped, compacted and stored at a nearby place for temporary deposit. The top soil will be reused to reinstate the borrow areas. It was proposed that when excavation of the clay was complete, the land would be restored and vegetation to be replanted. Around the stockpile area an intercepting drain has been excavated in order to prevent hill water from flowing into the borrow area and washing the slope excavated. It can be seen from site visits that the bits have been filled with water coming from rain water or infiltrating from hill slope, which is shown in the attached Photo A2-11.

As for the sand and gravel borrow areas, top useless layer is firstly stripped, compacted and stored surrounding the borrow areas to prevent muddy runoff and broken stones produced by quarrying process flowing into adjacent farmland. A sediment tank is built in a low-lying location to contain wastewater produced by washing aggregate. Sediment is dredged out and transported to waste disposal area, and the wastewater is discharged into nearby river. In 2005, one sand and gravel quarry area has been inundated by the reservoir impoundment in Sep 2005. For the other one, see Photo A2-12.

It was said that the predicted water and soil conservation work on the borrow areas would commenced in 2006 after their services are terminated.

Waste disposal areas

Few temporary barriers have been built for the four temporary waste disposal areas to prevent erosion. More water and soil conservation works or measures are expected for these areas to prevent potential risk for soil erosion upon arrival of the next rain season especially. One of the temporary disposal areas for the dam construction is shown in the attached Photo A2-9 and that for the water tunnel excavation in the Photo A2-10.

Inlet of two tunnels

The excavated material produced from the diversion tunnel has been reused to build platform in front of the inlet in 2003. The excavated material produced from the water supply tunnel has been located adjacent to the inlet of the water supply tunnel using the larger rocks externally to provide protection to the inner core. The elevation of the material stack has been kept less than 290m in order to prevent the rocks entering the tunnels once the reservoir becomes operational.

Roads

In order to reduce soil erosion, the constructors gave first priority to utilize existing roads for transportation and minimized building new temporary ones. Construction of two permanent roads within construction site and one temporary road from Shahe Town to the reservoir commenced in 2003. The road foundation has been completed. It is planned to build storm water discharge trenches along both sides of the roads as well as the road surface after most construction activities are completed.

Raw Water Transmission Pipelines

In order to prevent soil erosion, the constructors minimized the extent of the construction area. During excavation, top humus soil is firstly stripped and

stacked as the bottom layer after compacting at the designated places, and then the excavated earth is piled and compacted above orderly. Retaining walls are built to prevent soil erosion especially in hilly area. In area where the groundwater table is high, water drainage ditches and catchment wells are constructed to control water and soil loss. In order to ensure the water and soil conservation measured are implemented, one supervisor is appointed for each contract section.

Water Treatment Plant

Grass and shrub are planted in the space reserved for Phase II works for both landscaping and erosion control. It is planned to carry out the final construction of the internal access roads and landscaping during spring 2006. After construction of the internal concrete roads, drainage ditches are to be constructed which are 0.3m wide at the base, 0.3m deep and with a side slope of 1 to 0.75. Trees such as willows or poplars are to be planted on both sides of the roads with a space of 2m between each other. Around the boundary of the treatment plant, trees and shrubs are to be planted over a 10m wide strip to help prevent erosion. Within the treatment plant site, grass, shrubs and flowers are to be planted which will cover an area of some 30% of the site. The landscaping is to be carried out in two phases, 67,620m^2 in Phase 1 and 224,990m^2 in Phase 2. Current status of the plant is shown in the Photo A2-5.

Water Distribution Network

Every effort is made to avoid large volume of excavated material from stacking for a long period of time. Normally, construction is suspended in rainy days. Retaining barriers have been built surrounding the excavated material, and slope protection and water drainage facilities have been constructed along both sides of road. In order to ensure that the water and soil conservation measured are implemented, one supervisor is appointed for each contract section.

5.9 Health Protection

Mopanshan Dam

In the workers' living quarters, the sanitation system is periodically cleaned and pests exterminated in accordance with the requirements of Harbin Sanitation and Epidemic Protection Control Centre. Health services have been designed and provided as agreed in the original plan. Doctors have visited the reservoir site regularly to provide the staff and workers physical examination. Those examined have been provided with a health card.

Raw Water Transmission Pipelines

In order to ensure the continued good health of the construction workers a good diet and clean drinking water has been provided, and pest control work has been implemented. Periodically the construction workforce is provided with a physical examination and necessary vaccination. If a person is found to be sick he will be isolated and provided with medical treatment. Such sickness is reported to local Sanitation and Epidemic Protection Department.

5.10 Land Acquisition and Restoration

A new monitoring and evaluation report on land acquisition and resettlement has not been available which will involve the information on the permanent and temporary land acquisition up to the end of 2005. Some land has been permanently used by establishing inspection well for the raw water transmission, which can be seen in the attached Photo A2-13.

All project contractors are required, as their contractual obligations, to return the temporarily occupied land to its original form as soon as the construction is completed. The temporary land occupation shall in general not be over a two year period.

In the construction of the raw water pipeline and the treated water distribution pipes in rural area, contractors are responsible for restoring the land temporarily acquired along the pipeline after their contract sections are completed. They reuse the top soil onto the land, and try their best to make the quality of the restored land to be as good as possible to meet the owner's requirements. This is done in addition to compensation having been paid. If the restoration effect is satisfactory, both the farmer and the authority village committee will sign to record their acceptance. Normally, the land is to be returned to the owners after construction completion and land restoration within the two year period of temporary land occupation. Effect of the land restoration can be seen from the attached Photo A2-14. It is recommended that restoration and return of land temporarily occupied to the owners should be monitored in the future monitoring periods to ensure there are least impacts to the affected.

5.11 Traffic Congestion Control

When installing water mains across roads appropriate signs are used to warn drivers of the works ahead requesting them to slow down. A worker is designated to control the flow of traffic.

6. Environmental Monitoring and Evaluation

6.1 Raw Water Quality Monitoring and Evaluation

A. Water quality monitoring and evaluation in construction phase

In 2005, the water quality of both the upper reaches of the Lalin River and its tributaries flowing into the reservoir has been monitored by the Harbin Environmental Monitoring Station over six times on 8 May, 15 June, 29 July, 7 Sep, 19 Sep and 14 Nov, with the monitoring data available for review.

Environmental Quality Standards for Surface Water (GB3838-2002) is adopted for water quality evaluation, which is presented in Appendix 1. According to this standard, the surface water quality is divided into five classes, of which Classes I is the standard for headstreams, Class II is for the prior protection zone of raw water source, and Class III is for the secondary protection zone of raw water source. Some parameters not covered by this standard adopt the *Water Quality Standards for Drinking Water Source* (CJ3020-1993) and the *Sanitation Standard for Drinking Water* (GB5749-85), which are also presented in Appendix 1.

Through evaluation, a summary of the parameters which have been exceeded standards is presented in Table 6-1. The five related monitoring sections S1-S5 are shown in the following Figure 6-1. It can be seen from the evaluation results that major

pollutants include total bacterial, color and turbidity, frequently exceeded the limites in most monitoring sections.

Table 6-1: Summary of Parameters Exceeding Standards from Water Quality Monitoring in 2005

Parameter	Unit	Standard	Monitoring Data	Overload Times
S1-: Dam site at Shenjiaying				
Sample No：J05050802 Monitoring section: Shenjiaying Date: 2005/05/08				
Color	Degree	15	40	1.7
Turbidity	NTU	3	12.5	3.2
Fe	mg/L	0.3	0.576	0.9
COD	mg/L	5	6.2	0.2
Al	mg/L	0.2	0.782	2.9
Sample No：J05072903 Monitoring section: Shenjiaying Date: 2005/07/29				
Color	Degree	15	38	1.5
Turbidity	NTU	3	6.45	1.2
Total bacteria	no./ml	100	1200	11.0
Total coliform group	no./100ml	1000	1600	0.6
Sample No：J05083103 Monitoring section: Shenjiaying Date: 2005/09/07				
Color	Degree	15	20	0.3
Total bacteria	no./ml	100	140000	1399.0
Sample No：J05091945 Monitoring section: Shenjiaying Date: 2005/09/19				
Color	Degree	15	17	0.1
Total bacteria	no./ml	100	400	3.0
Sample No：J05111423 Monitoring section: Shenjiaying Date: 2005/11/14				
Color	Degree	15	18	0.2
Mn	mg/L	0.1	0.107	0.1
S2-: Lalin River at Fenghuangshan				
Sample No：J05072905 Monitoring section: Fenghuangshan Date: 2005/07/29				
Pb	mg/L	0.01	0.018	0.8
Total bacteria	no./ml	100	8000	79.0
Sample No：J05091946 Monitoring section: Fenghuangshan Date: 2005/09/19				
Total bacteria	no./ml	100	1400	
Sample No：J05111426 Monitoring section: Fenghuangshan Date: 2005/11/14				
Fe	mg/L	0.3	1.582	4.3
Total bacteria	no./ml	100	110	0.1
Al	mg/L	0.2	1.928	8.6
S3-: Lalin River at Liangdianzi				
Sample No：J05050805 Monitoring section: Liangdianzi Date: 2005/05/08				
Color	Degree	15	24	0.6
Sample No：J05072901 Monitoring section: Liangdianzi Date: 2005/07/29				
Color	Degree	15	16	0.1
Pb	mg/L	0.01	0.023	1.3
Total bacteria	no./ml	100	10800	107.0
Sample No：J05083104 Monitoring section: Liangdianzi Date: 2005/09/07				
Total bacteria	no./ml	100	2000	19.0
Sample No：J05091944 Monitoring section: Liangdianzi Date: 2005/09/19				
Total bacteria	no./ml	100	15000	149.0
Sample No：J05111424 Monitoring section: Liangdianzi Date: 2005/11/14				
Total bacteria	no./ml	100	480	3.8

Parameter	Unit	Standard	Monitoring Data	Overload Times
S4-: Dasha River at Wangjiajie				
Sample No：J05050804 Monitoring section: Wangjiajie Date: 2005/05/08				
Color	Degree	15	50	2.3
Turbidity	NTU	3	7.25	1.4
Al	mg/L	0.2	0.326	0.6
Sample No：J05072902 Monitoring section: Wangjiajie Date: 2005/07/29				
Color	Degree	15	36	1.4
Turbidity	NTU	3	3.45	0.2
Pb	mg/L	0.01	0.016	0.6
Total bacteria	no./ml	100	14400	143.0
Sample No：J05083105 Monitoring section: Wangjiajie Date: 2005/09/07				
Color	Degree	15	28	0.9
Total bacteria	no./ml	100	2000	19.0
Oxygen demand	mg/L	5	5.2	0.0
Sample No：J05091947 Monitoring section: Wangjiajie Date: 2005/09/19				
Color	Degree	15	16	0.1
Total bacteria	no./ml	100	900	8.0
Sample No：J05111427 Monitoring section: Wangjiajie Date: 2005/11/14				
Al	mg/L	0.2	0.378	0.9
S5-: Sancha River at Daxintun				
Sample No：J05050806 Monitoring section: Daxintun Date: 2005/05/08				
Color	Degree	15	32	1.1
Turbidity	NTU	3	10.1	2.4
Fe	mg/L	0.3	0.49	0.6
Al	mg/L	0.2	0.593	2.0
Sample No：J05072904 Monitoring section: Daxintun Date: 2005/07/29				
Color	Degree	15	60	3.0
Turbidity	NTU	3	31.7	9.6
Al	mg/L	0.2	0.352	0.8
Sample No：J05083101 Monitoring section: Daxintun Date: 2005/09/07				
Color	Degree	15	130	7.7
Turbidity	NTU	3	62.3	19.8
Fe	mg/L	0.3	2.122	6.1
Total bacteria	no./ml	100	1200	11.0
Oxygen demand	mg/L	5	5.7	0.1
Al	mg/L	0.2	2.833	13.2
Sample No：J05091943 Monitoring section: Daxintun Date: 2005/09/19				
Color	Degree	15	18	0.2
Total bacteria	no./ml	100	700	6.0
Sample No：J05111425 Monitoring section: Daxintun Date: 2005/11/14				
Color	Degree	15	16	0.1
Total bacteria	no./ml	100	560	4.6

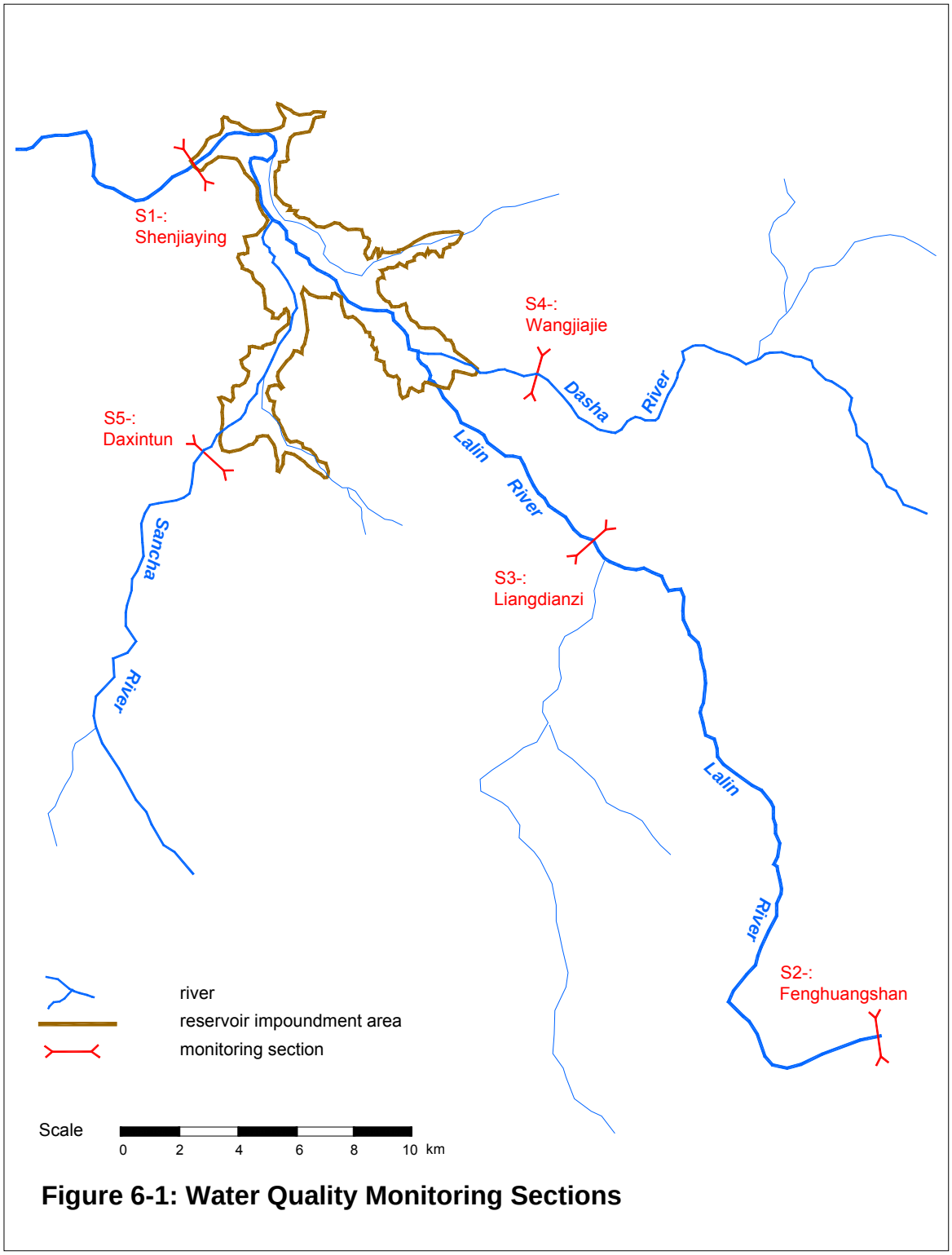

Figure 6-1: Water Quality Monitoring Sections

Integrated with the data of 2004, an analysis of level and trend of total bacteria is conducted. At the dam site, the outline of the major pollutant, total bacterial is shown as the following Figure 6-2. Those for the upstream monitoring sections are respectively presented in Figure 6-3, 6-4, 6-5 and 6-6. The charts give a direct impression and explanation on the cause/origin of high level total bacterial at the dam site. The changing trend of the parameter at the dam site is similar with that at Fenghuangshan, which is the headstream of the Lalin River. High level of total bacteria appearing in the headstream plus the contribution of the other two tributaries cause the highest 140000 bacteria per milliliter to take place at the dam site.

The standard of total bacteria is 100 no./ml for raw drinking water source, which can help to give a comparison and evaluation on the levels of total bacteria at the sections shown in the following charts.

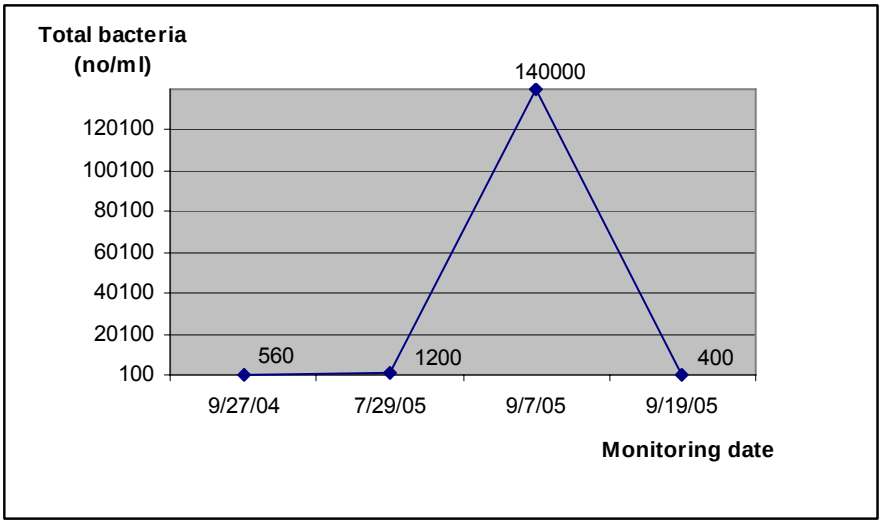

Figure 6-2: Levels of Total Bacteria at Dam Site of Shenjiaying

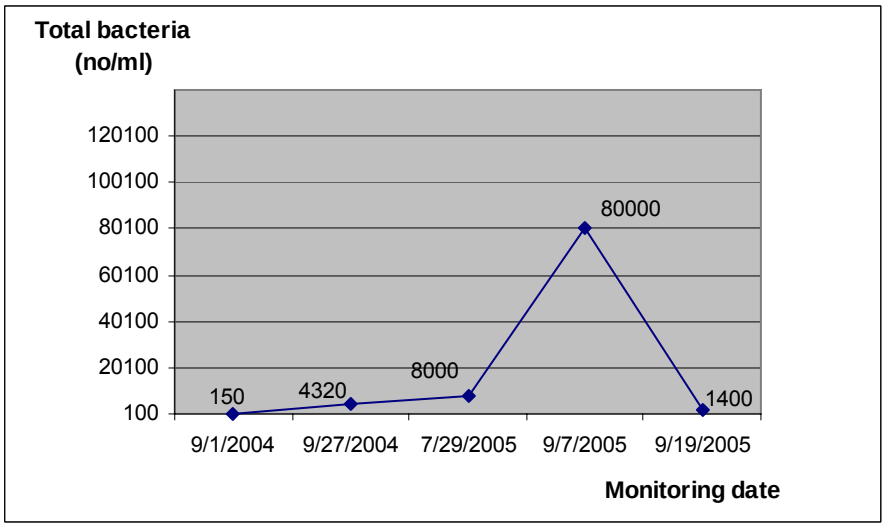

Figure 6-3: Levels of Total Bacteria at Fenghuangshan of Lalin River

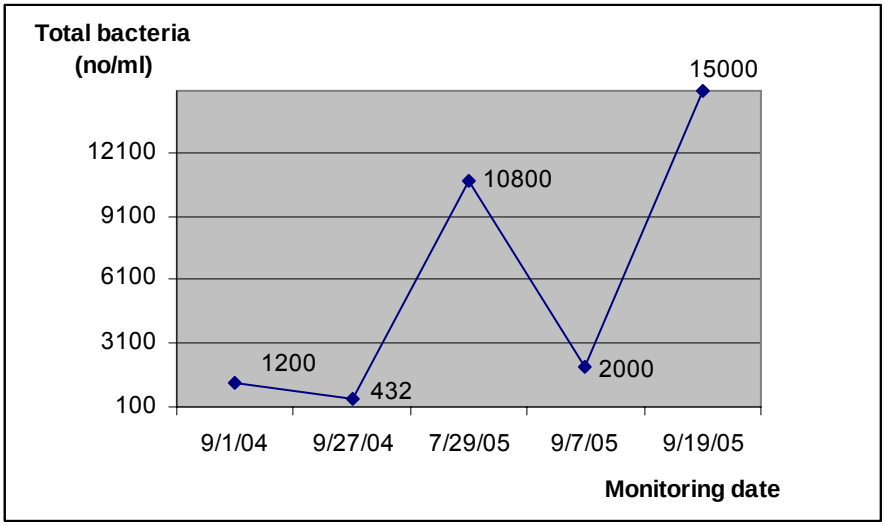

Figure 6-4: Levels of Total Bacteria at Liangdianzi of Lalin River

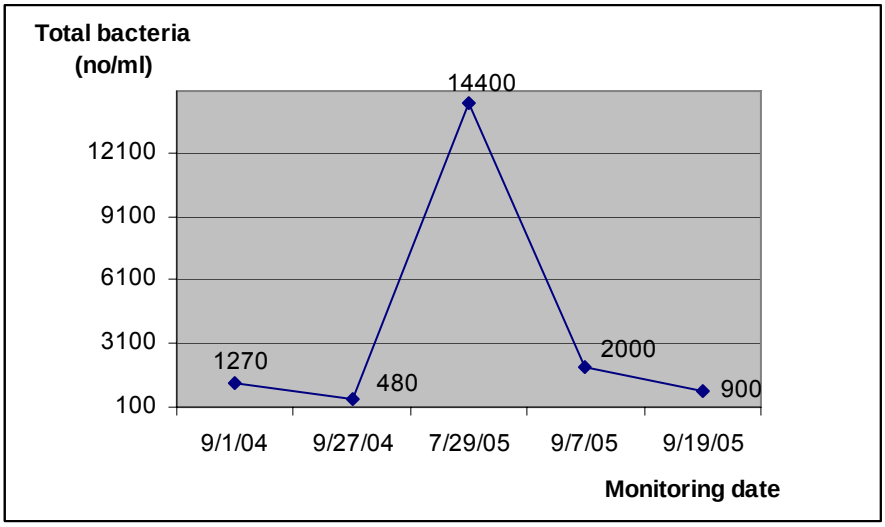

Figure 6-5: Levels of Total Bacteria at Wangjiajie of Dasha River

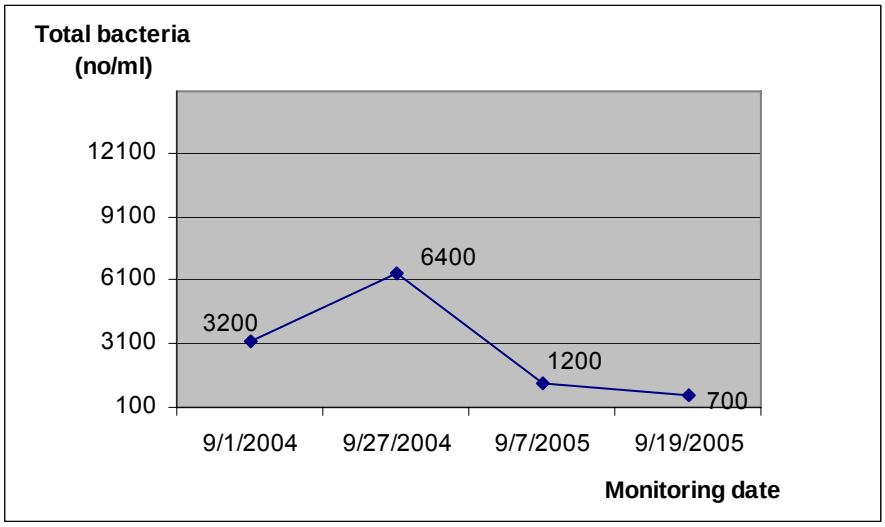

Figure 6-6: Levels of Total Bacteria at Daxintun of Sancha River

Beside the above mentioned parameters, it can be seen from the evaluation results that, in 2004, the water quality at the dam site is a little polluted by some other pollutants such as dissolved Fe^{x+}, COD, Total coliform group, Mn and Al.

According to the PRC regulations on raw water source, the water quality must meet the national standards. Raw water source will be thought unsuitable for drinking water use if the water quality can not meet the standards unless the treated water quality can meet the Sanitation Standard for Drinking Water (GB5749-85) through necessary treatment processes. Some of the above mentioned pollutants such as color, turbidity, COD, Total bacteria and Total coliform group are treatable by flocculation, sedimentation, filtration and disinfection proposed by the new water treatment plant. The high concentration of aluminum and dissolved Fe^{x+} at the dam site should be noted during treatment and the treated concentration should not be higher than 0.2mg/L and 0.3mg/L respectively. Further study on what has brought about the above pollutants and how to control the pollution sources should be conducted to protect the water quality of the raw water source.

B. Water quality monitoring equipment in operation phase

In order to protect the water quality of the raw water source, a set of automatic monitoring facilities are installed in the reservoir administration center and to be tested in 2006 spring. Eight parameters can be measured by this equipment, including water temperature, pH, turbidity, conductivity, DO, COD, alga and ammonia nitrogen.

At the same time, a set of portable water quality monitoring instrument is prepared to monitor water quality at the tributaries where entering the reservoir. Ten parameters can be measured by the instrument, including water temperature, pH, total hardness, turbidity, conductivity, DO, COD, ammonia nitrogen, total phosphorus and chloride.

6.2 Water and Soil Conservation Monitoring

Except for twice conducted in 2004, another two water and soil conservation monitoring exercises for the reservoir construction have been carried out by the Heilongjiang Provincial Water and Soil Conservation Science Institute (HWSCSI) in 2005 based on the Water and Soil Conservation Monitoring Action Plan which was prepared by HWSCSI in July 2004. The 4 corresponding reports have been provided to B&V.

Three kinds of monitoring have been conducted including earth surface disturbance monitoring, soil erosion monitoring and water and soil conservation works monitoring. In each exercise, 14 monitoring points have been set up for the earth surface disturbance monitoring and 4 for the soil erosion monitoring. Visual inspections have been carried out for the water and soil conservation works according to construction progress. Basic conditions of the monitoring points are shown in the following Table 6-2. Detailed monitoring data is shown in Table 6-3 and the evaluation results are shown in Table 6-4. It can be seen that the efforts on soil erosion control is still deficient and required to be strengthened in the next stage. However, most water and soil conservation works could be carried out only after the whole construction is finished.

Table 6-2: Basic Conditions of the Monitoring Points

No.	Monitoring Point	Location	Original Topography	Area of Original Land Category (ha)				
				Farm land	Forest land	Waste land	Flood plain	Total
1	Dam construction site	Right bank upstream main dam	Low mountain		1.49			**1.49**
2	Concrete mixing station	Left bank downstream dam	Flood plain		1.03		0.42	**1.45**
3	Temporary stone disposal site	Left bank downstream main dam	Flood plain		2.13		1.53	**3.66**
4	Living camp	Left bank downstream the Lalin River Bridge	Flood plain	1.28	0.51			**1.79**
5	1# gravel quarry area	Left bank upstream main dam	Flood plain	9.3		1.5	0.56	**11.36**
6	Management office building	Right bank downstream the Lalin River Bridge	Flood plain	2.13		0.3		**2.43**
7	Waste disposal area	In south of Mopanshan Village	Alluvium plain	0.64		0.22		**0.86**
8	2# gravel quarry area	Southeast of Mopanshan Village	Alluvium plain	3.44		1.84		**5.28**
9	Clay borrow area	North of Mopanshan Village	Hill	0.37	0.02	0.11		**0.5**
10	Outlet of water tunnel	Northeast of Mopanshan Village	Hill	2.35		1.41		**3.76**
11	Component processing plant	Right bank downstream main dam	Flood plain			0.72		**0.72**
12	Major works on right bank	Left bank of Lalin River	Low mountain		0.99			**0.99**
13	Temporary construction road	-	Flood plain	0.41	1.01	0.12	0.21	**1.75**
14	Shaft construction site	Northeast of Mopanshan Village	Low mountain	0.24	0.11			**0.35**
	Total			20.16	7.29	6.22	2.72	**36.39**

Table 6-3: Soil Erosion Monitoring Results in 2005 (2 exercises)

No.	Monitoring Point	Jun 2005		Sep 2005	
		Area (ha)	Quantity (t/month)	Area (ha)	Quantity (t/month)
1	Dam construction site	1.29	104.96	1.28	138.6
2	Concrete mixing station	0.12	25.84	0.17	30.31
3	Temporary stone disposal site	0.12	13.32	0.12	16.28
4	Living camp	0.29	38.42	0.29	45.74
5	1# gravel quarry area	0	221.34	0	221.34
6	Management office building	0.08	55.29	0.08	57.31
7	Waste disposal area	0.18	35.57	0.16	39.52
8	2# gravel quarry area	8.59	427.73	8.61	640.22
9	Clay borrow area	16.95	859.78	16.53	1267.74
10	Outlet of water tunnel	2.32	302.28	2.27	361.94
11	Component processing plant	0	0	0	0
12	Major works on right bank	0.4	64.37	0.15	68.31
13	Temporary construction road	0.18	22.71	0.18	27.25
14	Shaft construction site	0.07	13.13	0.08	15.23
	Total	30.59	2184.74	29.92	2929.79

Table 6-4: Evaluation Results for Soil Erosion Monitoring in 2005 (2 exercises)

Items	Standard	Evaluation Results			
		Jun 2005		Sep 2005	
		Value	Analysis	Value	Analysis
Rate of disturbed earth surface renovation	*	3.9%	*	3.9%	*
Ratio of soil loss and control	1.5	1.6	met standard	1.6	met standard
Degree of soil erosion control	*	16.9%	*	16.9%	*
Rate of residual retaining	95%	15.6%	not met standard	15.6%	not met standard
Coefficient of vegetation restoration	*	0	*	0	*

Note: * means dynamic during construction phase and to be evaluated after construction completed.

7. Results of Independent Monitoring of Resettlement Activities

As of the end 2005, the total resettlement cost is RMB 0.611 billion with 1871 household and 6952 people to be resettled.

The permanent land acquisition of the reservoir is 2970 ha, of which 2893.48 ha is submerged area. The construction of the reservoir will submerge eight villages in Shahezi Town and Xiangfeng Tree Plantation, Sanchahe Train Station and Hansong Tree Plantation. 1146 household, 4444 people is to be resettled in Shahezi Town Wuchang City and 652 household, 1890 people to be resettled in Shanhe Forestry Bureau. The resettlement activities have continued to the apparent satisfaction of all involved and will proceed into late 2006. The on-going work is associated with relocation of two villages. New villages are being constructed for residents associated with the Xiangfeng Tree Plantation and the Hansong Tree Plantation. 84 household and 372 people to be resettled in raw water pipeline areas, and the temporary land acquisition is 630 ha. The permanent land acquisition for the WTP is 29.83 ha.

Because HMWSCC have separate contracts with resettlement consultants, as for detailed information on resettlement activities, see relevant documents prepared by the resettlement consultants.

8. Problems Encountered

In 2005, no issues or problems associated with environmental aspects have been induced by the project construction.

A major event of significance to the Project, which occurred in late 2005, was a pollution incident in the Songhua River. This incident caused the Water Supply Company to close down the piped supply system in Harbin and supply water on an emergency basis. The event was significant in that it confirmed the need for the Mopanshan supply to be developed as soon as possible. It also resulted in discussions being held with Central Government officials. As a result, plans to develop Phase II of the Mopanshan Project are being brought forward and the work given the highest priority.

9. Conclusions and Recommendation

During the period of this report, the Project was assessed to be some 73% complete overall. In the construction phase, the contractors of all the contract sections have on the whole fulfilled their promise to protect the environment. Attention has been paid to

reservoir bed clearance and sanitation disinfection, heritage and archaeological sites protection, as well as wastewater treatment, air protection, noise control etc. Water quality monitoring and erosion monitoring have been carried out periodically. Through the implementation of these measures, the destruction of the environment has been lowered to a minimum level possible during construction. However, to certain extent there were still unavoidable adverse impacts on the environment during construction, for example more efforts are required on water and soil conservation to prevent soil erosion. The mitigation measures and monitoring program have been carried out generally satisfactorily, and the following conclusions and recommendations on the environmental performance can be drawn:

- The noise, dust and wastewater produced in construction have been minimized by relevant mitigation measures and there was no significant impact on nearby sensitive points.

- In 2005, the land temporarily occupied began restoration and return to the owners, which should be monitored in the future monitoring periods to ensure the least impacts to the affected.

- Water and soil conservation monitoring exercises for the reservoir construction have been carried out twice in 2005 with the results showing that efforts on soil erosion control are still deficient and required to be strengthened in the next stage. It is recommended that water and soil conservation at borrow areas and construction waste disposal sites be better considered and strengthened to reduce soil erosion during rainy seasons. However, it is recognized that most water and soil conservation works could be carried out only after the whole construction is finished. Landscaping and tuffing works are yet to commence at the water treatment plant.

- The water quality of both the upper reaches of the Lalin River and the tributaries flowing into the reservoir has been monitored periodically and the results show that in 2005, the water quality at dam site is somewhat polluted and some pollutants cannot meet the PRC standards for a raw water source. Therefore, it is recommended that further study should be conducted to investigate where the above pollutants came and how to control their sources for a better quality of the raw water source.

- Environmental responsibilities is to be defined and training to be provided for the environmental management office (EMO) of the HMWSCC to improve the environmental management, monitoring and reporting during construction period.

- Supervision of the implementation of environmental mitigation measures and water and soil conservation should be carried out by relevant supervision agencies according to prescribed procedures and timing, and all periodical data and records should be supplied to the HMWSCC in time.

- Environmental protection costs incurred should be identified and special costs for appropriate environmental protection and pollution prevention should be guaranteed.

APPENDIX 1
ENVIRONMENTAL STANDARDS

TABLE A1-1: ENVIRONMENTAL QUALITY STANDARDS OF SURFACE WATER (GB3838-88)

Unit: mg/l (excluding pH)

NO.	CLASSIFICATION STANDARD VALUE PARAMETER		CLASS I	CLASS II	CLASS III	CLASS IV	CLASS V
1	Water temperature (℃)		Artificial environmental water temperature change should be controlled as: Weekly average most temperature rise ≤1 Weekly average most temperature rise ≤2				
2	pH		6～9				
3	DO	≥	Saturation rate is 90% (or DO≥7.5)	6	5	3	2
4	Permanganate index	≤	2	4	6	10	15
5	COD	≤	15	15	20	30	40
6	BOD_5	≤	3	3	4	6	10
7	Ammonia nitrogen (NH_3-N)	≤	0.15	0.5	1.0	1.5	2.0
8	Total phosphorous (by P)	≤	0.02 (lake/ reservoir 0.01)	0.1 (lake/ reservoir 0.025)	0.2 (lake/ reservoir 0.05)	0.3 (lake/ reservoir 0.1)	0.4 (lake/ reservoir 0.2)
9	Total nitrogen (lake/reservoir, by N)	≤	0.2	0.5	1.0	1.5	2.0
10	Total copper	≤	0.01	1.0	1.0	1.0	1.0
11	Total zinc	≤	0.05	1.0	1.0	2.0	2.0
12	Fluoride (by F^-)	≤	1.0	1.0	1.0	1.5	1.5
13	Total selenium	≤	0.01	0.01	0.01	0.02	0.02
14	Total arsenic	≤	0.05	0.05	0.05	0.1	0.1
15	Total Hg	≤	0.00005	0.00005	0.0001	0.001	0.001
16	Total cadmium	≤	0.001	0.005	0.005	0.005	0.01
17	Chromium (six valance)	≤	0.01	0.05	0.05	0.05	0.1
18	Total lead	≤	0.01	0.01	0.05	0.05	0.1
19	Total cyanide	≤	0.005	0.05	0.02	0.2	0.2
20	Volatile Hydroxybenzene	≤	0.002	0.002	0.005	0.01	0.1
21	Oil	≤	0.05	0.05	0.05	0.5	1.0
22	Anion surface-active detergent	≤	0.2	0.2	0.2	0.3	0.3
23	Sulphide	≤	0.05	0.1	0.2	0.5	1.0
24	Faecal coliform (No./l)	≤	200	2000	10000	20000	40000

TABLE A1-2: ADDITIONAL PARAMETERS STANDARDS FOR CENTRALIZED SURFACE DRINKING WATER SOURCE (GB3838-88)

NO.	PARAMETER	UNIT	STANDARD VALUE
1	Sulphate (by S)	mg/L	250
2	Chloride (by Cl)	mg/L	250
3	Nitrate (by N)	mg/L	10
4	Fe	mg/L	0.3
5	Mn	mg/L	0.1

TABLE A1-3: SPECIAL PARAMETERS STANDARDS FOR CENTRALIZED SURFACE DRINKING WATER SOURCE (GB3838-88)

NO.	PARAMETER	UNIT	STANDARD VALUE
1	Chloroform	mg/L	0.06
2	Carbon tetrachloride	mg/L	0.002
29	BHC	mg/L	0.05
52	DDT	mg/L	0.001
66	BaP	mg/L	$2.8*10^{-6}$
…	…		

TABLE A1-4: WATER QUALITY STANDARDS FOR DRINKING WATER SOURCES (CJ3020-1993)

NO.	PARAMETERS	UNIT	LIMITS	
			CLASS 1	CLASS 2
1	Color		<=15 and no other color	no obvious other color
2	Turbidity		<=3	
3	Smell and taste		No smell and taste	No obvious smell and taste
4	pH value		6.5 to 8.5	6.5 to 8.5
5	Total hardness (by $CaCO_3$)	mg/L	<=350	<=450
6	Dissolved Fe^{x+}	mg/L	<=0.3	<=0.5
7	Manganese	mg/L	<=0.1	<=0.1
8	Copper	mg/L	<=1.0	<=1.0
9	Zinc	mg/L	<=1.0	<=1.0
10	Volatile hydroxybenzene (by phenol)	mg/L	<=0.002	<=0.004
11	Anion synthetic detergent	mg/L	<=0.3	<=0.3
12	Sulfate	mg/L	<250	<250
13	Chloride	mg/L	<250	<250
14	DTS	mg/L	<1000	<1000
15	Fluoride	mg/L	<=1.0	<=1.0
16	Cyanide	mg/L	<=0.05	<=0.05
17	Arsenic	mg/L	<=0.05	<=0.05
18	Selenium	mg/L	<=0.01	<=0.01
19	Hg	mg/L	<=0.001	<=0.001
20	Cadmium	mg/L	<=0.01	<=0.01
21	Chrome (+6)	mg/L	<=0.05	<=0.05
22	Pb	mg/L	<=0.05	<=0.07
23	Ag	mg/L	<=0.05	<=0.05
24	Beryllium	mg/L	<=0.0002	<=0.0002
25	N-NH_3 (by N)	mg/L	<=0.5	<=1.0
26	Nitrate (by Nitrogen)	mg/L	<=10	<=20
27	COD ($KMnO_4$)	mg/L	<=3	<=6
28	BaP	μg/L	<=0.01	<=0.01
29	DDT	μg/L	<=1	<=1
30	BHC	μg/L	<=5	<=5
31	BaiJunqing	mg/L	<=0.01	<=0.01
32	Total coliform group	no./L	<=1000	<=10000
33	Total α radioactivity	Bq/L	<=0.1	<=0.1
34	Total β radioactivity	Bq/L	<=1	<=1

Notes:

Class 1 – The water quality is good and before the water is supplied for drinking it only needs disinfection for groundwater source and simple purification for surface water source.

Class 2 – The water has been slightly polluted and needs purification treatment processes such as flocculation, sedimentation, filtration and disinfection and the treated water should reach GB5749 before supplied for drinking.

TABLE A1-5: SANITATION STANDARD FOR DRINKING WATER (GB5749-85)

PARAMETERS		UNIT	LIMITS
Sensory and general chemical parameter	Color	-	<=15 and no other color
	Turbidity	-	<=3
	Smell and taste	-	No smell and taste
	pH value	-	6.5 to 8.5
	Total hardness (by $CaCO_3$)	mg/L	450
	Dissolved Fe^{x+}	mg/L	0.3
	Manganese	mg/L	0.1
	Copper	mg/L	1.0
	Zinc	mg/L	1.0
	Volatile hydroxybenzene (by phenol)	mg/L	0.002
	Sulfate	mg/L	250
	Chloride	mg/L	250
	DTS	mg/L	1000
Toxicological parameter	Fluoride	mg/L	1.0
	Cyanide	mg/L	0.05
	Arsenic	mg/L	0.05
	Selenium	mg/L	0.01
	Hg	mg/L	0.001
	Cadmium	mg/L	0.01
	Chrome (+6)	mg/L	0.05
	Pb	mg/L	0.05
	Ag	mg/L	0.05
	Nitrate (by Nitrogen)	mg/L	20
	Chloroform	mg/L	60
	Carbon tetrachloride	μg/L	3
	BaP	μg/L	0.01
	DDT	μg/L	1.0
	BHC	μg/L	5.0
Bacteriological parameter	Total bacteria	No./mL	100
	Total coliform group	no./L	3
	Residual chlorine	mg/L	0.1
Radioactive	Total α radioactivity	Bq/L	0.1
	Total β radioactivity	Bq/L	1.0

APPENDIX 2
PHOTOS

Photo A2-1: Mopanshan Dam under construction

Photo A2-2: Mopanshan Reservoir since impoundment started in Sep 2005

Photo A2-3: Water supply tunnel under construction

Photo A2-4: Raw water pipeline trench

Photo A2-5: Landscaping to be done for the water treatment plant

Photo A2-6: Construction of water distribution network at Hongxing Village

Photo A2-7: Structure demolition at Sanrenban Village for reservoir bed clearance

Photo A2-8: Reservoir bed clearance

Photo A2-9: Temporary deposit of waste generated from dam construction activities

Photo A2-10: Temporary deposit of earth from excavation of water tunnel

Photo A2-11: Clay borrow area for dam construction

Photo A2-12: Gravel quarry area for dam construction

Photo A2-13: Land permanently occupied by inspection well of the raw water transmission pipeline

Photo A2-14: Farm land restoration after laying the raw water transmission pipeline

Photo A2-15: Integrative wastewater treatment facility house in the WTP

Photo A2-16: Boiler house of the WTP

Photo A2-17: Chimney and coal house of the WTP

Photo A2-18: Dust catcher in boiler house of the WTP