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WEN CHUAN EARTHQUAKE RECOVERY PROJECT
Cheng County Moba Gorge Water Source Project in Gansu Province

Environmental Impact Assessment

Moba Gorge Water Source Engineering Construction Management Department of Cheng County
Lanzhou University

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1. Response Letter

2. Power of Attorney for Environmental Impact Assessment

3.Reply of the World Bank Bonus Emergency Loan Project——Environmental Impact Assessment of the Moba Gorge Water Supply Project in Cheng County, Gansu Province

4.Reply of the World Bank Bonus Emergency Loan Project——Soil and Water Conservation Planning Report of the Urban Area Water Supply Moba Gorge Water Source (Reservoir) Project in Cheng County, Gansu Province

5. Response Letter of Related Questions about Soil and Water Conservation of the World Bank Bonus Emergency Loan Project——Water Supply Moba Gorge Water Source (Reservoir) of the Urban Area in Cheng County, Gansu Province

6. Current Situation Monitoring Data of the Environmental Quality of the "Cheng County Moba Gorge Reservoir Drinking Water Source Conservation Area"

7. Certificate from the People's Government of Cheng County about the Moba Gorge Project Won't Lie in Jifeng Mount Conservation Area

8. Certificate from the Forestry Bureau of Cheng County about the Moba Gorge Project Won't Lie in Jifeng Mount Conservation Area

9. Certificate from the Territorial Resources Bureau of Cheng County about the Moba Gorge Project Won't Contain Covered Mineral Resource

10.Letter from the Territorial Resources Bureau of Cheng County about Affirming the Total Cultivated Area of the Urban Area Water Supply Moba Gorge Water Source in Cheng County

11. Moba Gorge Project Migration Plan of the Water Authority in Cheng County

12. Demonstration Letter of the Water Authority in Cheng County for the Downstream Villages Suffer No Impact

13. Public Participation Questionaire

14. Governmental Agency Questionaire

15. Public Notice

16. Minutes of the First Symposium

17. Minutes of the Second Symposium

18. Registration Form of Examination and Approval

1 General Instructions

1.1 Project Background

There are two tap water suppliers in Cheng County to supply water for urban area: the County Tap Water Company and Gaofeng Water Supply Company. The water source of the County Tap Water Company is the well water lying on the west coast of the Blue Mud River in Chengguan Sun Family Dam. It belongs to the Quatermary period interspace connate water which is saved in grit layers and mainly supplied by the Blue Mud River and the atmosphere precipitation. However, the surface water of Blue Mud River contains plumbum and COD which exceed the IV standard of the Water Environment Quality Standard and have been affected by the Wenchuan Earthquake happened in Sichuan Province. The well water turbidity degree has become more serious with peculiar smell and floating garbage. The urban area citizens' health will be grievously influenced; the water source of Gaofeng Water Supply Company is Gaofeng Reservoir which only covers an area less than 10 km². As the uneven distribution of precipitation, the actual daily water supply ability of Gaofeng Company can only reach 1000m³. According to investigation, the existing water supply projects are not able to satisfy the needs of water use in urban areas.

The Cheng County Moba Gorge Water Supply Project lies in the west side about 11km away from the Cheng County town and 6km away from the Paosha Town. It's in the downstream of the South River basin. The geographic location: northern latitude 33°45'~33°38', east longitude 105°33'55''~105°37'60''. It belongs to Jialing River Water, upstream of the Yangtze River. The main tasks for Moba Gorge Water Supply Project are to provide water for urban areas in Cheng County; solve the water supply problem in urban areas; improve the water quality; reduce water supply cost; fulfill the sustainable development of Cheng County economic society; and improve the citizens' health level. After completion, this project will be able to solve the water problem in the county and offer favorable economic results to the society.

Lanzhou University finished compiling the "Reply of the World Bank Bonus Emergency Loan Project——Environmental Impact Assessment of the Moba Gorge Water Supply Project in Cheng County, Gansu Province" on June 10th, 2009. On June 30th, 2009, the Environmental Protection Bureau of Gansu Province replied the "Reply of the World Bank Bonus Emergency Loan Project——Environmental Impact Assessment of the Moba Gorge Water Supply Project in Cheng County, Gansu Province" by Gansu Environmental Protection Issue No. 【2009】60 and approved the environmental report of this project. The reservoir scale was designed to be 50,000 m³/d with normal impounded level of 1096.104m at that time. And the verified flood stage was 1101.70m, the total storage capacity was 20.19804 million m³, and the waterline length was 4.74km. After being checked by related departments, the reservoir scale design was changed to be 47,500 m³/d with normal impounded level of 1092.70m. The verified flood stage shall be 1098.52m, the total storage capacity shall be 1.790 million m³ and the waterline length shall be 5.15km. According to related regulations in the "Environmental Impact Assessment Law of the People's Republic of China" and NO. 253 State Council Regulation "Environment Protection Management Regulation of Construction Project", the construction management office of Urban Area Water Supply Moba Gorge Water Source Project in Cheng County, Gansu Province authorized Lanzhou University to recompile the environmental assessment of this project. After being authorized, we went to make an on-the-spot survey, collect related materials, and investigate the environmental conditions of surrounding area. Based on our survey and investigation, we compiled the "Environmental Impact Assessment Report of the Moba Gorge Water Source Project in Cheng County, Gansu Province".

1.2 Evaluation Basis

1.2.1 Law and Regulations

（1） “Environment Protection Law of the People’s Republic of China“ (Dec, 1989)

（2） “Environmental Prevention and Control Law for Air Pollution of the People’s Republic of China“ (Sept, 2000)

（3） “Prevention and Control Law for Water Pollution of the People’s Republic of China“ (June 1st, 2008)

（4） “Prevention and Control Law for Environment Noise Pollution of the People’s Republic of China “ (March, 1997)

（5） “Environmental Prevention and Control Law for Solid Waste Pollution of the People’s Republic of China “ (April, 2005)

（6） “Environmental Impact Assessment Law of the People’s Republic of China “ (Sept. 1st, 2003)

（7） “Clean Production Promotion Law of the People’s Republic of China “ (Jan. 1st, 2003)

（8） “Soil and Water Conservation Law of the People’s Republic of China “ (June, 1991)

（9） “Enforcement Regulations of Soil and Water Conservation Law of the People’s Republic of China “ (August 1st, 1993)

（10） “Notice from the State Council about Issuing ‘National Ecological Environment Protection Outline’ Published by the State Environmental Protection Administration“ (Dec 21st, 2000)

（11） “Forest Law of the People’s Republic of China “ (Jan., 1998)

（12） “Aquatic and Wild Animal Protection Enforcement Regulation of the People’s Republic of China “ (approved by the State Council on Sept. 17th, 1993; and published by the Ministry of Agriculture on Oct. 5th, 1993)

（13） “Wild Animal Protection Law of the People’s Republic of China “ (approved on the fourth meeting by the Standing Committee of the Seventh National People’s Congress on Nov. 8th, 1988 and put into force since March 1st, 1989. On the eleventh meeting of the Standing Committee of the Tenth National People’s Congress on August 28th, 2004, “The Modification of ‘The Decision of Modifying the Wild Animal Protection Law of the People’s Republic of China ‘ was approved.)

（14） “Land Management Law of the People’s Republic of China “ (August 28th, 2004)

（15） “River Management Regulation of the People’s Republic of China “ (June 10th, 1988)

（16） “Flood Control Law of the People’s Republic of China “ (Jan. 1st, 1998)

1.3.2 Department Rules and Normative Documents

（1）Environment Issuing No. [1999]61——“Notice of Implementing ‘The Environment Management Regulation of Construction Project’”, published by the State Environment Protection Administration, March, 1999;

（2） Environment Issuing No. [1999]107——“Notice of Implementing Related Construction Project Environment Impact Assessment System” , published by the State Environment Protection

Administration, April, 1999;

（3）No.2 regulation——"Environmental Protection Systematic Management List of Construction Project", published by the State Environmental Protection Department, Oct. 10th, 2008;

（4）Environment Issuing NO. (2001) 19——"Notice of Enhancing the Development of Construction Project Environmental Protection Management", published by the State Environmental Protection Administration;

（5）Price Issuing No. [2002]125——"Notice of Regulating Environment Effect Council Charge by the State Development Planning Commission and the State Environmental Protection Administration", published by the State Development Planning Commission and the State Environmental Protection Administration, Jan. 31st, 2002;

（6）Environment Issuing No. [2006]28——"Interim Procedures for Public Participation in Environment Impact Assessment", published by the State Environmental Protection Administration, Feb. 14th, 2006;

（7）State Issuing No. [2007]15——"Notice of Issuing the Working Plan for Energy Conservation and Emission Reduction by the State Council", published by the State Council, May 23rd, 2007;

（8） "Geological Environment Protection Regulations in Gansu Province"(standing committee of Gansu people's congress);

（9） "Basic Farmland Protection Regulations in Gansu Province"(standing committee of Gansu people's congress, Sept. 29th, 1997);

（10） "Regulations of Implementing Forest Law of Gansu Province (Revised Version)"(standing committee of Gansu people's congress, July 30th, 1997);

（11） "Methods of Implementing Water Law in Gansu Province (Revised Version)"(standing committee of Gansu people's congress, May 28th, 1997);

（12） "Methods of Implementing Land Management Law in Gansu Province (Revised Version)"(standing committee of Gansu people's congress, Sept. 29th, 1997);

（13） "Methods of Implementing Fishing Law in Gansu Province"(standing committee of Gansu people's congress, Sept. 29th, 1997);

（14） "Methods of Implementing Soil and Water Conservation Law in Gansu Province"(standing committee of Gansu people's congress, revised on May 28th, 1997);

（15） "Decision of Several Question about Environmental Protection Made by the Gansu Provincial Government"(Feb. 20th, 1997);

（16） "Safety Management Regulations for Reservoir and Dam" (the State Council Order No. 78, March 22nd, 1991);

（17） "Pollution Prevention Management Regulations for Drinking Water Source Protection Area" (the State Environmental Protection Administration, Health Ministry, Construction Ministry, Water Resources Ministry and Geological and Mineral Resources Ministry, July 10th, 1989);

（18） "Guidelines about Developing Ecological Compensation Site"(Environment Issuing No. [2007]130, published by the State Environmental Protection Administration);

（19） "Compilation Technical Outline for National Drinking Water Source Point Environmental Protection"(the State Environmental Protection Administration, May, 2006).

1.3.3 Technical Specifications & Standards

（1） “Technical Guide Rules for Environment Impact Assessment——Outline“ (HJ/T 2.1-2.3-1993);

（2） “Technical Guide Rules for Environment Impact Assessment ——Surface Water“ (HJ/T2.3-93);

（3） “Technical Guide Rules for Environment Impact Assessment——Acoustic Environment“ (HJ2.4-2008);

（4） “Technical Guide Rules for Environment Impact Assessment——Atmosphere Environment“ (HJ2.2-2008);

（5）“Technical Rules for Environment Impact Assessment——Non-pollution Ecological Impact“ (HJ/T19-1997);

（6） “Technical Rules for Environment Impact Assessment——Water Conservancy and Hydropower Project“ (HJ/T88-2003);

（7） “Technical Specifications for the Soil and Water Conservation of the Development Construction Project“ (GB50433-2008);

（8）“Technical Guide Rules for Construction Project Environment Risk Assessment“（HJ/T169-2004）;

（9）“Technical Specifications for the Management & Protection of the Infrastructure Construction in Natural Preservation Areas“（HJ/T129-2003）;

（10）“Technical Specifications for Soil and Water Conservation in the Development Construction Project“（GB50433-2008）;

（11）“Technical Specifications for Ecological Environment Situation Assessment“（HJ/T192-2006）;

（12）“Technical Specifications for Soil and Water Conservation Management“（GB/T16453-2008）;

（13）“Surface Water Environment Quality Standards“(GB3838-2002);

（14） “Environment Air Quality Standards“（GB3095-1996）;

（15）“Acoustic Environment Quality Standards“（GB3096-2008）;

（16）“Daily Use Water Hygienic Standards“（GB5749-2006）;

（17）“Noise Limit in Construction Spot“（GB12523-90）;

（18）“Soil Environment Quality Standards“（GB15618-1995）;

（19）“Emission Standards for Pollute Water“（GB8978-1996）;

（20）“World Bank——Bank Procedure“（BP4.01-1999）;

（21）“World Bank——Operation Policy Environment Impact Assessment“（OP4.01）;

（22）“World Bank——Operation Policy Involuntary Resettlement“（OP4.12）;

（23）“World Bank——Operation Policy Natural Habitat “（OP4.04）;

（24）“World Bank——Operation Policy Dam Safety“（OP4.37）；

（25）“Technical Guide Rules for the Treatment of Construction Wastes in Earthquake Area“ (on trial)；

（26）“Technical Guide Rules for the Cleaning of Solid Wastes on the Bottom of Yangtze River Three Gorges Reservoir“（HJ85-2005）。

The proposed project will not involve indigenous people, will not involve forest sector activities or have significant impact on forested areas, will not lead to purchase or use of any pesticides, will not have impact on any known physical cultural resources. It also does not involve international waters or disputed areas. Therefore, other Bank safeguards policies are not triggered.

1.3.4 Reference Technical Documents

（1） “Preliminary Design Report of Gansu Cheng County Moba Gorge Water Source Project”(Yangtze River Survey Planning Design Research Co., Ltd., December, 2010)

（2） “Soil and Water Conservation Planning Report of the Urban Area Water Supply Moba Gorge Water Source (Reservoir) Project in Cheng County, Gansu Province”(Gansu Lvhua Ecological Engineering Consult Co., Ltd. November, 2009);

（3） Letter of Attorney for Environment Impact Assessment;

（4） Back design materials provided by the Cheng County Construction Bureau.

1.2.4 Related Planning

（1）“General Planning of the Cheng County Urban Area”（2001-2020）；

（2） Development Plan of “Eleventh Five-Year Plan” of Longnan;

（3） Development Plan of “Eleventh Five-Year Plan” of Cheng County;

（4） General Planning of the Reconstruction for Cheng County after 5.12 Wenchuan Earthquake;

（5）“Eleventh Five-Year Plan”of Reasonable Water Source Use and Water Source Guarantee of Cheng County;

（6） Safety Guarantee Plan of the Drinking Water Source Spot in Cheng County;

（7） Special Planning of Geological Disaster Prevention in Cheng County (2008~2015);

（8） Planning Report for the Geological Disaster Prevention in Cheng County, Gansu Province;

（9） General Planning of the Mineral Source in Cheng County.

1.2.5 Technical Information

（1）demonstration report of Cheng County Moba Gorge Water Supply Project water source；

（2）investigation report of Cheng County Moba Gorge Water Supply Project geology；

（3）basic information related to this project。

1.3 Assessment Aim, Principles and Keys

1.3.1 Assessment Aim

（1）Investigate and make assessment of the natural environment, social environment, atmosphere air, surface water and acoustic environment quality situation within the range of the project planned to be built.

（2）Predict and make assessment of the impact brought by each construction activity to the surrounding environment during the construction period and operation phase of the project planned to be built.

（3）Demonstrate the positive effects and adverse effects caused by the construction engineering to the surrounding environment, and propose feasible measures to reduce and compensate the environment protection project in order to minimize the adverse impact degree.

（4）Provide scientific proof for the project environment protection design and environment management.

1.3.2 Assessment Principles

（1）Strictly carry out related national and regional regulations, orders, standards and specifications related to environment protection, and stick to the principle of “Scientific, Objective and Impartial”.

（2）Put the principles of “control total quantity”, “make standard emission”, “keep sustainable development”, “insist recycle economy” and “clean production” into effect.

（3）Insist on the principle of unifying environmental benefit, economic benefit and social benefit.

（4）The environment assessment shall be in accordance with the principles of pertinence, science and practical applicability, so as to give impartial judgment about the potential impacts that the construction project might bring to the environment.

1.3.3 Assessment Keys

According to the characteristics and properties of this construction project, it may cause big influence on the ecological environment, water losses and soil erosion with the impact on hydrology, regional climate, water temperature & quality, environmental geology and people health. Based on the above analysis, the assessment keys of this assessment are on the foundation of engineering analysis and pollution prevention. The keys are as follows：

（1）The impact brought by the engineering construction on the regional water losses and soil erosion, and measures for soil and water conservation;

（2）After completion, the impact brought by the engineering construction on the regional ecological environment, hydrology, geology, water quality and water environment.

1.4 Functional Division of Assessment Area

1.4.1 Functional Division of Surface Water Environment

According to “Functional Report of Water in Gansu Province”, carry out III level water quality standard to the South River current water quality and objective water quality. The objective water quality is III level water quality. The water quality of this project shall comply with the III level standard in “Quality Standard of Surface Water Environment Quality” (GB38 38-2002) and the limit value of water source supplement project.

1.4.2 Functional Division of Atmosphere Environment

The atmosphere environment of the project spot belongs to the second level of the functional division.

1.4.3 Functional Division of Acoustic Environment

The acoustic environment of the project spot belongs to the second level of the functional division.

1.5 Assessment Time Intervals and Factors

1.5.1 Assessment Time Intervals

The construction period and operation period of the project.

1.5.2 Assessment Factors

According to the pollutant discharge features of the newly-built project and the reorganization of environment influential factors, the assessment factors of this assessment are listed in Table 1-1.

Table 1-1 Assessment Factors List

Project Phase	Environmental factors	Assessment factors for current situation	Influential factors for prediction
Construction Period	Environment air	PM10、TSP、CO	PM10、TSP、CO
	Acoustic environment	LAeq	LAeq
	Water environment	water temperature, PH, Al, Fe, Mn, Cu, Zn, volatile phenol class, negative ion, synthetic detergent, sulfate, chloride, COD, DO, As, Cd, Cr (sexavalence), cyanide, fluorid, Pb, Hg, nitrate, Se, potassium permanganate index, BODS, ammonia nitrogen, total nitrogen, total phosphorus, escherichia coli and oil type	CODcr、BOD5、SS、oil or fat
Operation Period	Water environment	Water temperature, PH, Al, Fe, Mn, Cu, Zn, volatile phenol class, negative ion, synthetic detergent, sulfate, chloride, COD, DO, As, Cd, Cr (sexavalence), cyanide, fluorid, Pb, Hg, nitrate, Se, potassium permanganate index, BODS, ammonia nitrogen, total nitrogen, total phosphorus, escherichia coli and oil type	CODcr、BOD5、SS、oil or fat

1.6 Assessment Rating and Scope

1.6.1 Assessment Rating

1.6.1.1 Environmental Air

As there's no boiler set in the management station during the operation period of this project, there's no air pollutant. The atmosphere environment assessment rate is the third level.

1.6.1.2 Surface Water

According to the regulations in "Technical Guide Rules for Environment Impact Assessment——Surface Water Environment" (HJ/T2.1-2.3-93), the division of surface water assessment rating shall be decided by the pollute water discharge value, complexity of the pollute water quality, scale of receiving water and water area functional type of this project. The main waster water during the operation period after completion will come from management station workers' domestic sewage. The amount won't be big and the water complexity will be simple. Based on the above, the surface water environment grade of this project shall be the third level.

1.6.1.3 Acoustic Environment

The noise source of this project is mainly from the noise produced during the construction period. According to the analysis of the noise source situation, the noise level increase is few before and after construction and no obvious change appeared in the amount of influenced population. According to related regulations in “Technical Guide Rules for Environment Impact Assessment——Acoustic Environment” (HJ/T2.4-2008), the acoustic environment grade of this project shall be decided as the third level.

1.6.1.4 Ecological Environment

As this project doesn’t belong to sensitive area, according to “Technical Guide Rules for Environment Impact Assessment——Non-pollute Ecological Impact” (HJ/T19-1997), the econogical environment of this project shall be decided as the third level.

1.6.2 Assessment Scope

According to the characteristics of the construction project environment assessment and the environment impact assessment guide rules, combined with the natural environment features around this project, the environment impact assessment scope is shown in Table 1-2 and Graph 1-1.

Table1-2 Environment Impact Assessment Scope List of This Project

No.	Environmental factor	Assessment scope
1	Acoustic environment	Area within 100m outside the construction site
2	Environmental air	Area within 500m outside the construction site
3	Ecological environment	Area within 2km of the reservoir district
4	Surface water environment	Area within 1000m of the upstream of the reservoir to area within 4000m of the downstream of the reservoir. In total:5000m.

1.7 Environmental Protection Goal

The main sensitive points of environmental protection are listed in Table 1-3 and Graph 1-2.

Table 1-3 Sentitive Points of Environmental Protection

No.	Environmental protection goal	Position to the dam	Distance from the dam（m）	Sensitive factor	impact
1	Yan River	NW	Tributary of Moba Gorge Reservoir	River	Water environment
2	Erlang River	N	Tributary of Moba Gorge Reservoir	River	Water environment
3	Moba Gorge Reservoir Area	Reservoir Area		River	Water environment
4	Farmland	Reservoir Area		Land	Ecology
5	Forest	Reservoir Area		Land	Ecology
6	Ma Family Cliff	SE	800	More than 300 people	Resident drinking water

7	Jian Family Gouge	SE	1600	More than 350 people	Resident drinking water
8	Zhuanwan Village	SE	3500	More than 900 people	Resident drinking water
9	Genlu Temple	SE	4500	More than 1000 people	Resident drinking water
10	Xiao Village	SW	1300	More than 250 people	Resident drinking water
11	Zhang Faminly Mountain	SW	1800	More than 600 people	Resident drinking water
12	Wangou Door	SW	3300	More than 100 people	Resident drinking water
13	Niu Family Cliff	SW	4300	More than 120 people	Resident drinking water

1.8 Assessment Standards

1.8.1 Environment Quality Standards

1.8.1.1 Environment Air Quality Standards

The environment air quality assessment shall be conducted according to the second standard d of "Environment Air Quality Standard" (GB3095-1996). See Table 1-4.

Table 1-4 Environment Air Quality Standard

Standard	item	Pollute concentration limit（mg/m^3）	
		Average hour	Average day
Second level standard of（GB3095-1996）	PM10	/	0.15
	NO2	0.24	0.12
	CO	10.00	4.00
	SO2	0.5	0.15

1.8.1.2 Water Environment Quality Standard

The water source surface water quality shall meet the requirements of the III level standard of "Surface Water Environment Quality Standard" (GB3838-2002) and the limit value of water source supplement item. The III level standards of "Surface Water Environment Quality Standard" (GB3838-2002) are listed in Table 1-5, and the limit values are in Table 1-6.

Table1-5 "Surface Water Environment Quality Standard"（GB3838-2002）

No.	Item name		Standard value（mg/L）
1	pH(dimensionless）		6~9

2	COD	≤	20
3	NH3-N	≤	1.0
4	Total nitrogen	≤	1.0
5	Zn	≤	1.0
6	Se	≤	0.01
7	Hg	≤	0.0001
8	Pb	≤	0.05
9	Cyanide	≤	0.2
10	Oil type	≤	0.05
11	sulfide	≤	0.2
12	DO	≥	3
13	BOD5	≤	4
14	TP	≤	0.2
15	Cu	≤	1.0
16	Fluorid	≤	1.0
17	As	≤	0.05
18	Cd	≤	0.005
19	Cr（sexavalence）	≤	0.05
20	Volatile phenol class	≤	0.005
21	LAS	≤	0.2
22	E Coli（amount/L）	≤	10000
23	Potassium Permanganate index	≤	6
24	Water temperature（℃）		

Table 1-6 Limit Value of Water Source Supplement Items Unit：mg/L

No.	Item name	Allowable maximum concentration
1	sulfate(by SO42-)	250
2	chloride（by Cl-)	250
3	Nitrate(by N)	10
4	Fe	0.3
5	Mn	0.1

1.8.1.3 Noise Environment Quality Standard

The acoustic environment current situation assessment shall be conducted by the second level standards of the “Acoustic Environment Quality Standard” (GB3096-2008). Specific standards are listed in Table 1-7.

Table 1-7 Acoustic Environment Quality Standard

type	daytime dB（A）	At night dB（A）
Second level	60	50

1.8.1.4 River Bottom Quality Standard

The river bottom quality assessment shall be conducted by the first level standards of the “Soil Environment Quality Standard” (GB15618-1995). Specific standards are listed in Table 1-8.

Table 1-8 Soil Environment Quality Standard Unit：mg/kg

No.	Item name	Allowable maximum concentration
1	Cu	35
2	Cd	0.20
3	Pb	35
4	Zn	100
5	Hg	0.15
6	Cr（sexavalence）	No standard
7	As	15
8	Total Cr	90
9	sulfide	No standard

1.8.2 Pollutant Discharge Standard

1.8.2.1 Waste Water

The domestic waste water shall meet the first level standards of “Waste Water Discharge Standard” (GB8978-1996) after treatment. See Table 1-9 for more information.

Table 1-9 Waste Water Discharge Standard（GB8978-1996）

No.	Item name	unit	Allowable maximum concentration
1	pH value		6.0-9.0
2	Floating article	mg/L	70
3	BOD5	mg/L	30
4	CODcr	mg/L	100
5	Ammonia nitrogen	mg/L	15

1.8.2.2 Particulate Matter

The particulate matter discharge during construction period shall meet the requirements of inorganizaation discharge concentration limit value in “Atmosphere Pollutant Discharge Standard” (GB16297-1996). See Table 1-10 for more information.

Table 1-10 Atmosphere Pollutant Discharge Standard（GB16297-1996）

Item name	unit	level	Concentration control limit value
Particulate matter	mg/m^3	Inorganization discharge	The concentration for the highest outside area point is 1.0

1.8.2.3 Noise

The factory noise control during construction period shall be conducted according to “Noise Limit Value of Construction Site” (GB12523-90). See Table 1-11 for specific standard values.

Table 1-11 Noise Limit Value of Construction Site Unit：dB

Construction period	Major noise sources	Noise limit value	
		daytime	At night
cubic meter of soil and stone	Soil shifter, loader machine, excavator, etc.	75	55
pilling	Various pile drivers, etc.	85	No construction
structure	Concrete-mixer, vibrate, electric saw, etc	70	55
decorations	Hoister, lifter, etc.	65	55

1.8.3 Hygienic Standard

Water from the water source of Moba Gorge Water Supply Project shall meet the requirements of “Hygienic Standard for Drinking Water” (GB5749-2006). See Table 1-12 for more information.

Table 1-12 Hygienic Standard for Drinking Water（ GB5749-2006）

index		unit	Limit value
1、microbiological indicator	Total coliforms	MPN/100ml	Can’t be detected
	Heatproof coliforms	MPN/100ml	Can’t be detected
2、toxicology indicator	As	mg/L	0.01
	Cd	mg/L	0.005
	Cr（sexavalence）	mg/L	0.05
	Pb	mg/L	0.01
	Hg	mg/L	0.001
3、sensory organ character and normal chemical indicator	Color degree	Pt & Co color	15
	turbidity	NTU	1
	Smell and taste		No stinky or other smell
	PH		≥6.5 & ≤8.5
	Al	mg/L	0.2
	Zn	mg/L	1.0
4、radioactive indicator	Total a radioactivity	Bq/L	0.5

	Totalβ radioactivity	Bq/L	1

Note： Radioactive indicators are instructive values.

2 regional environment overview

2.1 General Situation of Natural Environment

2.1.1 Geographic Location

Cheng County lies in Longnan City which belongs to the six southern cities of Gansu Province. Geographic location of Cheng County: eastern longitude 105°24′～105°57′; northern attitude 33°31′～34°02′. The east side of Cheng County is next to Hui County and the west side is close to He County. The southwestern side is opposite to Kang County across the West Han River while the southeastern side is next to the Lveyang County of Shanxi Province. The length from north to south is 55km and the width from east to west is about 52km with an area of 1701km². This project lies in the location 11km away from the west side of Cheng County. It's 6km away from Paosha Town in the downstream of South River. The geographic location: northern attitude: 33°45´~33°38´, eastern longitude 105°33´55″. It belongs to the Jialing River in the upstream of the Yangtze River. See Graph 2-1 for specific geographic location.

2.1.2 Terrian and Landform

Cheng County locates in Nanlu Mount land of Qinling with numerous high and low mountains and ravines crossbars. The highest peak within the area is the White Cliff Mount with a height of 2377m while the lowest point is the junction of West Han River with a height of 725m and a relative height difference of 1652m. Terrian in the northwestern part is high and dangerous with multiple mountains overlapping on each other. The southeastern side is the exit for all river within the county. Protective shape of Chicken Mounts in the southern part together with the mountains mentioned just now embrace the county and make it the center of the central hill basin area. In general, the mountain land is about 500m higher than the river bed with a gradient of 30°—50°. The mountain range is from south to north while the northern part is higher and the southern part is lower. The whole terrain tilts from northwest to southeast with high and precipitous mountain terrain.

There're three types of the landform in Cheng County:

(1)The river valley alluvion surface is plane and wide with obvious bedded deposit. It covers 6.5% of the total county area.

（2）Hilly Land

Cheng County covers large area with wide range. The brae part can reach 35° with steep hill and bare sandy cliff. The hill tope is high but the terrain is plane. It covers 13.5% of the total county area.

(3) Mountainous region is mainly in the northern and southern parts of the county. Most part of it is lithoidal mountainous region with big gradient, thin soil layer and cover of forest bushwoods. It covers about 80% of the whole county area.

2.1.3 Geologic Aspects

Cheng County locates in south into county qinling fold belt in a more open faulted the basin. Basin bottom-up development of the southern mafic volcanic series, gold rock, slate. Take in northern for sediment, the lower part is the glutenite department, central is slate, the limestone department, at the top is the thousand pieces of rock, slate, for river deep, GuLing level difference, composed of limestone mountainous lherzolite appearance to special development, northern main sedimentary basin for the glutenite, shale rock. In the middle is volcanic rocks and volcanic rock.

Emblem of the basin in hilly area of Mesozoic began to development, formed in the new generation. Jurassic sedimentary basins in a coal formation, surface layer is loess in the quaternary period, red layer is cutting into hills.

2.1.4 Hydrology Situation

The Cheng County rivers belong to the Jialing River of Yangtze River. Main rivers are East River, South River, Rhinoceros River and Luo River (unified as one big river with three smaller rivers). There're about 299 perennial flowing rivers and 67 rivers whose annual runoff is more than one million m³. See Table 2-1 for the basic features of main rivers.

Table 2-1 Basic Feature List of Main Rivers in Cheng County

Item name	River name / Unit	Rhinoceros River	South River	Main stream of East River	Luo River
Belonging water		Jialing River	East River	Jialing River	Jialing River
Source		Luo Family Village	Erlang and Xiao Chuan of Cheng County	Mayuan Village of Xihe County	Mishu Mountain of Hui County
entrance		Xujia Ping of Lveyang County in Shanxi Province	Chengguan Town of Cheng County	White Water River Town of Lveyang County in Shanxi Province	White Water River Town of Lveyang County in Shanxi Province
River length	km	82.00	48.00	88.40	21.10
Flowing area	km^2	470.00	400.50	711.80	107.70
Average flowing water quantity	10,000 m^3	75426.00	0.00	13810.00	5236.00
Average water yield	10,000m^3	7929.82	7578.90	15126.33	2436.05
Average total surface water	10,000m^3	83355.82	7578.90	28936.33	7672.05
Average flow	m^3/s	26.43	2.40	9.18	2.43
Water quality		bad	good	bad	good
Average sand input	10,000 ton/km^2	1714.80	801.70	801.70	801.70
Average sand output	10,000 ton	80.60	32.11	57.07	8.63
Average gradient of river bed	‰	2.80	26.00	5.30	4.10

The total underground water of the whole county is 0.13724 billion m³ among which the East River area is 62.77 million m³, the South River area is 31.35 million m³, and the West Han River area is 32.91 million m³. Allowable exploit quantity of the underground water in the whole county is 35.67 million m³ among which the East River area is 17.28 million million m³, the South River area is 8.15 million m³ , and the West Han River area is 4.89 million m³.

2.1.5 Climate Characteristic

Cheng County has continental monsoon climate with obvious four seasons. In winter, it's influenced by the cold air from north and northwest; while in summer, it's influenced by the southeast monsoon and warm monsson from Bay of Bengal. The climate regions have big differences with distinct changes. It's can be classified as Longnan temperate zone half humid region according to the climate divisions of Gansu Province. see Table 2-2 for basic climate features.

Table 2-2 Basic Climate Feature List

Annual average temperature	11.7℃		Frost-free season	200 days
Extreme highest temperature	37.3℃		Extreme lowest temperature	-15.0℃
Annual average precipitation	620.8mm		Annual maximum precipitation	763.9mm
Annual average relative moisture	75%		Annual average evaporation capacity	1149.0mm
Drought indicator	1.006		Annual average sunshine duration	1711h
Relative sunshine duration	39%		Prevailing wind direction	Southeast wind
Annual average wind speed	0.9m/s		Maximum frozen earth depth	100cm

2.1.6 Soil Vegetation

The distribution of soil in Cheng County is not only affected by the zonality factors, but also influenced by terrain, landform and hydrogeologic conditions. The soil distribution situation is complex. According to soil survey, the soil types within the county are abundant with distinct fertile degree differences. The carbonate capacity is high with alkaline reaction. The capacity of phosphorus, nitrogen and organic matter is low. It belongs to the fourth level and fifth level of soil. The main soil types are: moist soil, brown soil, land soil and rice soil.

The vegetation in Cheng County is mainly consisted of broadleaved deciduous forest and theropencedrymion with minor vertical distribution and complex communities. The low hillside has natural shrubwood mainly consisted of wornwoods and grass. According to survey, the common trees contain about 55 branches, 105 categories and 178 species among which there're 105 kinds of arbors, 58 kinds of shrubs and 14 kinds of cane timbers.

2.1.7 Mineral Resources

Cheng County lies in the "golden triangle" district of Shanxi Province, Gansu Province and Sichuan Province. It contains abundant kinds of mineral resources with various species and adequate storage. The distribution of the recourses are central and there're about 20 kinds of mineral resources according to the preliminary survey. Major metal mineral products are Pb, Zn, gold, silver, Cu, Fe and Hg, etc.; while major non-metal mineral products are granite, marble, dolomite, agate and raw coal, etc. The storage of Pb and Zinc ranks No.2 nationwide; the quality of granite, marble and dolomite are outstanding and related storage ranks top in the northwest part of China.

2.1.8 Earthquake

According to the "Block Plan of the Earthquake Intensity in China" (1992) of State Seismology Bureau, the basic earthquake intensity of the passing route is 7, so aseismatic design shall be considered.

2.2Social environment overview

2.2.1 Historical Evolution,

Cheng County has a long history with strong sense of culture. It was a road in Qin Dynasty, a county in East Han Dynastry, a state in Tang, Song and Yuan Dynasties, and then became a county in Ming Dynasty till now.

2.2.2 Administrative Division and Population Distribution

There are 12 towns, 15 villages, 15 neighborhood committees, 245 village committees and 1472 corporations in Cheng County with Hui, Man, Meng, Bai and other 9 minorities. In 2007, the total population of the county was 0.2652 million with 0.2543 regular citizens. All employees were 0.1467 million among which there were 0.112 million in village and 0.0347 million people in the urban area.

2.2.3 General Situation of Social Economy

In 2007, the total gross domestic product of Cheng County was 2.896 billion Yuan, increased by 12.9% compared with last year. The first industry production increased 0.479 billion Yuan with the increase percentage of 4.2%; the second industry production increased 1.731 billion Yuan with the increase percentage of 18.1%; and the third industry production increased 0.685 billion Yuan with the increase percentage of 10.0%.

In 2007, the annual worker's average salary increased 17,044 Yuan; the urban per capita disposable income was 8500 Yuan, the urban per capita consumable outcome was 7630 Yuan; and the farmer's average net income was 2320 Yuan.

2.2.4 General Situation of Agricultural Production

In 2007, the county to realize the agricultural sector was 479.16 million Yuan. Annual crops sowing area 653100 Chinese acres, among them: food crop planting area of 515500 mu, oil planting area of 38400 mu, vegetable planting area of 57900 mu. Annual total grain output of 132203 tons, including: the summer crops 55999 tons, 76204 tons of fall crops.

2.2.5 General Situation of Industrial Production

In 2007, the county-wide realize industrial sector was 1.60126 billion Yuan, including: large-scale industry, realize the sector was 1.46426 billion Yuan, sales income amounted to 3.50775 billion Yuan, RMB 473.75 million Yuan, profit of 226.46 million Yuan.

2.2.6 Cultural Relics and Historical Sites

Cheng County contains a long history and it was an important town in the ancient time with various minorities living here. There were sign of human beings in Neolithic Period. The existing cultural relics and historical sites are: 19 sites of primary social cultural relics, 10 sites of ancient relics, 16 sites of famous ancient architectures, 12 ancient historic tombs, 74 upright stone tablets and 623 holding cultural relics.

According to on-the-spot survery, there's no cultural relic or famous scenic spot around this project.

2.3 General Situation of Environmental Quality

2.3.1 Monitoring and Assessment of the Current Situation of Moba Gorge Water Environmental Quality

2.3.1.1 Monitoring Fracture Surface

There're 6 monitoring fracture surfaces. See table 2-3 and 2-2 for specific names and locations.

Table 2-3 Distribution Chart of Surface Water Monitoring Fracture Surface

Monitoring Spot No.	Surface water monitoring spot	location
W1	Xiao Groove of Back Village in Erlang Cliff	100 meters in front of the joint between Xiao Groove and Jiao Groove
W2	Yan He Village	100 meters in the downstream of Yan
W3	Ya Bei Village	the joint between Xiao Groove and Jiao

W4	Yan Village	1km away from Yan River to the upstream of the dam
W5	Erlang River	1km away from Erlang River to the upstream of the dam
W6	Dam location	The joint part of the two rivers

2.3.1.2 Monitoring Time and Frequency

（1）Monitoring Time

From Dec. 8th to 10th, 2010, 3 days in total.

(2) Monitoring Frequency

Contious monitoring for 3 days, once per day.

2.3.1.3 Monitoring Items and Analysis Methods

The sampling method shall be in accordance with “Environmental Monitoring Technical Methods”. See Table 2-4 for specific monitoring items and analysis methods.

Table2-4 Moba Gorge Water Environmental Monitoring Items and Analysis Method List

No	Item	Analytical Method	Source
1	Water Temperature	Thermometer	GB13195-91
2	pH	Glass-electrodes method	GB6920-86
3	Dissolved Oxygen	Lodometry	GB7489-87
4	Permanganate Index	Permanganate Index Method (acid)	GB1192-89
5	Chemical oxygen demand	Potassium dictromate method	GB11914-89
6	BODS	Direct cultivation method	GB7488-87
7	Ammonia nitrogen	Nessiier colorimetry	GB7497-87
8	Total phosphorus	Ammonium molybdate spectrophotometry	GB11893-89
9	Total nitrogen	Alkalinity potassium sulfate UV dispel spectrophotometry	GB11894-89
10	Copper	Atomic absorption spectrophotometry	GB7475-87
11	Zinc	Atomic absorption spectrophotometry	GB7475-87
12	fluorid	Ion selective electrode method	GB7484-87
13	Se	Atomic fluorescence	GB11902-89

14	As	Atomic fluorescence	“Monitoring Analysis Method of Water and Waste Water” (4th version)
15	Hg	Atomic fluorescence	“Monitoring Analysis Method of Water and Waste Water” (4th version)
16	Cd	Atomic absorption spectrophotometry	GB7475-87
17	Cr VI	Two benzene carbon usions hydrazine two spectrophotom	GB7467-87
18	Pb	Atomic absorption spectrophotometry	GB7475-87
19	Cyanide	Different niacin-pyrazole fuorone photometry nature	GB7487-87
20	Volatile phenol	4-amino Ann than Lin for extractionphotometric method	GB7490-87
21	Oil type	Infrared spectrophotometric method	GB/T16488-1996
22	Negative ion surface active agent	Methylene blue spectrophotometric method	GB7494-87
23	Sulfide	Amino two p-trifluoromethylaniline photometric method	GB/T16489-1996
24	Fecal coliforms	Mind fermentation	“Monitoring Analysis Method of Water and Waste Water” (4th version)
25	sulfate (by SO42-)	Chromium acid barium spectrophotometry	“Monitoring Analysis Method of Water and Waste Water” (4th version)
26	chloride（by Cl-)	Nitric acid silver titration	GB11896-89
27	nitrate (by N)	Ultraviolet spectrophotometry	“Monitoring Analysis Method of Water and Waste Water” (4th version)
28	Fe	Flame atomic absorption spectrophotometry	GB11911-89
29	Mn	Flame atomic absorption spectrophotometry	GB11911-89

2.3.1.4 Monitoring Results and Analysis

See Table 2-5 for monitoring results.

Table 2-5 **Moba Gorge Water Environment Monitoring Result List**

Item	Unit	Standard Limit value	Date	Monitoring Fracture Surface					
				W1	W2	W3	W4	W5	W6
Water temperature	℃		Dec. 8th	3	2	1	0	0	2
			Dec. 9th	2	2	1	1	0	2
			Dec. 10th	3	2	3	2	1	2
			Average value	2.67	2	1.67	1	0.33	2
pH	dimensionless	6～9	Dec. 8th	8.13	8.25	8.35	8.24	8.32	8.33
			Dec. 9th	8.16	8.30	8.25	8.37	8.29	8.28
			Dec. 10th	8.23	8.32	8.38	8.34	8.29	8.29
			Average value	8.17	8.29	8.33	8.32	8.30	8.30
DO	mg/L	≥3	Dec. 8th	8.41	8.56	8.68	8.69	8.44	8.76
			Dec. 9th	8.62	8.59	8.47	8.79	8.81	8.69
			Dec. 10th	8.59	8.59	8.57	8.90	8.78	8.58
			Average value	8.54	8.58	8.57	8.83	8.68	8.68
Potassium permanganate index	mg/L	≤6	Dec. 8th	3.40	3.33	3.19	3.26	3.62	3.62
			Dec. 9th	3.90	2.84	3.69	3.48	3.40	3.62
			Dec. 10th	3.19	3.05	3.33	3.55	3.40	3.12

			Average value	3.50	3.07	3.40	3.43	3.47	3.45
Chemical oxygen demand	mg/L	≤20	Dec. 8th	6.76	6.19	6.24	6.76	6.40	5.98
			Dec. 9th	6.40	7.90	6.81	6.71	6.66	6.81
			Dec. 10th	6.08	6.03	6.50	6.19	6.03	5.93
			Average value	6.14	6.71	6.52	6.55	6.36	6.24
Five-day biochemical oxygen demand	mg/L	≤4	Dec. 8th	2.40	2.18	1.92	1.85	1.97	1.86
			Dec. 9th	1.99	1.94	1.81	2.08	2.18	2.20
			Dec. 10th	2.21	2.37	2.35	2.29	1.70	2.32
			Average value	2.20	2.16	2.03	2.07	1.95	2.13
Ammonia nitrogen	mg/L	≤1.0	Dec. 8th	0.052	0.062	0.062	0.036	0.068	0.036
			Dec. 9th	0.049	0.062	0.052	0.058	0.062	0.036
			Dec. 10th	0.062	0.049	0.062	0.052	0.058	0.045
			Average value	0.054	0.058	0.059	0.049	0.063	0.039
Total phosphorus	mg/L	≤0.2	Dec. 8th	0.107	0.090	0.076	0.097	0.093	0.079
			Dec. 9th	0.097	0.086	0.086	0.079	0.104	0.093
			Dec. 10th	0.100	0.104	0.079	0.090	0.090	0.100
			Average value	0.101	0.093	0.080	0.089	0.096	0.091
Total nitrogen	mg/L	≤1.0	Dec. 8th	0.80	0.69	0.80	0.69	0.69	0.91
			Dec. 9th	0.91	0.69	0.69	0.69	0.91	0.90

			Dec. 10th	0.80	0.80	0.69	0.69	0.80	0.91
			Average value	0.84	0.73	0.73	0.69	0.80	0.91
Volatile phonel	mg/L	≤0.005	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Oil type	mg/L	≤0.05	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
sulfide	mg/L	≤0.2	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
sulfate	mg/L	≤250	Dec. 8th	58	53	50	49	43	40
			Dec. 9th	58	49	49	45	49	41
			Dec. 10th	57	53	49	47	43	43
			Average value	57.7	52.3	49.3	48.3	43.7	40.3
chloride	mg/L	≤250	Dec. 8th	3.20	2.80	4.20	2.20	4.60	3.60

			Dec. 9th	3.00	3.00	3.40	3.60	2.80	2.40
			Dec. 10th	2.20	2.80	4.80	4.00	3.40	3.60
			Average value	2.80	2.87	4.13	3.27	3.60	3.20
nitrate	mg/L	≤10	Dec. 8th	1.23	1.37	1.86	1.38	1.99	1.62
			Dec. 9th	1.18	1.37	1.88	1.37	1.94	1.64
			Dec. 10th	1.27	1.34	1.90	1.41	1.90	1.77
			Average value	1.23	1.36	1.88	1.39	1.94	1.68
Fe	mg/L	≤0.3	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Mn	mg/L	≤0.1	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Cu	mg/L	≤1.0	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found

Cd	mg/L	0.005	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Pb	mg/L	≤0.05	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Zn	mg/L	≤1.0	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Se	mg/L	≤0.01	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Fluoride	mg/L	≤1.0	Dec. 8th	0.431	0.438	0.479	0.436	0.428	0.430
			Dec. 9th	0.461	0.454	0.477	0.456	0.502	0.472
			Dec. 10th	0.438	0.431	0.428	0.426	0.440	0.433

			Average value	0.443	0.441	0.461	0.439	0.457	0.445
Hg	mg/L	≤0.0001	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
CrVI	mg/L	≤0.05	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
As	mg/L	≤0.05	Dec. 8th	0.008	0.004	0.005	0.005	Not found	0.001
			Dec. 9th	0.009	0.004	0.004	0.003	Not found	0.001
			Dec. 10th	0.010	0.003	0.004	0.003	Not found	0.001
			Average value	0.009	0.004	0.004	0.004	Not found	0.001
Cyanide	mg/L	≤0.2	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found
Negative ion surface active agent	mg/L	≤0.2	Dec. 8th	0.048	0.033	0.045	0.086	0.064	0.052
			Dec. 9th	0.047	0.060	0.050	0.075	0.068	0.055

			Dec. 10th	0.053	0.039	0.068	0.063	0.076	0.061
			Average value	0.049	0.044	0.054	0.075	0.069	0.056
Fecal coliforms	amount/L	≤10000	Dec. 8th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found	Not found	Not found	Not found
			Average value	Not found	Not found	Not found	Not found	Not found	Not found

From Table 2-5 we can know that except As contained in the Xiao Groove of Erlang Cliff Ya Bei Village is higher than other fracture surfaces, there's no distinct difference in other items. All monitoring factors in each fracture surface meet the III level standards of "Surface Water Environment Quality Standard" (GB3838-2002) and the limit value of water source supplement project.

2.3.2 Current Situation of Moba Gorge River Bottom Quality

2.3.2.1 Monitoring Fracture Surface

There're 3 monitoring fracture surfaces in total. See table 2-6 and chart 2-2 for specific names and locations.

Table 2-6 Surface Water Monitoring Fracture Surface Distribution List

Monitoring Spot No.	Surface water monitoring spot	location
Q1	Xiao Groove of Back Village in Erlang Cliff	100 meters in front of the joint between Xiao Groove and Jiao Groove
Q2	Yan He Village	100 meters in the downstream of Yan River
Q3	Dam location	The joint part of the two rivers

2.3.2.2 Monitoring Time and Frequency

（1）Monitoring Time

From Dec. 8th to 10th , 2010, 3 days in total.

（2）Monitoring Frequency Continuous monitoring for 3 days and once per day

2.3.2.3 Monitoring Items and Analysis Methods

See Table 2-7 for monitoring items and methods.

Table 2-7 Moba Gorge River Bottom Quality Monitoring Items and Analysis Methods List

No.	Item	Analysis Method	Method source
1	Cu	Atomic absorption spectrophotometry	GB7475-87
2	Zn	Atomic absorption spectrophotometry	GB7475-87
3	As	Atomic fluorescence	"Monitoring Analysis Method of Water and Waste Water" (4th version)
1	Hg	Atomic fluorescence	"Monitoring Analysis Method of Water and Waste Water" (4th version)
5	Cd	Atomic absorption spectrophotometry	GB7475-87
6	Cr VI	Two benzene carbon usions hydrazine two spectrophotom	GB7467-87
7	Pb	Atomic absorption spectrophotometry	GB7475-87
8	Total Cr	Atomic absorption spectrophotometry	GB7475-87

9	sulfide	Two benzene carbon usions hydrazine two spectrophotom	GB/T16489-1996

2.3.2.4 Monitoring Results and Analysis

See Table 2-8 for monitoring results.

Table 2-8 Moba Gorge River Bottom Quality Monitoring Results List Unit：mg/kg

No.	Monitoring item	Standard limit value	date	Monitoring fracture surface		
				Q1	Q2	Q3
1	Cu	≤35	Dec. 8th	13.3	12.4	13.3
			Dec. 9th	12.8	11.9	12.4
			Dec. 10th	12.5	12.1	12.8
			average value	12.9	12.1	12.8
2	Cd	≤0.20	Dec. 8th	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found
			average value	Not found	Not found	Not found
3	Pb	≤35	Dec. 8th	27.4	26.4	35.0
			Dec. 9th	28.1	29.0	35.0
			Dec. 10th	28.7	27.7	34.0
			average value	28.1	27.7	34.6
4	Zn	≤100	Dec. 8th	36.0	36.1	36.5
			Dec. 9th	38.2	30.7	37.2
			Dec. 10th	38.9	34.5	36.2
			average value	37.7	33.8	36.6
5	Hg	≤0.15	Dec. 8th	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found
			average value	Not found	Not found	Not found
6	Cr VI		Dec. 8th	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found

			average value	Not found	Not found	Not found
7	As	≤15	Dec. 8th	0.179	0.148	0.051
			Dec. 9th	0.158	0.124	0.049
			Dec. 10th	0.168	0.133	0.054
			average value	0.168	0.135	0.051
8	Total Cr	≤90	Dec. 8th	Not found	Not found	Not found
			Dec. 9th	Not found	Not found	Not found
			Dec. 10th	Not found	Not found	Not found
			average value	Not found	Not found	Not found
9	sulfide		Dec. 8th	2.16	2.16	1.52
			Dec. 9th	1.23	1.23	1.32
			Dec. 10th	1.84	1.84	1.40
			average value	1.74	1.66	1.41

From table 2-8 we can know that except As contained in dam location is obviously lower than other fracture surfaces, the concentration differences in other fracture surfaces of other items are not distinct. Except there's no assessment standard for sulfide and Cr VI, all other indicators meet the first level standards of "Soil Environment Quality Standard" GB15618-1995.

2.3.3 Assessment of the Current Environment Air Quality

There's no air pollute source surrounding Moba Gorge Water Source Project. The vegetation coverage degree is high with fresh environment air which can meet the second level standards of "Environment Air Quality Standard" (GB3095-1996).

2.3.4 Assessment of the Current Acoustic Environment Quality

As this project lies in mountainous district with few people living nearby, there's no noise source in the neighborhood and the acoustic environment quality is good which can meet the second level standards of "Acoustic Environment Quality Standard" (GB3096-2008).

2.3.5 Assessment of Moba Gorge Current Ecological Situation Monitoring Survey

2.3.5.1 Survey of Current Vegetation Situation

By visiting local citizens and collecting historical materials, we know that there're 178 kinds of common trees within the project area among which exist ailanthus, white poplar, dahurian larch, Pinus armandi and Chinese pine which have high development value. And there're 42 kinds of economic tree species among which exist lacquer tree, pistacia chinensis bunge and woody medicinal material Eucommia ulmoides which have good development value with fruit trees like nut, persimmon, pepper and cherry, etc. There's no species that is in national grade or listed in the Appendix I and II of "International Trade Conventions of Endangered Wile Animals and Plant Species" or in the "Endangered Animals List of China".

2.3.5.2 Survey of Terrestrial Animal Current Situation

By visiting local citizens and collecting historical materials, there're wild boar, hare, pheasant, golden pheasant, goat, hedgehog and other wild animals within the project area. There's no species that is in national grade or listed in the Appendix I and II of "International Trade Conventions of Endangered Wile Animals and Plant Species" or in the "Endangered Animals List of China".

2.3.5.3 Monitoring of Fish Resource Current Situation

Site on December 21, 2010 to 28 in the mill dam gorge river diversion works are the six segments surface (with surface water monitoring segments) using 30m × 1m in three different network mesh size of gill nets and 30m × 1.5 m of the different network layer mesh size gill nets, fishing nets and the actual network continuously for a week fishing, 16 fish were caught, there are short to be Ju jaw, heavy moth Schizothorax, JialingSchizopygopsis rump fish and carp. Through visits to local people, combined with historical information, this project affect the river fish, a total of eight species. The works are shown in Table 2-9 List of river fish.

Table 2-9 Fish Directory in the River Segment Affected by Moba Gorge Water Source Project

No.	Fish Name
1	*Misgurnus anguillicaudatus*(Cantor)
2	*Glyphothorax sinense*(Regan)
3	*Schizopygopsis kialingensis Tsao et Tun*
4	*Gnathopogon imberbis*
5	*S.Racoma davidi*
6	*Schizothorax*(s.)*sinensis Herzenstein*
7	*Carassius auratus* (Linnaeus)
8	*Pseudorasboraparva*

There're not many fish species in this segment and the district composition is simple. Regarding from the point of source, there're species belonging to the China river plain complex: Pseudorasbora parva and Gobioninae; species belonging to Central Asia plateaux complex: Schizothorax and Cobitidae; species belonging to the Tertiary Period complex: crucian; and species belonging to Chindia mountainous district complex:Sisoridae. There's no species that is in national grade or listed in the Appendix I and II of "International Trade Conventions of Endangered Wile Animals and Plant Species" or in the "Endangered Animals List of China". Wile hydrophilous animals which are under the protection of the provincial government are Schizopygopsis kialingensis and Schizothorax davidi Sauvage which are also aboriginal fish species containing high economic value in that river segment.

2.3.5.4 Monitoring of Phytoplankton Current Situation

From Dec. 21st to 28th in 2010 on the spot, before the dam 200m, 300m behind the dam laid two sampling points, 8:00-10:00 am every day for a week in vertical plexiglass sampler used in the at 0.5m-1.0m below the surface water samples, each collected water 2L, add 20ml Luge's solution, fixed, back to the lab into the 2000ml graduated cylinder in standing precipitation 36 hours or more, and then siphon the sediment. The supernatant was used for the 3mm diameter latex tube slowly aspirated (non-action for the sake of stirring gently to the bottom of the subject, otherwise all the re-precipitation), the remaining sediment into the quantitative 30ml bottle, to prepare for the count, account number, it will be fully quantitative, after shaking the sample bottle, suction 0.1ml, 0.1ml of the counting box placed in the observation of 400-600 400 times magnification view. Continuous observation of the same sample two producers, whichever uniform value, two averages were calculated and the difference of ± 15% within only a few of their uniform as valid results. There're 4 categories and 43 families affected by this project. 20 families of Bacillariophyta are affected and 13 families of

Chlorophyta are affected. For blue green algae, there're 6 categories and 3 families got influenced. The average amount of plankton is 320,400/L with a biomass liveweight of 0.077mg/L among which the amounts of Bacillariophyta, Euglenophyta, Chlorophyta and green algae are 0.063mg/L, 0.003mg/L, 0.009mg/L and 0.002mg/L respectively. Bacillariophyta has absolute advantage on species and amount and the advantageous species are Navicual, Nitischia, Melosira granulate, Cymbella, Nitzsehia acicularis, Chlorococcum of green algae, Oscillatoria of Cyanophyta, Spirulina of Spirulina and Trachelomonas of Euglenophyta. The detected phytoplanktons are shown in Table 2-10.

Table 2-10 Phytoplankton List in Moba Gorge

Category	Name	Category	Name
Bacillariophyta	*Navicula* *Nitischia* *Melosira grancelata* *Cymbella* *Nitzsehia acicdlaris* *Gyclotella Rhizosoleniel Tabellaria* *Dzatoma Fragilaria Aeterionelle* *Pennularia Cyrosigma Amphorema* *Gomphorema Surirella Achnanthes* *Amphiprora* *Cocconeis placentala Cymatopleura* *Diploneis eliptica*	green algae	*Chlamgdomonas* *Carteria* *Iobomones* *Eudorina* *Chlorococcum Micractiniam* *Treubaria Gloeocystis Chlorella* *Sceredesmas Tetrallantos* *Crucigenia* *Closterium*
		Cyanophyta	*Chroococcus* *Merismopedia* *Oscillatoria* *Spiralatina* *Anabaena* *Oscillatoria limosaag*
		Euglenophyta	*Euglent* *Trachelomonas* *Phacus*

2.3.5.5 Survey of Zooplankton Current Situation

Samples of zooplankton sampling time with the deployment and phytoplankton, zooplankton samples with protozoa and rotifers phytoplankton, sediments above 30ml, shake immediately after take 1ml, 1ml counting box placed in the in times magnification, the entire film count, count two for each sample, whichever uniform value, and then concentrated in multiples of 1 liter of water converted into the number of zooplankton. Cladocerans and copepods collected water samples every 10 liters mixed, removed from 10 l, with the 13th plankton mesh filter, plus samples from the quantitative formalin fixed 400ml save. Examination before the first samples of precipitation, with a straw carefully sucked the above supernatant, concentrated to 5-10ml at low magnification under the microscope after all counts. 15 collected by on-site determination of the sample bottle and the effective weighted. The river

segment affected by this project have 20 kinds of zooplankton among which there are 13 kinds of protozoa, 2 Cladoceras, 4 rotifers and 1 Copepoda. Advantageous protozoa are Difflugiasp, Ciliata and Brachionus. The average amount of zooplankton is 79 per litre with a biomass liveweight of 0.051mg/L. For biomass liveweight, Cladocera is the most:0.023mg/L and protozoon is the least:0.003mg/L. The biomass liveweights of rotifer and Copepoda are 0.008mg/L and 0.017mg/L respectively. The detected zooplankton are shown in Table 2-11.

Table 2-11 Moba Gorge Zooplankton List

Category	Name	Category	Name
protozoon	*Difflugia sp.* *Amoeba sp.* *Ciliata* *Aelimophry sp.* *Askenasia sp.* *Bursella gargamella*e *Holophrya visiculosa Didinidium baiaianii Cycljdium aitrallus* *Paramtcium sp. Amoeba proteus Acanthocystis sp.* *Chilodonella sp.*	rotifer	*Brachionsa* *Acpbanchna s*p *Polyarthra trigla*
		Cladocera	*Daphnia longispina* *Bosming sp.*
		Copepoda	*Micrccycolops sp.*

2.3.5.6 Monitoring of Zoobenthos Current Situation

The layout of benthic samples with plankton, Bode collection tools for the improvement of students borrowing device, open area 1/16m^2, each soil sample collected two samples of 1/8m^2. Will be collected two soil samples with 40 mesh / inch sub-sample screening approved screening (screen 6 times total) to prevent the special small benthic animals missing, at 40 mesh / inch sieve and then set a 60 mesh / inch screen. Filtered sample into a plastic bag, add labels, truss pocket, into the wide mouth thermos, back to the laboratory monitoring. According to quantitative determination, the zoobenthos in the river segment affected by this project mainly are Aquaticinsevta and minor Oligochaeta. The larva of Chironomidae has absolute advantage with average density of 79 per m² and the biomass liveweight is 0.20g/m². The average density of Oligochaeta is 52 per m² and the biomass liveweight is 0.029g/m². The zoobenthos directory in the river segment affected by this project are shown in Table 2-12.

Table 2-12 Moba Gorge Zoobenthos List

Category	Name	Category	Name
Aquatic insect	*Procladius choreus* *Procladius skuze* *Cryptochironmus sp* *Spaniotoma kibunensis*	Oligochaeta	*Bothrioneurum* *Tubifex sp Lliyodrilus sp Llmnodrilus* *L,hoffmeister*

	Pscalaenum *Cryprtochironmucs fulcimanus*		

2.3.5.7 Survery of Aquatic Reptile Current Situation

During this survey, there's no auatic reptile found in the river segment affected by this project. By visiting local citizens and collecting historical materials, there's no aquatic reptile distribution ever recorded here in history.

2.3.5.8 Survey of Aquatic Vascular Plant Current Situation

During this survey, there's no big scale of aquatic vascular plant found in the river segment affected by this project. Only scattered Phragmites communis and Typha minima funk were seen. By visiting local citizens and collecting historical materials, there's no big scale of aquatic vascular plant distribution ever recorded here in history and the value of aquatic vascular plant bait is little.

2.3.5.9 Survey of Fish "Three Fields" Distribution

On the river segment affected by this project has tributary——Erlang River which is the south entrance for the breeding migration of Schizothoracinae in winter and also the spawning site for Schizothoracinae. There's no "Three Fields" distribution of other fishes in this segment.

3 Project Profile

3.1 Project Profile Summary

（1）Project name： Moba Gorge Water Source Project in Cheng County, Gansu Province

（2）Construction unit：Cheng County Water Supply Moba Gorge Water Source Engineering Construction Management Office

（3）Project characteristic：new construction

（4）Project tasks：the main tasks are to provide water for the urban area of Cheng County; to solve the water supply problem in urban area; to improve water quality; to reduce water supply cost; to accomplish the sustainable development of Cheng County economic society; and to improve urban area citizens' health level.

（5）Construction site：this project lies in the west side about 11km away from the Cheng County town and 6km away from the Paosha Town. It's in the downstream of the South River basin. The geographic location: northern latitude 33°45'~33°38', east longitude 105°33'55''~105°37'60''. It belongs to Jialing River Water, upstream of the Yangtze River.

（6）Project content：dam, water intake structure, water pipe, road approach to the dam, etc.

（7）Project scale： the total storage capacity of reservoir is 17.90 million m³ and the utilizable capacity is 10.40 million m³ with normal impound level of 1096.38m. The maximum daily water supply amount is 47,500 m³. The annual average water supply amount is 16.51 million m³. The daily average water supply amount is 45,200 m³. Water pipeline is 5.15km long and the backwater length of the reservoir is 3.5km.

（8）Project construction period：27 months.

（9）Project investment：the total static investment of this project is 226.563 million Yuan.

3.2 General Situation of River Basin

South River is the main tributary of Green Mud River. It's from the Sea Wine Mount in Erlang Village within the range of the West Qinling South Mountains. It flows through Erlang, Shaba, Paosha and enters Green Mud River in Sun Family Dam in Chengguan Town. The total length is 48km with an area of 401km². It's 32km away from the up side of this project with an area of 248.2km². The height above sea level is 1026~2451m. The annual change of the river path is significant and the annual precipitation distribution is not even with features of frequent rainstorm, flood and high flood peak. On side of the river channel is limestone structure and the other is scattering field distribution. The earth layer covering depth is about 2m. The lower layer is limestone structure. The longitudinal slope of the river bed is 14%. Calculating according to the runoff depth graph in "Hydrologic Atlas of Gansu Province", we can know the annual runoff of the central South River area is 220mm and the average flow rate of South River in several years is 2.70m³/s. the total annual runoff length is 73million m³. The average flow rate of Moba Gorge fracture surface is 1.43m³/s with a total annual flow rate of 45.10million m³. The flow area division in Cheng County is shown in Chart 3-1.

The water source above the South River Moba Gorge is mainly from atmospheric precipitation. The whole year can be divided into April~June spring flood period which supplemented by the melt snow from the upstream, July ~September summer & autumn flood period which is supplemented by large scale of precipitation, Novermber~December autumn level period which is mainly supplemented by underground water and river channel storage, and the winter drought period from January to March in the next year which is mainly supplemented by underground water. The water amount is small but stable.

3.3 Project Tasks, Scale and Operation Methods

3.3.1 Project Tasks

The main tasks for Moba Gorge Water Supply Project are to provide water for urban areas in Cheng County; solve the water supply problem in urban areas; improve the water quality; reduce water supply cost and fulfill the sustainable development of Cheng County economic society.

3.3.2 Project Scale

The total storage capacity of reservoir is 17.90 million m³ and the utilizable capacity is 10.40 million m³ with maximum annual water supply amount: 16.6592 million m³. The maximum daily water supply amount is 47,500 m³. The annual average water supply amount is 16.51 million m³. The daily average water supply amount is 45,200 m³. Water pipeline is 5.15km long.

3.3.3 Project Operation Methods

According to the development task of Moba Gorge Water Source Project, the operation methods can be divided into water supply mode and flood control mode with the precondition of ensuring project safety.

Water supply adjustment operation mode: when the input storage is less than the urban area water need, supplement water from the reservoir according to the water demand of the urban area until the water level in the reservoir is down to 1068m; when the input storage is more than the urban area water need, the storage water level can be adjusted to 1092.7m with the precondition of satisfying the water demand of the urban area.

Flood control adjustment mode: when the reservoir water level reaches normal level during flood period, discharge the input flow of the dam until the water level of the dam is 1092.7m same as normal water level if the input flow amount is less than the dam discharge ability; if the input flow exceeds the dam discharge ability, conduct “smooth discharge” according to the dam discharge ability to make it safe.

3.4 Project Arrangement and Constructions

The project arrangement is mainly consisted of: concrete gravity dam (with overflow Holes and flood discharge sand flowing holes), water intake construction, water pipeline,road approach to the dam, etc. This project is the III level medium reservoir. The main constructions like reservoir dam, flood discharge channel and water input tunnel shall be designed according to the 3level architecture. Other permanent buildings and temporary buildings shall be designed as the 4 level. The anti-seismic degree of the project area is VIII.

The plane layout of this project is as Table 3-2.

3.4.1 RCC (roller compacted concrete) Gravity Dam

The RCC gravity dam locates in a “U” profile river valley. The dam structure is symmetrical including non-overflow dam side of the left and right bank and a river bed overflow segment. It’s divided into 4 dam segments. The dam height is 1099.80m with an axis to the dam top whose length is 136.50m. the maximum dam height is 91.4m. The floor plan of the dam is shown in Graph 3-3 and the vertical section graph is as Graph 3-4.

3.4.4.1 Non-Overflow Segment of the Left Bank

The axis along the non-overflow segment on the left bank has a length of 44.15m, including 1# dam segment and 2# dam segment. The 1# dam segment has a length of 35.25m. The dam height of the non-overflow segment on the left bank is 1099.80m with the top width of 10m. The height in the upstream of the dam is 1045.0m Dam body below 1045.0m has a minus grade of 1:0.1. The height in the downstream of the dam is 1092.50m. The below part has a minus grade of 1:0.75.

3.4.4.2 Overflow Dam Segment of the River Bed

The river bed overflow axis along the dam side is 41.4m long, mainly lying on the 2# and 3# dam

segments. Each dam side axis length is 30.0m. The upstream of the dam body has a vertical height of 1045.0m with a minus grade of 1:0.1 on the below part. The downstream of the dam body has a minus grade of 1:0.75.

The crest height is 1092.7m. It's an open WES practical crest type with 3 holes whose net width is 13m. The involving chute part is stair type overflow surface. The downstream contains streaming energy dissipation with a height of 1038.0m.

There's a 10m wide connecting bridge on the top of the overflow dam segment. The height of the bridge surface is 1099.80m. The dam bottom is 75.88m long along the river flowing direction with a height of 1008.4m

3.4.4.3 Non-Overflow Dam Segment on the Right Bank

The axis along the dam non-overflow segment on the right bank is 50.95 long, including 4# dam segment and part of 3# dam segment. The 4# dam segment is 35.25m long. The non-overflow segment on the right bank has a height of 1099.80m with a top width of 11.5m.

3.4.4.4 Flood Discharge Sand Flushing Hole

The flood discharge sand flushing holes are set on the RCC concrete dam 3# segment. The discharge holes are set on the right side mainly consisted of entrance body, hole body segment, exit segment and on and off chamber. The middle hole entrance body asix number is D0+089.45m with steel concrete structure whose strength degree is C30 and the total length is 46.93m. There's a repair panel steel gate, a working panel steel gate and a fixed winch on-and-off set on the entrance part.

The entrance part is a vertical well type tube structure which is cast-in-place. The entrance bottom height is 1042.0m with a segment length of 4.70m. The outside plane size of the RCC concrete dam segment is 4.8×5.7m. The minimum depth of the concrete is 50cm. The sizes of repair panel gate and working panel gate are all 1.0×4.7m.

Hole body segment is rectangle hole type structure with plane bottom and the segment length is 36.57m. The size of the fracture surface on the boundary to the RCC concrete dam body is 4.5×5.7m (width×height) and the flowing fracture surface size is 3.5×4.8m (width×height). The bending radius of the plane surface is 26.8m with a deflection angle of 5°. The hole wall depth is 50cm.

Exit segment is rectangle hole type structure with a segment length of 5.66m. The ridge is 1043.6m long with a reverse arc vertical bending radius of 11m and the central angle is 37°. The size of the flowing fracture surface on the exit is 3.5×4.72m (width×height). The hole wall depth is 50cm.

The on-and-off chamber is an array structure. There's a repair panel gate, a working panel gate and an on-and-off chamber set on the entrance part. The repair platform height is 1097.3m with a size of 4.2×4.7m and the plane size of the chamber is 6.5×7.7m. The indoor ground height is 1106.1m with a floor height of 3m.

3.4.2 Water Intake Construction

The water intake construction shall be set on the right dam shoulder for pope laying. The height of the entrance bottom is 1065.0m with a round shape water flowing fracture surface. The inner diameter is 1.0m and the pipe depth is 50cm. C20 concrete shall be cast-in-place on the surrounding. There's a repair gate set on the entrance. The repair platform height is 1096.2m. The on-and-off chamber shall be set on the upstream of the dam top. Steel concrete pipes and 2 round water intake stress pipes shall be set on the exit segment. The pipe diameter is 600mm and there shall be one butterfly gate set on each water intake stress pipe. The on-and-off chamber is on the exit.

3.4.3 Waterline

The starting point of the waterline on the right bank is from the control butterfly gate on the end of the water intake construction which is on the right side of the dam. 13m of exposed conduit shall be set

along the 1065m long right bank of the dam. For avoiding the directing water flow from the downstream, the conduit shall enter the right tunnel on 0+013.00 spot and get out on 0+309.40 spot. The exposed conduit inside the tunnel shall be 296.4m long. Outside the tunnel, closed conduit shall be laid along the terrain downwards and connect the simple road on the right bank on 0+468.29 spot and then go down along the road and cross the South River by inverted siphon way on 2+296.07~3+364.93 part. After crossing the river, the closed conduit shall go upwards to the 1018m high part along the terrain and then cross two gullies by inverted siphone way on spots of 2+502.25 and 2+706.62. It shall be arranged along the 1020m high routine and stopped on the 1020m high part on the northern side of Pb & Zn Smeltery in Cheng State, Paosha Town. The total conduit length is 5150m. See more in Graph 3-5.

3.4.4 Road Leading to the Dam and the Traffic within the Field

The road leading to the dam starts at the Diaogou Gate connecting S218 provincial road with an elevation of 1005.0m. It goes upwards along the Yan River leading to the dam by mountain side. The road grade is the third level of field road. The road bed width is 8.5m, road surface width is 7m and the total length is 2.81km among which the exposed road length is 2.2km, 1# tunnel length is 0.44km and 2# tunnel length is 0.14km. The road surface is made of concrete.

3.5 Construction Arrangement

3.5.1 Construction Conditions

3.5.1.1 Geographic Location and Current Situation of Site Access

The project area lies in Paosha Town, Cheng County of Longnan City which is 430km away from Lanzhou, 130km away from Tianshui and 11km away from the downtown of Cheng County. There're S205 provincial road and G316 state road connecting Cheng County with Tianshui City. The Long Sea railway passes Tianshui City with good site access.

3.5.1.2 Construction Site Conditions

The terrain of the dam downstream right bank village and S218 provincial road is plane and there's exposed river bank on the right bank of the South River downstream which can be used as construction site. The available area is about 230,000 m^2 which can meet the requirements of construction.

3.5.1.3 Hydrological and Meteorological Conditions

South River is a first level tributary of Changfeng River (also names as Green Mud River) and a second level tributary of Jialing River. It starts from the Sea Wine Mountain of Erlang Village in West Qinling South Mountainous Area within Cheng County. It flows through Erlang, Shaba, Paosha and enters Changfeng River in the Sun Family Dam in Cheng County. The Moba Gorge reservoir is on South River, about 200m away from the entrance of the Erlang River flowing into South River.

The reservoir project area has temperate zone moist climate with distinct four seasons. The rainfall is abundant with big moisture. According to the statistics of meteorology survery station in Cheng County, the average temperature is 12.0℃ during several years with an extreme highest temperature of 37.3℃ and lowest temperature of -15.0℃. In most months, there's only temperature below 0℃ in January. The average temperature is -0.8℃ in January of former years. The average rainfall is 628.3mm in several years with maximum annual rainfall of 1037.5mm (1964) and maximum rainfall of 457.2mm (1968). The rainfall mainly happens from May to October which covers a percentage of 84.6% of the rainfall in the whole year. The rainfall in July to September is 54.4% of the rainfall in the whole year. The annual evaporation capacity is 1082mm with maximum wind speed of 16.7m/s. The wind directions are mainly E and ES. The average frost-free season is about 211 days during several years. The maximum frozen earth depth is 21cm happened ever. The earliest freezing happened on Dec. 14th and the latest defrost happened on Feb. 11th.

3.5.1.4 Terrain and Geological Conditions

The project area lies on the west edge of the Huicheng Basin between the South and North Qinling mountains. The general terrain trend is high on northwest side and low on southeast side. The general direction of the mountain body is from northwest to southeast, forming a small valley from northwest to southeast. The reservoir area is on the downstream of the main tributary of South River (Yan River) and its tributary——Erlang River. The peaks on both sides extend from northwest to southeast. Most valles are in "V" profile. The valley bottom depth is mainly 15~20m. Part segment width is only 7~8m. There're many hard limestones with few siliceous slates on both banks. The mountain shape is steep and some parts are almost vertical. Plane slopes are formed on both sides of the valley with general gradient of 40°to 60°. Steep cliffs often appear on part hard rocks with gradient of 65°~80°.

The dam sites lies in the Moba Gorge which is on the downstream of the combination port of Erlang River and Yan River. It belongs to bed rock mountainous zone. The highest height of the slope on both sides is 1651.5m and the lowest elevation of the dam site is 1033.2m. The gorge bottom width is around 40m and the gorge direction gradient is about 150°. The mountain body on both sides is thick and hard. Bank slope on the east bank is vertical limestone steep cliff. The upper part is comparably flat with a highest height above sea level of 1283m. The slope on the underpart of the west bank is relatively flat with a gradient of 45~60° while the upper part is vertical steep cliff with a highest height above sea level of 1651.5m. The slope bottom has 2-4m deep fragment accretion consisted of artificial quarrying.

The water pipe goes downwards along Moba Gorge from South River to the river valley in the direction from NW to ES. The slopes on both banks are steep and there's 1-5m slope proluvium on the slope bottom and even 10m in part segments. The upstream segment is on the hollow of the slope on east bank with scattering stones on the river bed. Part segments are cut into vertical ridge by river washout with bed rocks exposed. The terrain outside the gorge is comparably open with the view of low hills. The river valley zone culvivates I-III level lands with plane and wide fields. The back edge of the strairy land connects with the hill zone. The terrain is in wave shape and all the fields are farmlands mainly consisted of alluvial deposits with a binary structure. The upper part lies low liquid limit floury soil with lithotriptic inside. The upper part depth is 0.5~4.5m. The underpart is consisted of sand gravels. The surface is 0.5~2m higher than the river bed with a width of 10~40m.

3.5.1.5 Supply of the Needed Main Materials

The steels for the this project are carried from Lanzhou and all timers and oil materials are supplied by Cheng County. Cement is supplied by Wudang Cement Factory and the coal ash is carried from Tianshui. The material delivery and goods supply conditions are quite good.

The stock taking yard of natural construction materials is set in small village material yard. This yard is located on the right bank of South River on the downstream of the dam. It's on the west side of Xiao Village, about 800m away from the dam line and 650m away from Xiao Village. There're small path and simple roads connecting with Xiao Village, so as the transportation is convenient.

3.5.1.6 Water Supply, Electricity Supply and Communication

The water source for construction and daily domestic use is from the river on the upstream of Moba Gorge. The water capacity is abundant and easy to take. The water quality is good and isn't corrosive for the normal concrete steel contained in concrete. It can definitely meet the requirements of the water use for construction and daily life. The Erlang River, Yan River and South River within whose ranges lies the project area has good water quality and are able to meet the requirements of production and domestic water uses. The water supply amount is 12500m³/d among which the production water use is 12000m³/d and the domestic water use is 500m³/d.

Transformer substation outlet from Cheng County with 2 circles of 35KVoverhead line can be used as the electricity source for Moba Gorge reservoir construction. Single circuit length is about 12km.

There's no communication line on the spot, but the signals of China Mobile and China Unicom can cover this area which can basically satisfy the need of construction communication. A communication line can be built from Paosha Town with a length of 5.0km.

3.5.2 Exploit of the Natural Material Yard

The natural construction material yard for this project lies in Xiao Village material yard which is on the right bank of South River on the downstream of the dam. It's on the west side of Xiao Village, about 800m away from the dam line and 650m away from Xiao Village. There're small path and simple roads connecting with Xiao Village, so as the transportation is convenient.

Yard area was a protruding spur east, east and north side of the steep terrain, the terrain was like cliff, almost in the shape of vertical slope, exposed bedrock, the north side of its base elevation of about 1100m, to the east side of its base and gradually lift up to 1125 ~ 1150m, north slope height of about 100m, east slope height of about 25 ~ 50m; south of the collapse talus slope, straight slope, slope angle 20 ° ~ 25 °; the west side of the highest terrain, a wide slow east-west ridge was an extension of the terrain on the west to east, north and south sides of the ridge slope angle of 30 ° ~ 35 ° slope, the surface to collapse talus gravel soil, thick 3 ~ 15m.

Yard rock engineering properties better compressive strength of saturated rock, softening coefficient and dry density can meet the specifications of artificial coarse and fine aggregate demand, the distribution of thickness of 3 ~ 15m top of the hill's slope of the plot and the residual slope collapse laminated to be done to clear the deal. Mined by north-south length of 220m, 120m east-west length of the calculation mining, excavation area of about 26,000 m^2, layer thickness by 50m excavation useful to consider the use of the average thickness of the method, reserves of about 1.3 million m^3. RCC gravity dam of concrete required for coarse and fine aggregate of approximately 327,800 m^3, so reserves to meet regulatory requirements.

3.5.3 Construction Diversion

3.5.3.1 Diversion Methods

According to the terrain conditions, hydrological features and hydraulic structure of the dam site, the construction of Moba Gorge Water Source Project shall take one-time cutting river bed and tunnel diversion methods.

3.5.3.2 Design of Diversion Construction

The diversion hole lengths is about 342.5m with a 20.7m long entrance part and 12.8m long exit part. The tunnel length is 309m. the diversion tunnel is in city door shape with a net size of 6.0×7.5m. The top arc α=120°.The diversion tunnel entrance has no inflow tower. There's a gate slot directly set on the entrance. When the diversion tunnel is blocked, use a truck crane to directly block the tunnel by pushing down the gate. The blocking gate size is 7.3×8.1×1.5m (width×height×depth). The gate is about 45t heavy. During the blocking operation, the highest water top is around 37.2m high.

The maximum height of the cofferdam on the upstream of the dam is 8.5m and the axis length is 51.7m. The cofferdam width is 6m with a water surface gradient of 1:2 and the air face gradient is 1:1.75. The cofferdam is made of river bed sand gravels. It takes high-pressure spout wall for seepage-proofing. The wall depth is 0.2m and 0.5m deep into the bed rock.

The maximum height of the cofferdam on the downstream of the dam is 4.5m with a water surface gradient of 1:2 and the air face gradient is 1:1.75. The cofferdam is made of river bed sand gravels. It takes high-pressure spout wall for seepage-proofing. The wall depth is 0.2m and 0.5m deep into the bed rock.

3.5.3.3 Diversion Procedures

According to the general engineering construction scheduling, the construction diversion procedures are as follows:

Start the construction of diversion tunnel and flood discharge sand flushing tunnel in March of the first year. In September, the diversion tunnel will be able to contain the conditions for water flow.

Occupation in advance of cofferdam in October of the first year. Cut South River in middle October and put water flow into the diversion tunnel. Complete the construction of cofferdam in middle November. In the second half of November, drain out the water from the base and start digging the dame base.

Start casting the dam concrete in January of the second year. Pour the elevation to 1052.0m at the end of May. The dam is in charge of blocking water by self in flood period. Combine the diversion tunnel and flood discharge holes to get through the flood period.

Pour the dam until the dam top elevation is 1099.8m in October of the second year.

Start saving water in diversion tunnel in December of the second year.

Finish the construction in January of the third year. The whole construction shall be completed in March.

3.5.3.4 Arrangement of Diversion Construction

The diversion tunnel is set on the right bank of the river bed. The entrance is on Yan River, about 80m away from Yan River and Erlang River. The angle of the entrance tunnel axis and the main direction of the river bed is 58°. The total length of the diversion tunnel is 342.5m. The exist lies on the downstream of the dam axis, about 169m away. The cliffs around the entrance and the exit are deep with bed rock exposed outside. They have the conditions for directly entrance or get out of the tunnel. The cofferdam on the upstream of the dam is set on the downstream of the combination port of the two rivers, about 60m away. It's 80m away from the dam axis. The axis is basically vertical to the river tunnel. The cofferdam axis is basically vertical to the river tunnel. It's 135m away from the downstream of the dam axis. The cofferdam bottom is about 20m away from the diversion tunnel hole.

3.5.4 Closure

3.5.4.1 Closure Time and Amount

Selection of closure time will directly affect the scheduling of the following project. According to the hydrological features of South River and combing it with the general construction scheduling, choose October for the closure. According to regulations, the closure amount shall be in accordance with 10% of the average flow rate of 3.91m³/s in October.

3.5.4.2 Closure Methods

The closure of this project usually takes normal rock ballast to block the flow. No closure clash bank needs to be built.

3.5.5 Main Construction

3.5.5.1 Dam Construction

（1）Digging

Use 2m³ excavator to directly dig the covering layer. Use 100HP~120HP soil shifter to collect he residues. Use 15t self-discharge truck to discharge the residues. Dig the rock by drilling explosion method. Use hydraulic pressure drill carriage to drill holes and then explode the stairs from up to down. The stair height is 10m~15m. Leave a protective layer of 2m for the basic digging. Collect the residues by 2m³~3m³ excavator. Use 100HP~120HP soil shifter to collect he residues. Use 15t self-discharge truck to discharge the residues.

（2）Curtain grounding.

The order for curtain grounding is digging→rockfill grounting→curtain grounting. Use leg shape air drill to drill hoes. Conduct the construction by one-time fracture digging, cutting undermine of the central

hole and glazing explosion of the surrounding holes.

Use handfilling trams to carry the digging residues to the tunnel entrance (average distance is 20m) and then use 1.0m³ excavator with 10t~15t self-discharge truck to carry them to the5# residue yard on the downstream. The average distance is 1.0km.

The dam curtain grounting will be operated after the basic gallery is formed. The curtain grounting is single row hole type with hole distance of 2m. Use geology abrasion drill or hydraulic core drill to drill the holes for curtain grounting. Use grount pump for grounting and relative records will be made by the automatic recording instrument. The equipments are two drills , one grounting machine, one recording instrument and one wet grinding set. The site craft parameters shall be decided in compliance with the site productivity test.

（3）Consolidation Grouinting

Start the dam consolidation grounting when the consolidation grounting concrete reaches 70% of the design strength. Conduct the construction by orders. The serial holes of II procedures shall be drilled after the holes of I procedures are completed.

Take fast drilling method to drill the holes. Take one-time grounting is the hole depth is less than 6m. Take grounting up to down by segments if the hole depth is more than 6m. When the liquid absorption amount is not enough, use 2~3 holes for grounting at the same time.

（4）Contact Grounting.

The craft procedures for contact grounting are: bury conduit→check waterflow→block holes→check grounting quality.

Bury the grounting pipes in relative positions in the concrete structure in advance. Before grounting, clean the drill way. While taking orifices block plug grounting, conduct the grounting from the lower position and the high holes shall be used for air discharge and water discharge. After the underflow (the density is close to thick liquid) is discharged, close the liquid entrance hole from the lower part and start grounting from higher position. Use a 3SNS grounting pump to grount liquid. If the hole distance is big, cement plaster can be grounted. Under regulated pressure, the procedure can be stopped when the grouting holes have stopped absorbing liquid for 10 mins. Use cement plaster or grounting liquid to block the grounting holes. The site craft parameters shall be decided in compliance with the site productivity test.

3.5.5.2 Layout of Waterlines

Use 100~120HP soil shifter to push the covering layer soil near the waterlines for temporary stacking. Use handy wind drill to drill and explode rocks. Use whole digging method to dig the cubic metre stone. Use handy wind drill to drill holes and explode the surrounding. Use tram to carry the residues out from the tunnel.

3.5.6 Transportation of Construction

3.5.6.1 Site Access Transportation

There already exists simple road leading from Moba Gorge to the dam location, starting from Paosha Town with a length of 3.5km. The road surface is made of macadam pavement which can be used after reconstruction.

Depending on the project location and transportation conditions, carry reinforcing steel bars, steel products, timbers and cement by road transportation to the project site.

3.5.6.2 Transportation within the Yard

（1）Current Transportation Conditions

Pave 2# road, 3# road with temporary river crossing equipments on the right bank of the dam site, combined with the requirements of site access.

The right bank connects S218 provincial road with Diao Gou Door area. There's village road leading to the dam site, Xiao Village and Gumu Channel. The road bed is 4.5m with running lane width of 3.5m. on the left bank lies stone pit road (which can be connected to the river bed in drought season).

（2）Main Transportation Circuit Layout

1#Road: starts from South River Road connecting the 5# Road with elevation of 1040.0m; it passes through the diversion tunnel exit, gravity dam, from the upstream and downstream of cofferdam to the entrance of the cofferdam with an elevation of 1039.0m. It mainly bears the cubic stone digging, residue discharge and concrete transportation work. The road bed is 8.5m wide and the pavement is 7m wide and 0.8km long with mud stones as a temporary road.

2#Road: starts from the temporary river crossing traffic facility and ends on the left bank. The elevation of the whole path is 1065m. It mainly bears the transportation of gravity dam RCC and the digging with residue discharge work on the left bank of the gravity dam. The road bed is 8.5m wide and the pavement width is 7m with a length of 0.65km. The pavement is made of mud stones as a temporary road.

3#Road (road on the dam): starts front the culvert of Diao Gou Door connecting with S218 provincial road with an elevation of 1005.0m. There's Yan River village road leading to the dam site along the mountain side, passing through Xiao Village and entering the comprehensive processing factory and concrete system in Gumu Channel. It goes through 1# tunnel and connects with the 7#road on the upstream. Then gets through 2#tunnel and reaches the top of the right dam. It mainly bears the personnel and goods transportation, digging, residue discharge, concrete transportation, electromechanical and metal structure installation work of the gravity dam abutment and diversion tunnel entrance. The road level is the third level road within the yard. The road bed is 8.5m wide and the pavement width is 7m with a total length of 2.81km, among which the exposed road length is 2.2km, 1#tunnel length is 0.44km and 2#tunnel length is 0.14km. The pavement is made of concrete as a permanent road.

4#Road: start from connecting 2#Road with an elevation of 1050.0m and ends to the downstream of the rock cofferdam whose elevation is 1036.5m. It mainly bears the work of transportation of rock cofferdam and gravity dam RCC, and the digging, residue discharge construction of part rocks on the river bed section of the gravity dam left bank. The road bed width is 8.5m and the pavement width is 7m with a length of 0.16km. The pavement is made of mud stones as a temporary road.

5#Road: connect 3#Road and stone pit. The road bed width is 4.5m and the pavement width is 3.5m with a length of 2.1m The pavement is made of mud stones as a temporary road.

6#Road: starts from the upstream of the cofferdam and ends in 1# residue discharge yard. The road bed width is 4.5m and the pavement width is 3.5m with a length of 0.23km. The pavement is made of mud stones as a temporary road.

7#Road: connect 3#Road, 1# tunnel exit and the entrance of the diversion tunnel. The road bed width is 4.5m and the pavement width is 3.5m with a length of 0.95km. The pavement is made of mud stones as a temporary road.

8#Road: starts of connecting the entrance of the diversion tunnel and ends in 1# residue discharge yard. The road bed width is 4.5m and the pavement width is 3.5m with a length of 0.19km. The pavement is made of mud stones as a temporary road.

Temporary river crossing traffic facilities: tempoporay traffic facilities are set on the downstream, 0.55km away from the dam site with an elevation of 1040m, a length of 60m and a width of 8.5m.

3.5.6.3 Construction Area

According to the needs of construction arrangement, the total area for the production, temporary domestic construction facilities, quarry and construction pavements of this project is 23.45hm².

3.5.7 Aggregate Scheduling of the Construction

The total construction period of this project is 27 months among which the construction preparation period is 11 months, main construction period is 11 months and the completion period is 5 months. The 6-month engineering establishment preparation period doesn't count in the total construction period.

3.5.7.1 Construction Preparation Period

The construction preparation period starts from January to November of the first year in total of 11 months. The content of construction includes the main construction of field engineering, transportation within yard, adit of construction, dinas processing system, concrete blending system, temporary house building and construction factory done by the contractor unit with the digging of diversion tunnel and dam abutment on both banks. The control program is that the diversion tunnel shall have the ability to overflow in October of the first year.

3.5.7.2 Main Engineering Construction Period

The main engineering construction period is from December of the first year to October of the second year in total of 11 months. The completion is the dam concreting, metal structure installation and curtain grounting after the closure. The dam engineering construction is a control engineering in the main engineering construction period.

3.5.7.3 Engineering Completion Period

The engineering completion period is from November of the second year to March of the third year in total of 5 months. It blocks the diversion tunnel, make reservoir start reserving water and conducts the completion check.

3.6 Submerging Area and Migration Arrangement

3.6.1 Submerging Range of the Reservoir

Submerging area: land area: 53.85hm² among which the forest area is 45.13 hm², cultivate land area is 7.45hm² and unexploited land area is 1.27hm².

The backwater length of the reservoir is 3.5km which belongs to narrow and long type reservoir. The reservoir surface is narrow and the wind blowing distance is comparably short. There's scattering cultivate land on both banks of the reservoir.

3.6.2 Real Object Index of the Reservoir Submerging Influence

There's big area of vegetation cover on the upstream of the reservoir. The submerging area of the reservoir mainly involves Shaba Town, Paosha Town and Chenyuan Town, part sections of the six administrative villages and there're 3 families need to move. According to survey, there's no mineral resource or historical relics (see attachment for demonstration) in the reservoir of the water source area. There're only scattering towns and cultivate lands. According to statistics, the vegetation area is 51.13hm², cultivate land is 9.86hm², unexploited land area is 1.27hm² and there are 3 submerged houses. The 10Kv farm-oriented current lead is 1.2km long.

3.6.3 Engineering Area

The total engineering construction area of this project is 95.35hm² among which the construction influence area is 41.51hm² and the reservoir submerging area is 53.85hm². Divided by the types, the cultivate land is 12.92hm², vegetation land is 51.64hm² and unexploited land area is 30.8hm². Divided by coverage property, the permanent land is 71.91hm² and temporary land area is 23.45hm².

3.6.4 Migration Arrangement Plan

In order to ensure the people's long-term living, production and infrastructure, use new development cultivate landing method to supplement and start development according to the locak situation combined with Cheng County reality. New migration living area is the Baima Temple Professional Technology School in Chenyuan Town of Cheng County. There's 20 rebuilt dorms for the migrants and give 5.07hm² fields of the school experiment fields to the 3 families. By communal land adjustment, the citizens' agricultural production needs can be satisfied. As the 5.07hm² of experiment fields and surrounding communal land have been listed in the Cheng County Chenyuan Town Lugou Reservoir Water Saving Irrigation Project, the migrans' high-efficiency agricultural planting can be supported by sufficient water supply and their economic income can be increased in this way.

3.7 Engineering Feature List

See table 3-1 for the main features of this project.

Table 3-1 Main Engineering Feature List

No.	Name	Unit	Amount	Note
I	hydrology			
1	Flowing area			
	Total flowing area	km^2	401	
	Above the dam site	km^2	248.2	
2	Used hydrological age limit	year	51	Practical measurement, 1959~2009
3	Average annual runoff	10,000 m^3	4352	
4	Representative flow rate			
	Average annual flow rate	m^3/s	1.38	
	Normal use (design) flood standards and flow rate	m^3/s	954	P=2%
	Normal use (verified) flood standards and flow rate	m^3/s	1550	P=0.2.%
	Diversion standards and flow rate of the diversion tunnel	m^3/s	544	P=10%，whole year
	Diversion standards and flow rate on the upstream and downstream of the cofferdam.	m^3/s	29.4	P=20%，10~5 month
5	silt			
	Average suspended sand load	10,000 t	14.72	
	Average sediment concentration	kg/m^3	3.509	
	Average annual bed sand load	10,000 t	2.21	

II	General situation of the project			
1	reservoir			
	Verified flood level	m	1098.52	
	Designed flood level	m	1096.38	
	Normal impounded level	m	1092.70	
	Dead water level	m	1068.0	
	Total storage	10,000m^3	1790	
	Utilizable capacity	10,000m^3	1040	
	Dead storage capacity	10,000m^3	380	
	Maximum discharge amount of the verified flood level	m^3/s	1410	
	Maximum discharge amount of the designed flood level	m^3/s	865	
2	Water supply for urban area			
	Annual water supply amount	10,000m^3	1651	
	Ensurance rate of water supply	%	96.3	
3	waterline			
	Pipeline lengths	km	5.15	
	Pipeline amount	amount	2	
	Designed water supply flow rate	m^3/s	0.65	
	Leakage loss rate	%	10	
III	Submerging loss and permanent land of the project			
1	Backwater length	km	3.5	
2	Submerged cultivate land	hm^2	9.86	
3	Submerged vegetation	hm^2	51.13	
4	Migrant amount		14	
5	Submerged houses		3	
6	Important special facilities influenced by the submerging			
	10kv circuit	km	1.2	

7	Project coverage	acre	145.17	
	Involved: cultivate land	acre	36.17	
Ⅳ	Main buildings			
1	Water retaining structures			
	type			RCC gravity dam
	Foundation feature			limestone
	Basic seriousness of earthquake	degree	8	
	Height of dam top	m	1099.8	
	Maximum dam height	m	91.4	
	Dam top length	m	136.5	
	Dam top width	m	10	
2	Water discharging structures			
2.1	Overflow hole			
	Foundation feature			limestone
	Crest top height	m	1092.7	
	net width of overflow section	m	39	
	Energy dissipation mode			energy dissipation by trajectory jet
	Designed flood discharge flow rate	m^3/s	462	
	Verified flood discharge flow rate	m^3/s	1003	
2.2	Flood discharge sand flushing hole			
	Hole size	m	3.5×4.8	
	Hole length	m	46.9	
	Maximum discharge amount	m^3/s	107	
3	Road on the dam			
	length	m	2810	
	Pavement width	m	7	
Ⅴ	construction			
	Open cut cubic stones	10,000m^3	43.16	

	Backfilling of cubic stones	10,000m^3	5.54	
	Digging cubic stones	10,000m^3	2.31	
	concrete	10,000m^3	25.28	
	Metal structure installation	t	186.5	
	Curtain grounting	m	8580	
	Consolidation grounting	m	3100	
2	Main construction material amount			
	Cement	10,000t	4.79	
	Coal ash	10,000t	2.66	
	Reinforcing steel bars and steel materials	10,000t	1.0	
3	Needed labor			
	Labor needed in construction peak period	Working days	1000	
4	Construction labor and source			
	Electricity supply	km	12	35kv，Cheng County
5	Site access			
	distance	km	5	Rebuild current village road
6	Construction diversion			
	method			Cofferdam blocks water
	method			Diversion of tunnel
	Diversion tunnel size(length×width)	m×m	6×7.5	City door shape
7	Construction time limit			
	Construction preparation period	month	11	
	Construction period for main engineering	month	11	
	Completion period	month	5	
	Total construction period	month	27	
	Economic index			
1	Total static investment	10,000 Yuan	22656.3	

	Construction project	10,000 Yuan	17032.00	
	Electromechanical equipment and installation	10,000 Yuan	920.22	
	Metal equipment and installation	10,000 Yuan	1351.19	
	Temporary construction project	10,000 Yuan	3675.70	
	Basic preparation fee	10,000 Yuan	1550.76	
	Financing interest in construction period	10,000 Yuan	458.50	
	Compensation fee for reservoir submerging	10,000 Yuan	3257.40	
	Construction and covering land fee	10,000 Yuan	1355.95	
	Environmental protection project fee	10,000 Yuan	408.6	
	Soil and water maintenance project fee	10,000 Yuan	1118.67	
2	Comprehensive economic index			
	Economic net present value	10,000 Yuan	7493	
	Inner economic benefit rate	%	10.39	
	Economic benefit fee ratio		1.22	

3.8 Comparison with Original Project

On June 10th in 2009, Lanzhou University finished the compilation of "Environmental Impace Report of World Bank Emergency Loan Item——Moba Gorge Water Supply Project in Cheng County, Gansu Province". On June 30th, 2009, Gansu Environmental Protection Bureau replied the "Environmental Impace Report of World Bank Emergency Loan Item——Moba Gorge Water Supply Project in Cheng County, Gansu Province" by Gansu Environmental Protection Issuing No. 【2009】60 and approved the report of this project. This report was then verified by related departments of the World Bank. The reservoir scale was changed and some changes were made in project quantity. See more information in Table 3-2.

Table 3-2 Comparison Summary List with Original Project Work Amount

No.	Comparison item	Work amount of this project	Work amount of original project
	Construction site	11km away from the downtown of the county. On the downstream of South River and	Same with the plan of this project

1		6km away from Paosha Town.	
2	Construction scale	Total capacity 17.90 million m^3 Average daily water supply :45,200 m^3	Total capacity 20.198 million m^3, Average daily water supply :50,000 m^3
3	Water level	Normal impounded level: 1092.70m, Verified water level:1098.52m	Normal impounded level:1096.104m, verified water level: 1101.70m
4	Paved pipeline length	5.15km	4.74km
5	Construction coverage	Covered area:95.36hm^2, permanent land: 71.91hm^2, temporary land: 23.45hm^2	Total cover area: 68.73hm^2, permanent land: 59.33hm^2, temporary land: 9.4hm^2
6	Cubic meter of earth and stone	Total dug cubic:453.600 m^3, backfilling: 386.300 m^3, debit: 400.000 m^3, abandoned cubic: 467.300 m^3	Total dug cubic 603.000 m^3, backfilling:801.000m^3, debit: 198.000 m^3, no abandoned cubic
7	Migration	3 families	40 families
8	Dame type	Concrete gravity dam	Concrete panel rock-fill dam
9	Water intake method	Bury the pipe on the dam boty. Put steel concrete pipe and two round water supply pressure tubes on the exit.	Vertical well shape water entrance with pressured round tunnel. Pressure-free steep slope connected with water supply pipes are set on the exit.
10	Total static investment	226.563 million Yuan	217.8962 million Yuan

4 Project Analysis

4.1 Selection of the Dam Site Plan

4.1.1 Intended Plan

According to he water supply situation and actual terrain of the Cheng County urban area, there're three intended dam sites for selection: Moba Gorge, Erlang River and Drop Cliff.

Plan 1

Choose Moba Gorge. The control reservoir flow area is can be 248.2k㎡. The dam site has good terrain conditions. The intendedly built utilizable reservoir capacity is 10.4 million m³ with a total capacity of 17.9 million m³.

Plan 2

Choose the Huang Family River on the tributary of South River. The control reservoir flow area can be 74.70km². The annual flow rate can be 14.61 million m³. This site has good terrain conditions. The intendedly built utilizable reservoir capacity is 5.5 million m³ with a total capacity of 7.49 million m³.

Plan 3

Choose the Drop Cliff on the tributary of South River. The control reservoir flow area can be 67.2km². The annual flow rate is 13.15 million m³. This dam site has good geological conditions. The intendedly built utilizable reservoir capacity is 11.48 million m³ with a total capacity of 16.28 million m³.

4.1.2 Comparison from Economic and Technical Angles

The three plans mentioned above can all be chosen to build the water facilities. The water quality can all meet the requirement of daily water use after special treatment. However, there exist differences on water amount and construction period of each plan. The comprehensive comparison from economic and technical sides of the three plans are shown in Table 4-1.

Table 4-1 Comprehensive Comparison List of Each Plan

No.	Plan	The first plan	The second plan	The third plan
1	name	Moba Gorge	Huang Family River	Drop Cliff
2	River name	South River	Erlang River	Erlang River
3	Flow rate area（km^2）	248.2	74.7	67.2
4	Annual flow rate（10,000 m^3）	4514	1461	1315
5	Backwater length（km）	3.5km	1.5	2.4
6	Utilizable reservoir（10,000 m^3）	1040	550	1148
7	Estimated investment（10,000 Yuan）	22656.3	7964.20	12686.80

After comparing the above three plans, the first plan can provide sufficient water amount with good quality. Building the dam here can meet the requirements of water supply for the urban area and the height difference is suitable for the natural water supply condition. This can reduce the water supply cost and it's easy to master the operation. There's no adequate water amount in the second plan while the reservoir adjustment function can not meet the requirements of water supply to the urban area. The geological conditions are worse than those of Moba Gorge. So the second plan shall not be taken. There's no convenient transportation in the third plan. The water construction investment is hug and

the ensurance rate is less than 95%. After the above comparison, the first plan is better than the other two.

4.1.3 Comparison from Environmental Angle

As the district environment conditions of the three plans are similar with no sensitive area, there's no big difference in environmental impact. The selection for dam site in the three plans are not limited by the environmental factor.

4.1.4 Conclusion of Dam Site Selection

Through the analysis from economic, technical and environmental angles, the first plan (Moba Gorge) is better than the other two. The first plan is approved.

4.2 Conformity Analysis of Project Site and Planning

4.2.1 Analysis of the Conformity with Policies

According to "Guide Directory of Industrial Structure Adjustment" (2005) (Order No. 40 of the State Development and Revolution Committee), the "Water resource Project for Water resource Shortage District" is encouraging project. Until now, the drinking water quality in the urban area of Cheng County can not reach the standard and the water supply amount is not sufficient. Cheng County is a water resource shortage area, so this project is in compliance with industrial policies.

4.2.2 Conformity Analysis of Related Planning

4.2.2.1 Conformity Analysis of Related Planning

（1）According to the planning content of "The Eleventh Five-Year Planning Guideline of Cheng County Economy and Social Development", planning content related to this project are: continue the principle of "combined use of three waters, develop benefit and remove harmness, emphasis on water reservation and improving benefit", insist on developing beneficial project and abandoning unimportant project, energy saving and throttling, combine flood resistance with flood prevention, actively conduct safe drinking water project, develop water saving industry, and establish a water saving society.

（2）According to the conformity analysis, the construction of this project is good for ensuring safe drinking water and improving water resource utility rate, so it's in accordance with the requirements of implementing safe drinking water project, developing water saving industry and establishing a water saving society of the Cheng County "Eleventh Five-Year"plan.

4.2.2 Conformity Analysis of the Cheng County General City Planning Guideline

（1）Planning content

According to the water engineering planning of "Cheng County Urban Master Planning Guideline (2008-2025)", there'll be 3 water factories built in Cheng City, He Dong and Paosha. The total scale of city water supply will reach 65.000 m^3/d.

（2）Conformity Analysis

The newly built Moba Gorge Water Source Project lies only 11km away from Cheng County and only 6km away from Paosha Town. It takes use of height difference to transport water to the tap water factory in Paosha Town for the water supply of urban area.

4.2.2.3 Conformity Analysis of the Cheng County Water Resource "Eleventh Five-Year" Plan

（1）According to the planning

Content of "Eleventh Five-Year Plan of Cheng County Reasonable Water Resource Usage and Water

Resource Ensurance", there're two reservoirs which need to be built: Moba Gorge reservoir and Yitan Men reservoir.

（2）Conformity Analysis

The main construction content is to build Moba Gorge reservoir. It accords with the requirements of "building a reservoir in Paosha Town Moba Gorge' in the Cheng County "Eleventh Five-Year" plan.

4.2.3 Site Selection Assessment

4.2.3.1 General Situation of the Site

The Cheng County Moba Gorge Water Supply Project lies in the west side about 11km away from the Cheng County town and 6km away from the Paosha Town. It's in the downstream of the South River basin. The geographic location: northern latitude 33°45'~33°38', east longitude 105°33'55''~105°37'60''. It belongs to Jialing River Water, upstream of the Yangtze River. The total length of Moba Gorge is 32km with a flow area of 248.2km². There're 2379 people living within the area which account for 9.3% of the total county population. The elevation above the water source project central level is 1026~2415m with a forest coverage rate of 69%.

4.2.3.2 Yard Site Assessment

This yard site assessment will assess from angles of planning conformity, social environment, local terrain and landform, hydrology and geology. See more in Table 4-3.

Table 4-3 Yar Site Assessment

Environment	Conditions	Yard Site Selection
Social environment	Accords with the Cheng County Eleventh Five-Year plan and the planning of water resource utility	Conformed
	Supported by the public	Satisfied
	Ensure the safe distance with important objectives (including important military facilities, big water electricity facilities, main circuit of communication, nuclear power station, airport, important bridge and dangerous explosive facilities)	Satisfied
	Connected and coordinated with the living and public facilities of the urban life.	Satisfied
	Connected and coordinated with the urban traffic, communication, energy and municipal administration.	Satisfied
Natural Environment	Doesn't belong to natural reservation district, scenic area or holiday resort.	Satisfied
	Doesn't belong in the relic reservation area regulated by the nation, province or city.	Satisfied
	Doesn't belong to important resource district.	Satisfied
Yard environment	Avoid large scale of land cleaning, forest cutting and covering protective	Satisfied
	Reduce the influence cause by the use of facilities and large scale of migration.	Satisfied

Geology	Avoid districts where natural disasters often appear and unstable geological districts (abandoned mineral area, subsiding area, sliding, talus, landslide area, debris flow area, active fault layer and other dangerous unstable areas)	Satisfied
	The earthquake degree is lower than VIII.	Basic earthquake degree is
	Adequate water resource which can meet the requirements of urban area water need.	Satisfied
	The water quality can satisfy the needs of drinking water area.	Satisfied

4.2.4 Assessment Conclusion

From the above, we can see the building of this project lying in the west part of Cheng County downtown which is 6km away from Paosha Town basically accords with the Cheng County "Eleventh Five-Year"plan , land utility planning and water resource utility planning. It's supported by the local environmental protection depart, urban master department and the public. The site construction has good conditions which can satisfy the requirements.

4.3 Relation with the Newly Built Water Factory

The water of this project is transferred to the new water factory through a 5.15km long waterpipe. The new Cheng County feasibility and environmental assessment have been approved and replied by related departments.

The urban water supply project factory lies on the high land of Paosha Town, 7.0 km away from the downtown. The design scale is 50,000m³/d with 14.7km long matching pipe net. The water treatment techniques are "geogrid+mechanical stirring mixing pit+reseau response pool+pipe chute deposition pool+air water back flowing filtering pool". According to he "Environmental Impact Report of Urban Water Supply Project of Cheng County, Gansu Province" and related reply suggestions, the dealt water can meet the requirements of "Daily Drinking Water Hygienic Standards" (GB5749-2006).

4.4 Project Pollutant Source, Pollutant Discharge and Environmental Impact Analysis

4.4.1 Project Coverage, Cubic Earth Stone Balance and Situation of Material Taking and Residue Discharge

4.4.1.1 Project Coverage

The total project coverage is 95.36hm²among which the project construction influence coverage is 41.51hm², the reservoir submerging area is 53.85hm². Divided by type, there're 12.92hm² of cultivate lands, 51.64 hm²of vegetation and 30.8 hm²of uncultivated lands. Divided by property, there're 71.91 hm² of permanent covered lands and 23.45 hm² of temporary covered lands. See more in Table 4-1.

Table 4-1 Project Coverage Statistic Table Unit：hm^2

Item	Division		Area			Summary
			Cultivated land	Vegetation	Uncultivated land	
Permanent coverage	Main project	dam		5.13	1.27	6.4
		Management station		0.8	0.07	0.87
		Road leading to the dam	1.07		2.61	3.68

		Water pipeline	4.4	0.58	2.13	7.11
	Land submerged by the reservoir		7.45	45.13	1.27	53.85
	summary		12.92	51.64	7.35	71.91
Temporary coverage	Construction area, living and working area				8.2	8.2
	Residue discharge yard				10.9	10.9
	Construction path				2.25	2.25
	Quarry				2.1	2.1
	Summary				23.45	23.45
Total			12.92	51.64	30.8	95.36

4.4.1.2 Cubic Earth and Stone Amount

The total digging cubic amount is 453.600m³ (including the 3,200 m³ of residue discharged from cofferdam), among which there're 123,300 m³ of cubic earth. The cubic filling amount is 386.300 m³ among which there're 44.200 m³of earth filling cubic, 23,000 m³ of macadam filling cubic, 8,000 m³of dimension stone filling cubic, 14,000 m³ of sand gravel filling and 325,000 m³ of artificial aggregate rock filling. The utility cubic is 61,300 m³ and the abandoned cubic is 467,300 m³ (including 7.5 m³ of residue discharged from stock ground). The debit is 400,000 m³.

4.4.2 Pollutant Discharge in Construction Period

4.4.2.1 waste water

The waste water produced in the construction process of Moba Gorge Water Supply Project mainly comes from working site car repair, car washing and construction workers' domestic waste water.

（1）industrial wastewater

Wastewater from the construction site concrete mixing, aggregate processing and pit drainage wastewater generated, in which the pit wastewater regular emissions is 136m / h, the maximum aggregate processing backwash water discharge capacity is 142m³ / h, alkaline waste water is 12m³ / d.

（2）Domestic Waster Water

The main pollutants of domestic waster water are CODcr, BOD5 and SS. There're almost 1000 workers during the construction peak period with a water usage of 30L/people.d. The waste water supply is 80% which is 24m³/d. The produced concentrations are CODcr300mg/L, BOD5180mg/L and SS200mg/L.

（3）The waster water containing oil comes from the running, dropping, emitting and leaking of the mechanics. The mechanic washing waste water is 54.6m³/d.

4.2.2.2 waste gas

（1）dustraised dust

Dust during construction of the air pollution is dust pollution. Construction of earth excavation, which dry rock drill rock dust generation of 4.8g / s, dust explosion is the generation of 25g/m^3; building

materials transport, handling, mixing process of a large number of dust scattered into the surrounding atmosphere in; building materials piled up period due to dust pollution caused by the wind, especially in the larger wind speed or handling, fast car driving case, dust pollution more serious.

（2）waste gas

During the construction process, the main components of the fuel oil waster gas coming from construction mechanics and transportation vehicles are CO, NOx and THC. The total consumption of fuel oil in this project is 1663.4t and the discharge amount of each pollutant are: CO148.1t, NOX95.78t, THC27.5t.

4.4.2.3 Noise

The mechanic equipments used in the construction of this project are mainly gadder, soil shifter, excavator, blender and drilling machine. If there's no measure taken, the noise source will affect the surrounding environment. The acoustic pressure level is shown in Table 4-6.

Table 4-6 Acoustic Level Measurement Value and Range of the Construction Mechanic Equipment Unit：dB（A）

No.	Construction equipment	Distance between the measuring spot and the construction equipment/m	Maximum noise level/dB
1	gadder	5	100
2	Soil shifter	5	86
3	excavator	5	84
4	blender	5	87
5	Drilling machine	5	95

4.4.2.4 Solid Waste

The solid waste produced in the construction period of this project mainly comes from the construction workers' domestic garbage. There're about 1000 workers during the construction peak period. Calculate as 0.8kg garbage/ person, the daily garbage production during the construction peak period is 0.8t/d.

467,300m³ abandoned cubic is produced in the construction of this project and are piled up in the designated residue discharge yard.

Refer to "Yangtze River Three Gorges Reservoir Bottom Solid Waster Cleaning Technical Specifications" and requirements of water source protection, clean the submerged vegetation and construction garbage after the project is completed. According to estimation, there're about 50,000m³ vegetation needs to be cleaned and the broken area is 549.33 ㎡. Calculate by the 1.3t/㎡ of "Treatment Technical Guideline of Earthquake Disaster District Construction Garbage" (trial version), the cleaned construction garbage is about 14.13t heavy.

4.4.3 Pollutant Discharge during the Operation Period

4.4.3.1 Waste Water

The project area by the county in Gansu Province into a mill dam Gap water supply construction management, preparation of 35 key management task is to observe the dam, water quality monitoring, engineering maintenance, rescue and other work. Management staff by 100L / person. D calculation, the largest living water of about 3.5m³ / d. Accordingly, the sewage discharge of about 3.3m³ / d.

Analog wastewater quality, the main pollutants in sewage CODcr, BOD5, SS; their concentrations were 300mg / L, 180mg / L, 200mg / L. After calculation, the emissions of sewage treatment before run-time pollutant are: CODcr0.30t / a; BOD50.18t / a; SS0.20 / a.

4.4.3.2 Solid Waste

After the project is completed, there're 35 formation workers determined to master the management work. Calculate by 0.8kg garbage produced by each person per day, the annual total garge amount produced by the 35 workers will be 10.22t.

4.5 Recognition of Environment Impact Factor

The analysis of Cheng County Moba Gorge Water Supply Project environment impact factors emphasizes on the construction and operation phase of the project. During the construction period, because of construction coverage, ground cleaning, ground surface digging and water pipeline pavement, the construction area and the ecological environment, water environment and air environment in the surrounding are affected by different levels, and the use of related mechanic equipments in each project have influence on the surrounding environment and air quality. There's no pollutant emitted during operation period, so this project has no palliative impact on the environment. The project itself is a pollution-free project. The environment impact factors are shown in Table 4-7.

Table 4-7 Environment Impact Factor Analysis List

<table>
<tr><th>Time</th><th colspan="2">Project construction item</th><th>Possible environmental problems</th></tr>
<tr><td rowspan="11">Construction period</td><td rowspan="3">Main body construction</td><td>Dam body construction</td><td rowspan="11">a construction excavation, destruction of surface structure, causing soil erosion
b permanent and temporary covering an area of damage to vegetation
c construction machinery, transportation and material processing exhaust gases and noise, the construction area and the surrounding air and the sound of an impact on the environment
d spoil handling and surface restoration
e construction of the surrounding environment has been damaged</td></tr>
<tr><td>Pavement of water pipeline</td></tr>
<tr><td>Management station construction</td></tr>
<tr><td rowspan="8">Auxiliary facilities construction</td><td>transportation</td></tr>
<tr><td>Sand stone division yard</td></tr>
<tr><td>Blending station</td></tr>
<tr><td>Steel bar processing factory</td></tr>
<tr><td>Timber processing factory</td></tr>
<tr><td>Wind, water and electricity supply for the construction</td></tr>
<tr><td rowspan="7">Operation period</td><td rowspan="6">Reservoir area</td><td>Dam block</td><td rowspan="7">a small change in climate around the reservoir area
b library district degradation of water quality
c management of domestic wastewater generated
d management of waste generated
e water level elevation, easily induced geological disasters around the reservoir area</td></tr>
<tr><td>Water level increase</td></tr>
<tr><td>Water level improvement</td></tr>
<tr><td>Change of reservoir water temperature</td></tr>
<tr><td>Change of reservoir water temperature situation</td></tr>
<tr><td colspan="2">Management station</td></tr>
</table>

We conduct selection of the major factors shown in the above table. The results and degrees are shown in Table 4-8.

Table 4-8 Recognition of Environment Impact Factor

Environment factor / project		Terrestrial ecology	Aquatic ecology	Soil and water loss	Aquatic environment	Air environment	Noise environment	Solid waste	Social environment	Human health
Construction period	Main construction	●	△	●	△	△	○	○	/	△
	Diversion work	●	△	●	△	△	○	○	/	△
	Other construction	○	△	○	△	△	○	○	/	△
	shortcut	●	△	●	△	△	○	△	/	△
	Human activities	△	△	△	△	△	△	△	△	△
Operation period	Management station	△	△	△	○	/	△	○	△	△
	Area of Repository	△	●	△	△	△	△	△	/	△

Note：● big influence ○ normal influence △ slight influence

5 Environment Impact Prediction and Assessment

5.1 Hydrology and Mud Sand Prediction and Assessment

5.1.1 Hydrological Change Situation

5.1.1.1 Influence on local water resource

The Cheng County Moba Gorge water supply project uses reservoir to store water. The normal water level is 1092.70m with a total storage capacity of 17.9 million m³. The backwater length is about 3.5km and the designed quoting water amount is 16.51 million m³/a During the operation period, there's a 11km long water adjustment section on the downstream of the dam until the water is discharged back into the river where the river emerges with its trunk river of Qingnihe.

5.1.1.2 Assessment of Influence on Water Adjustment Segment

For the 11 km flow-reduction section, there's a Fengquan River entering South River at 4km the downstream of the dam. The normal annual flow rate of Fengquan River is 20.60 million m³. Within this area, there're Zhuanwan Village, Ganlu Temple Village, Majia Cliff, Jianjia Groove, Xiao Village, Zhangjia Mount, Wangou Men and Niujia Cliff. There're about 900 people in Zhuanwan Village, 1000 in Ganlu Temple Village, 300 in Majia Cliff, 350 in Jianjia Groove, 250 in Xiao Village, 600 in Zhangjia Mount, 100 in Wangou Men and 120 in Niujia Cliff. The domestic water in these eight villages come from the local mountain spring and underground water, not the water source within the river area (see Attachment 12).

For the remaining 7 km, the main water demand is farmland irrigation and domestic water use of Paoshan Town and 7 villages. The annual domestic water demand is 0.37 million m^3, which will be covered by the proposed water supply project. The agricultural irrigation water demand is 3.29 million m^3. Considering the remaining flow from the dam, and incoming flow of Fengquan River (20.60 million m^3), the agricultural water demand is less than 10% of the remaing flow in the river.

Therefore, the water diversion will not have significant impact on water demand for the 11km downstream section that is susceptible to flow reduction.

5.1.2 Prediction and Assessment of Sediment Load

As there' re many reasons for bed-load sediment, the test material precision is not high with the limit of current technologies and testing methods and instruments. The relation between the sediment bed-load ratio and hydrological factors of each item is bad. According to the normal relation of the Yangtze River area mountain river bed-load ratio : 10～20%, it's estimated that the bed-load sediment of this area is 15%. Cheng County hydrological station has an annual bed-load sediment amount of 13.36 million t while the average total sediment amount is 1.024 million t. The average sediment modulus is about 22,100 t while the average total annual sediment amount is 169,000 t.

The completion of this project can help to slow down the water flow rate which is good for the sediment deposition and the sediment deposition in the reservoir can be accelerated. In order to ensure the storage capacity, occasional sand discharge to the downstream is used in this project. During the sand discharge period, the flow rate in the influenced segment will be increased but the influence is within the acceptable range.

Compared with the 200,000 t of average annual sediment amount of the original plan, the storage capacity of this plan is reduced. As the flow rate is bigger than that of the original plan, the average annual sediment amount of this plan is increased for about 31,000 t and related influence on the environment is reduced.

5.2 Local Climate Impact Assessment

After the reservoir storage function works, the uneven land of submerged area is replaced by smooth water surface and the exchange method and strength of the energy between underlying surface and air are changed. As the water heat capacity is bigger than that of land soil, the

temperatures on the same spot of the submerged place are different before and after the completion of the reservoir. The difference of water and land temperature will cause horizontal exchange, resulting in the change of land temperature in the surrounding.

Since the construction of the project formed a large area of water, sunlight radiation, rainfall, increased evaporation caused by the increase; reservoir temperature effects can change the distribution of rainfall, reservoirs and coastal flow over the leeward precipitation will be lots reduce the airflow on the windward slope of precipitation will increase; reservoir underlying surface from the land surface into the water, and energy exchange between the air and the intensity changes, leading to changes in temperature, annual average temperature increased slightly , but the impact of the region within an acceptable range.

5.3 Prediction and Assessment of Water Environment Impact

5.3.1 prediction and assessment of water environment impact during construction period

(1) the construction process wastewater mixing concrete, aggregate processing and pit drainage wastewater generated, the main pollution is high SS concentration. If not treated, to be disposed of, will have a greater impact on the surrounding environment.
(2) As a result of the higher number of domestic wastewater, sewage produced large, if not treated, disposed of, not only pollute the environment, but also to provide mosquito breeding sites, harm to human health.
(3) The mechanical construction of oily waste water to run, run, drain, drop a small amount of oily wastewater, such wastewater discharge was relatively low, large changes in emission concentrations, emission greater randomness, but the sphere of influence is extremely limited.

5.3.2 Prediction and Assessment of Water Environment Impact during Operation Period

5.3.2.1 Water Temperature Impact Analysis

After this project stars to store water, there'll be distinct difference between the water

Temperature and the water temperature in natural river before the construction. The change

of water temperature will have influence on the vertical structure of the reservoir and

water temperature layer will form. This will have great impact on the aquatic animals in

the raw river segments. For this reason, we shall make judgment on the reservoir layer.

Runoff-storage capacity comparison method is often used for the judgment of a whole

Reservoir layer, which is：

$$\alpha = \frac{\text{Average annual runoff}}{\text{Total reservoir capacity}} \qquad \beta = \frac{\text{Flood amount for one time}}{\text{Total reservoir capacity}}$$

（1）α≤10 : stable layer type

β≥1: flood will affect the water temperature structure. The type is temporary mixing

type.

β≤0.5: flood will have no impact on the water temperature structure.

0.5＜β＜1: flood will affect the water temperature structure in some level but won't destroy the layer structure.

（2）α≥20 : mix type

（3）10＜α＜20: transition type

The average annual runoff of the intendedly built dam site is 45.10 million m^3 with a total capacity of 17.90 million m³. the calculated reservoirα=2.52 which means it's a stable layer type reservoir. β=0.2 which means flood won't have impact on the water temperature structure.

5.3.2.2 Impact on Water Quality

According to survey, there's Pb Zn Mineral Factory and a Gold Mineral Factory with a gold mineral mountain (about 20km away from the dam) on the upstream of the reservoir area. Although the factories and the mountain are out of the backwater area, the Cheng County Environment Protection Bureau has closed the two factories and blocked the mountain in order to further ensure the water quality of water supply.

In addition, no pollution sources around the reservoir area and industrial pollution enterprises, the concentrator off, gold seal, the reservoir water quality and soil erosion mainly from areas some soil organic matter with sediment into the reservoir, leading to the reservoir increase in sediment, nitrogen, phosphorus content increased. But produce smaller, basic reservoir will not impact water quality. In order to ensure the water quality of the reservoir, the project is completed to strengthen the monitoring of reservoir water quality, prevent emergencies on water quality.

5.3.2.3 Reservoir Eutrophication Analysis

The eutrophication is caused by the overwhelm deposition of nutrient substances in the water. It makes the water change from poor nutrition situation with low productivity to eutrophication status with high productivity. Reservoir with serious eutrophication will worsen the sensitive organ shape in the water and cause short-time oxygen deficit in the water, resulting in the death of fish. The reasonable utility of the reservoir resource will be affected in this way.

Eutrophication of water bodies due to the development of the entire environmental system imbalance, leading to an advantage during the growth of algal blooms. Eutrophic oxidation has occurred in the following three main factors: the total phosphorus, total nitrogen and other nutrients are relatively abundant; slow flow pattern; appropriate temperature conditions. Only three conditions are more appropriate in the case, some kind of advantage would appear algae "crazy" long phenomenon, the outbreak of eutrophication. As the regional geographic features, natural climatic conditions, pollution of aquatic ecosystems and features, and many other differences.

After the dam is completed, water storage body will form. Although big scale of land and vegetation will be submerged, clean the reservoir and reduce the exposed nutrition substances on the submerged soil according to related requirements. The nourishment provided for the alga growth is not too much and it won't cause eutrophication in the water body.

In order to prevent the appearance of eutrophication, related department shall make acceptance assessment of the cleaning situation before the reservoir starts to store water. It can only start storing water after the assessment is verified to be qualified.

5.3.2.4 Administrative Staffs' Domestic Waste Water Impact Assessment

There're 35 official staffs in the Moba Gorge water source project management office of Cheng County in Gansu Province. Their major works are dam observation, water quality monitoring, project maintenance and emergency solution. Calculate by 100L/person.d, the maximum domestic water use is 3.5m³/d. Based on this calculation, the domestic waste water discharge amount is about

3.3m³/d. The main pollutants in waste water are CODcr, BOD5, SS whose densities are300mg/L, 180mg/L, 200mg/L. In order to ensure that the waste water produced by the administrative staffs' domestic use won't pollute the water source place, treatment shall be done to the waste water by waste water process equipments.

5.3.3Water Intaking Amount Guarantee Prediction and Assessment in Operation Period

5.3.3.1 Supply and Demand Balance of the Reception Basin Water Resource

According to "Gansu Province Cheng County Urban Planning (2008~2025)" and related technical materials, the estimated net water supply amount in Cheng County was 6.33 million m³ in 2007 and in 2020 it will be 22.54 million m³. In 2007, the available local water sources for urban water supply were Gaofeng Reservoir and underground water with a water supply amount of 3.35 million m³. The annual water storage was 2.98 million m³. In 2020, excluding local water supply, the available water supply sources will be Gaofeng Reservoir, underground water and recycled water usage, among which the underground water and recycled water will be mainly used for the urban ecological environment and industrial needs. According to the available water supply amount of 713 m³ mentioned above, the annual water shortage will be 15.40 million m³. In 2020, the increased water supply amount will be 15. 40 million m³. The water resource supply and demand balance analysis of the reception basin is shown in Table 5-1.

Table **5-1** **Supply and Demand Balance List of the Reception Basin Water Resource**
Unit：10,000 m^3

Target year	Storage capacity							Available water supply				Water shortage
	Daily life	industry	Architecture industry	The third industry	Urban green land	Environmental sanitation	total	Gaofeng Reservoir	Underground water	Recycled water	In total	
2007	362	414	16	43	42	29	633	95	240		335	298
2020	1186	760	30	95	127	54	2254	95	365	253	713	1540

5.3.3.2 Guarantee of Water Intaking Amount during Operation Period

The conral area of this project dam site is 248.2km² which accounts for 16.52% of Cheng County hydrological flow area. The average annual runoff amount is 43.52 million m³ （Q=1.38m^3/s and the runoff depth is 178mm）. Designed annual runoff and flow rate in different frequencies are shown in Table 5-2.

Table**5-2** annual runoff and flow rate in different frequencies

Station name	F（km^2）	Statistic parameter			Design value（m^3/s）				
		Q0（m^3/s）	Cv	Cs/Cv	50%	75%	85%	90%	95%
reservoir	248.2	1.38	0.57	2.0	1.24	0.81	0.63	0.52	0.39
		4352			3920	2550	1970	1640	1220

The distribution results of the annual runoff with 50% and 95% in this project are shown in Table 5-3.

Table **5-3** **Annual Runoff Result List Designed in This Project**

P	Project	Month	Year

(%)		7	8	9	10	11	12	1	2	3	4	5	6	
50	Flow rate (m^3/s)	1.49	3.90	3.58	1.60	0.76	0.49	0.37	0.34	0.40	0.49	0.95	0.44	1.24
	runoff (10,000 m^3)	401	1046	931	429	198	132	98	83	107	127	254	114	3920
95	Flow rate (m^3/s)	0.78	0.33	0.32	0.66	0.41	0.22	0.17	0.15	0.22	0.55	0.49	0.32	0.39
	runoff (10,000	206	88	85	174	108	57	46	39	59	146	130	84	1220

As the annual distribution of South River is not mean, the annual changes are big. Reservoir storage method is used in this project to supplement drought. According to the water input situation in reservoir year, the water input amounts are quite different on the fracture surfaces with various frequencies of South River Moba Gorge dam. P=95% : annual water input amount is 12.20 million m^3； P=90%: annual water input amount is 16.40 million m^3； P=75%: annual water input amount is 2550m^3. Compared with the guarantee rate (95%) provided by the Moba Gorge water supply project to the urban water supply ,they are not good enough. As the desing of water supply project is the water intaking shall be less then natural water input of the reservoir, the reservoir can supplement drought during the alternative appearance of sufficient rainfall and drought, so as to ensure the guarantee rate of 95%.

5.3.4 Prediction and Assessment of Riverway Ecological Water Use

After the Moba reservoir is completed, it can block the water input amount above the dam site on South River (flow area of 248.2km²). When the guarantee rate is 95%, the average annual runoff is 12.20 million m³. use the Tennant Calculation method recommended by “River Area Planning Environment Impact Assessment Specifications” which is take 10% of the average annual flow rate as the minimum ecological water amount. The minimum South River ecological water use amount is 0.138m³/s by this method. The dam operation is designed to allow the minimum flow of 0.138 m³/s to ensure the environmental flow..

5.4 Environmental Geological Impact Assessment

5.4.1 Local Geology and Earthquake

The Moba Gorge water source project dam area and surrounding districts belong to the east-to-west structure of Qinling and the “Shan” profile structure of Wudang Mount which lies on the northwest edge of the Huicheng Basin. The southern and northern sides are composed of a series of SWW~NEE arc drape and breakage. In the Pieistocene of the Quatemary period, this area was involved in the general uplift phase of Tibet Plateau and piled up a Quatemary system deposition with the depth of 10~50m.

New tectonic movement is more active, the main difference in lifting movement is given priority to, especially since the quaternary more prominent, the valley terrace development, in order to develop the periphery of the activity more than fracture. Within the scope of activities in order without sexual fault zone, in a relatively WenDingOu structure. The movement to peak acceleration vibration is 0.20 g, basic seismic fortification intensity for Ⅷ degrees, seismic response spectrum feature period 0.40 s. Recently the activity of the dam site 6 km from the fracture.

5.4.2 Project Geology

5.4.2.1 Engineering Geological Condition of the Reservoir

The Moba Gorge water source project river segment is about 3.2km long. The dam site is on the combination spot of the two rivers on the downsream where is about 200m away. Erlang River flow direction is SN while Yan River flow direction is NE. The two river trends mix in an almost straight line on the head of the reservoir and are called South River after the combination. South River flows through the dam site from northwest to southeast. The whole riverway is smooth and straight with a direction angle of SE150°. South River and its tributary are the minimum discharge base surfaces for the ground surface water and underground water within the reservoir area. The closure conditions of the terrain is good and there's no possibility of leakage from nearby valleys to the reservoir.

Reservoir is a typical valley landscape, topography and steep cliffs on the multi-form, the main reservoir banks to rocky slope, its length accounted for 71.7% of the entire length of the reservoir banks, rock slope is generally stable, stable after storage of little change; Quaternary reservoir bank length 3.8km, accounting for 28.3% of the total length of reservoir banks, bank mostly colluvial soil causes of stone clip, good stability, even after water storage to maintain the current steady state, individual lots of local bank collapse may occur, but the safety of reservoirs and dams do not pose a threat.

According to the survey of reservoir, there's no submerging and mineral resource loss problem existing in the reservoir area. The breakages inside and outside the reservoir and dam is are non-active breakages. The possibility of the reservoir to cause earthquake is few. Even if the earthquake appears, the degree will be small. It won't bring threat to the stability of the reservoir and the its influence on the dam won't exceed the basic earthquake degree in the project area.

5.4.2.2 Dam Site Engineering Geological Conditions and Assessment

The dam site terrain is steep with strong riverway cutting. It forms a view of high mountain and deep valley. The river valley is narrow with exposed bed rock, forming a valley of "U" profile. The elevation of the valley bottom is 1028~1040m. The elevation of the first bank top is 1170~1290m.

The basic rock layer of the project area is simple with a whole unicilnal structure. The quaternary system stratum is complex with various types and each type forms substances piled up there. The exposed stratum is carboniferous system (C2+3) with medium thick layer limestone. The rock property is a medium thick limestone argillite. The shape of medium thick limestone is stable with shape degree of 210°∠40°. The general shape of thin layer limestone is almost the same with medium thick layer but with distinct changes between.195°～220°∠15°～65°. The quaternary system is mainly composed of fragment or mud with thickness of about 10~20m.

Dam site is from regional faults, but the development of three small faults, fractures are less developed. The right bank of the lower part of the development of two thin limestone crushing sandwich (J1, J2), flat slope along the distribution, roughly along the downstream layer gradually decreased. Poor engineering properties J1, J2 relatively good engineering properties.

5.4.2.3 Engineering Geological Conditions and Assessment of Water Pipelines

Use open cut combined with tunnel cutting method for the dam site section along the arrangement of South River right bank and gets out of the tunnel on the Moba Gorge exit. The pipeline then goes downwards to the village road near the river side and goes along the road, gets through South River nearby the KZ2 control point and reaches the left bank. It ends on the gentle land on the northern side of Pb Zn Production Factory in Cheng Zhou of Paosha Town. The pipeline is mainly along the quaternary system piling structure steep landform. The general condition is stable. While starting to dig the pipeline, part of the slope structure may be flexible and immediate measures shall be taken for protection in order to prevent affecting the stability of the slope. With the precondition of meeting the requirements of design, try to avoid digging the slope body as much as possible.

5.5 Air Environment Impact Assessment

5.5.1 Air Environment Impact Assessment during Construction Period

The main sources of the air pollution during construction period are: dust from dirt mixing, cubic earth and stone digging, backfilling, material transportation and assemble & unassessmble; waste gas from various mechanic constructions and transportation vehicles.

5.5.1.1 Construction Dust Impact Analysis

The construction dust is mainly consisted of vehicle dust, natural wind dust, ground construction material piling dust and construction work dust.

(1) raised dust from transportation vehicles
Transportation vehicles for the entire construction period in terms of dust, construction dust generated mainly in the civil construction phase. From the dust by the wind can be divided into the reasons and motivation from the dust from the dust, which was mainly due to dust and wind from open dumping of building materials (such as sand, cement, etc.) and surface dust exposed construction area dry and windy weather, resulting in dust; and power from the dust, mainly in materials handling, mixing process, due to external forces arising from dust caused by resuspension, construction and loading and unloading of vehicles which caused the most severe dust. According to the literature description, vehicle dust generated 60% of the total dust.

According to survey, as there're many trucks with 10-ton load capacity during the construction period, the calculation formula for the dust produced by the vehicle in absolute dry condition is:

$$Q = 0.123(V/5)(W/6.8)^{0.85}(P/0.5)^{0.75}$$

Q——vehicle dust，Kg/km·per truck；

V——driving speed，Km/hr；

W——vehicle load，ton；

P——dust amount on the ground surface，kg/m^2。

Table 5-4 Vehicle dust in various speeds and ground cleanness degrees unit: kg/ truck·km

dust level / vehicle speed	Ground cleanness degree（kg/m^2）					
	0.1	0.2	0.3	0.4	0.5	1.0
5（km/h）	0.05	0.09	0.12	0.14	0.17	0.29
10（km/h）	0.10	0.17	0.23	0.29	0.34	0.57
15（km/h）	0.15	0.26	0.35	0.43	0.51	0.86
25（km/h）	0.26	0.43	0.58	0.72	0.85	1.44

Table 5-4 is dust amount produce by a 10-ton truck passing a pavement of 1km long with various ground cleanness degrees and different speeds. From the table we can see the under the same ground cleanness degree, the faster the speed, the bigger amount of dust; with the condition of same speed, the dirtier the ground, the bigger the amount of dust. Therefore, we can take measures of limiting the speed and keep the ground clean to reduce the impact of vehicle dust on the environment.

（2） wind dust: during the construction period, the piled construction materials (grit, cement),

exposed construction floating mud and cubic earth and stones piled on the road will bring dust in windy days. The dust amount can be calculated by the following formula:

$$Q = 2.1(V_{50} - V_0)^3 e^{-1.023W}$$

Q ——dust amount，kg/t.a；

V_{50} ——wind speed 50m away from the ground，m/s；

V_0——dust wind speed，m/s；

W ——dust particle moisture content，%。

From the above we can see the dust amount is related to V0, particle diameter and moisture content. The higher moisture content, the bigger dust amount with high wind speed. Dust can affect people's health in affected area. It can cause respiratory disease. However, with the completion of the construction, the impact will disappear.

（3）dust from construction process

Dust generated during construction dust generated during construction and the main source of dry rock drill and blasting, dry rock drill rock dust generation of 4.8g / s, dust explosion is the generation of 25g/m^3. The main part of the dust hazard during tunnel construction, the construction environment is closed, a large concentration of dust, likely to cause respiratory diseases. In need of intermittent construction, and pay attention to ventilation, construction workers must wear a mouth for added protection.

5.5.1.2 Construction Waste gas Impact Analysis

Construction process, construction machinery and transport vehicles have fuel emissions, the main components are CO, NOx and THC. The project total consumption of fuel for the 1663.4t, the pollutant emissions: CO148.1t, NOX95.78t, THC27.5t. Low mechanical exhaust discharge of fuel, is a low point source emissions of disorder, the main source of emissions 100m range. Construction of this project is no environmentally sensitive area 100m point, the main impact of the works area. Transport vehicle during the transport process, along with less environmental impact on the exhaust.

5.5.2 Environment Air Impact Analysis during Construction Period

During the construction period, the heating method in the engineering management station

is electric heating without boiler. So there's no pollution to the air.

5.6 Prediction and Assessment of Acoustic Environment Impact

The noise impact of this project mainly comes from the construction period with little impact on the environment.

5.6.1 Prediction and Assessment of Acoustic Environment Impact During Construction Period

The mechanic equipments used in the construction of this project are mainly jackdrill, soil shifter, excvavtor, blender and drilling machine. If there's no measure taken to the noise source, it will have influence on the surrounding environment. The acoustic pressure levels are shown in Table 5-5.

Table 5-5 Acoustic Test Values and Range of Construction Mechanical Equipment
unit：dB（A）

No.	Construction equipment	Distance to the measurement spot /m	Maximum noise level/dB

1	jackdrill	5	100
2	Soil shifter	5	86
3	excvavtor	5	84
4	blender	5	87
5	Drilling machine	5	95

5.6.2 Noise Prediction during Construction Period

During the construction period of this project, the equipment work needs time and there's a working interval during the mechanical equipment operation. So the noise source strength is point acoustic source and the noise attenuation formula is as follows:

$$L_A = L_0 - 20\log(\frac{r}{r_0})$$

LA——construction noise measurement value *r* m away from the acoustic sourcedB(A)；

L0——construction noise prediction measurement value away from the acoustic source dB(A)。

The prediction results are shown in Table 5-6.

Table 5-6 prediction values of the construction mechanical environment noise impact

Acoustic leveldB(A) / Construction mechanism	distance(m)							Standard valuedB(A)		Qualified distance(m)	
	10	20	40	60	80	100	150	daytime	night	daytime	night
Jackdrill	94.0	88.0	82	76.4	74.0	72.0	70.5	75	55	75	1250
Soil shifter	81.0	75.0	69.0	65.4	63.0	61.0	57.5	75	55	35	170
excvavtor	80.0	74.0	68.0	64.4	62.0	60.0	56.5	75	55	18	177
Blender	78.0	72.0	66.0	62.4	60.0	58.0	54.5	70	55	24	140
Drilling machine	89.0	83.0	77.0	71.4	69.0	67.0	63.5	75	55	50	200

5.6.3 Construction Noise Environment Impact Assessment

（1）If you use a single construction machinery, daytime than 75m away from the construction site can be reached GB12523-90 "construction site boundary noise limit", overnight in the 1250m can be achieved outside the standard limits. But in the actual construction process, often using a variety of machinery at the same time, the scope of its noise impact will be greater.

(2) from the construction site in the world average of about 5-35m range, the construction noise greater impact on the surrounding acoustic environment;

(3) With the completion of the project, construction noise will no longer exist, the construction noise, adverse environmental impact is temporary, short-term behavior.

(4) due to the construction site, the horse Linjiaya construction site away from the horse Linjiaya 400m, a small village construction site area from a small village 650, nighttime construction will have

on its significant impact, it should be banned high-noise construction machinery (such as drilling machines and rigs) at night time. In addition, the response to site work and construction site well protected.

5.7 Solid Waste Environment Impact Assessment

5.7.1 Solid Waste Environment Impact Assessment during Construction Period

5.7.1.1 Construction Garbage and Vegetation Cleaning

Refer to “Yangtze River Three Gorge Reservoir Bottom Solid Waste Cleaning Technical Specification” and the requirements of water source protection, this project needs to clean the submerged vegetation and construction garbage. Part of the leaned vegetation can be planted again. Random piling will not only affect the environment, but also brings resource waste. It’s suggested that the recoverable plantings shall be given to the farmers nearby. Vegetation that can not be planted any more shall be sent to the county garbage yard for landfill. The discharged construction garbage shall sent to the residue discharge yard set for this project.

There’ll be 460,730 m³ of permanent abandoned residue during the construction of this project. They shall all be piled in the appointed residue discharge yard. Take soil and water reservation measures in the residue discharge yard and it wont’ affect the environment.

5.7.1.2 Construction Staffs’ Domestic Waste

The random piling of large-scale domestic garbage will not only pollute the environment, but also bring mosquito and the human health will be harmed.

5.7.2Solid Waste Environment Impact Assessment during Operation Period

After the project is completed, the management station staffs shall collect the produced domestic garbage. The random piling of large-scale domestic garbage will not only pollute the environment, but also bring mosquito and the human health will be harmed.

5.8 Impact on Human Health

5.8.1Impact on Human Health during Construction Period

The construction staffs of this project come from various places. Staffs from other provinces and local staffs form a united working community and frequently contact each other while working. As the crowd structure is complex with various living customs and health conditions, they have different immunity abilities. There may exist various pathogeny carriers which increases the danger of susceptibility. Therefore, it’s very important to make good sanitation prevention work. If not, contagious diseases (alimentary canal, respiratory tract, entomoplily) may be brought and cause cross infection which will do lots of harm to the crowd health.

5.8.2 Impact on human health during operation period

Because this project form the valley is "U" shape of the main valley, the two sides more symmetrical mountain, river deep, river bed exposed bedrock, large gap, there is a large submerged low-lying land is not flat, long Tong marsh plants and so on, so the flood run-time this project will not cause the transfer of Anopheles and malaria disease transmission.

5.9 Social Economic Impact Assessment

Cheng County Moba Gorge dam is into the gorge after the implementation of water supply projects have a high social benefits, the project will address as county residents living water, and to ensure the health of local residents has important significance. The project of socio-economic impact of construction are shown in the following areas:

5.9.1 Sufficient Use of Water Resource

After Moba Gorge dam water supply project is completed, construction can increase the basis of

social development Cheng County, not only solve about 10 million people in urban water demand, Cheng County to protect the health of residents, and this project will also take into account the irrigation water around the reservoir area, increase agricultural productivity. In short, the construction of this project can make full use of water resources.

5.9.2 Promoting the Development of Local Economy

Cheng County Moba dum water supply project will ensure water hundred factories and enterprises, will promote the development of local businesses, increase local incomes, and promote Cheng County's social and economic development.

5.9.3 Improvement of the Investment Environment

The completion of Moba Gorge water supply project can make better investment environment, build local government image, solve local water supply problem, help to attract investors for sustainable development, increase social employment opportunities and promote a new growth of county economy.

5.10 Landscape Environment Impact Assessment

5.10.1 Landscape Impact Assessment during Construction Period

Moba Gorge water supply project during the construction period is mainly earthwork and construction of access roads and the destruction of vegetation during construction dust generated by the impact on the landscape. Although the process has a certain impact on the landscape, with the end of construction, good land preparation, revegetation measures, followed by elimination of the impact on the landscape.

5.10.2 Landscape Impact Assessment during Operation Period

The project is located to the west of the county town 11km, from Paosha Town 6km, in the South River basin downstream, far from the area, not leading to the scenic tourist route, and the visual impact is very small.

5.11 Ecological Environment Impact Assessment

5.11.1 Terrestrial Plant Impact Assessment

The project covers an area permanently in occupation of forest land for the 57.91hm^2, use of farmland for the 15.33hm^2, according to county statistics, the annual output per hectare of forest land to local 3200kg, the annual output per hectare of arable land 2746.83kg, project covers an area of the local loss of biomass to 234.37t / a, detailed in Table 5-7.

Table 5-7 Biological Amount Loss Caused by Construction Land Coverage List

type	Area （hm^2）	Biological amount loss（t/a）
vegetation	57.91	185.31
farmland	15.33	49.06
total	73.24	234.37

South River Moba Gorge dum is above the gorge section of the drainage area 248.2km, arable land 3133.3hm^2, forest area 17133.3hm^2, grassland 1800hm^2, vegetation coverage area up to 69%. See Figure 5-1 for the county soil and vegetation maps.

Although this project will have some impact on the local plants, but plants affect the whole region within an acceptable range (less than 0.3% of surface vegeation coverage). These plants are mostly secondary plants and bushes, all are common species. There are no valuable and specially protected spices in the area. The loss of biomass will partially be recovered through extensive

reclamation plan on the borrow area, disposal sites and disturbed areas.

Compared to the original program of biological loss 163.38t / a, because this program area increases, the amount of biological damage increased 70.99t / a, impact on the environment has increased, but less due to increased volume and quality of ecological environment in the region better to increase the amount of little effect.

5.11.2 Terrestrial Animal Impact Assessment

5.11.2.1 Terrestrial Animal Impact Assessment during Construction Period

During the construction of the project construction, engineering and construction activities affect an area of habitat for wildlife in the project area, mainly with some of the common agricultural and scrub with a small reptiles, mammals and birds, such as snakes, rats, frogs. There are protected species in the project area. The construction process, the habitat of these animals have some damage or disturbance, but their distribution throughout the region and the number was less affected.

(1) influence on mammalian species

The impact of construction on the mammals mammal activity on the interference, mainly in the hub, plant, tunnel construction area, and its effects on mammals are:

① construction workers of the construction activities on mammal habitat also cause interference, making the beasts move it to another place;

② construction machinery noise on the mammals of driving, it makes the beast fled at the shock;

③ construction, food debris left behind by human activity and garbage will attract rodents (mice) in the construction area to gather. These effects will make some mammals migrate it to another place, away from the works area.

The overall result is within the scope of the project area and number of species of mammals during the construction period may be reduced in the short term. As mammals through migration to avoid causing harm to the construction project, the project of construction of the mammals the total direct impact on us. With the end of construction activities, construction site and nearby restoration of natural ecological environment, animals will return to the original project area activities, and therefore the long-term project impact on the small mammals are minimum.

（2）Impact on Bird

① activities of construction workers living habitat for bird habitat and damage can also cause interference, making it at the bird migration;

② construction machinery noise, blasting and other birds of driving, making it at the bird frightened to flee;

③ construction, food debris left behind by human activity and garbage will attract birds with human habitation in the construction area is relatively concentrated;

④If the construction of the birds will be a direct result of the breeding season of birds nest eggs and fledglings of death

There are no protected bird species in the project area. All the birds are common species in the region. Construction activities will cause disturbance of habitat. These effects, the results will enable the majority of bird species migrate it to nearby place, away from the works area; small part to forest-dwelling bird habitat and shrubs as habitat loss and the disappearance from the project; part of the bird populations as nest destruction is reduced, especially when the construction period is when the bird breeding season (summer). The overall result is within the scope of the project area

and number of species of birds will be reduced. Since most birds can fly and the short distance through the migration to avoid causing harm to the project construction, project construction and therefore have little effect on birds. The main impact is indirect because the construction of the interference will make their food such as rodents in the project area to reduce, thereby forcing them in a larger range of prey. With the end of construction activities, the line near the construction site and the restoration of natural ecological environment, the activities of birds in the project area will return to the project area activities, and therefore the long-term projects have little effect on birds.

5.11.2.2 Terrestrial Animal Impact during Operation Period

During operation period, the project is completed to ensure the ecological water discharged cases, the local animal does not have a significant impact. Wildlife at the reservoir will store water for the project to reduce its habitat, some species may have an impact, but this effect is temporary, after a period of time will form a new habitat for local wildlife fauna within an acceptable range.

5.11.3 Assessment of Impact on Fish Resource

According to the “Impact Assessment of Current Situation Monitoring and Assessment Report of Aquatic Animal in Moba Gorge Water Source Project in Gansu Province” provided by Gansu Fengyuan Ecological Biomass System Consult Center, conduct assessment of the impact on river section aquatic animals caused by the project.

The formation of water reservoir will create a much larger habitat for aquatic life, compared to the original mountain creek, thus creates provide positive enhancement of natural habitat for the Nanhe River. The reservoir will provide favourable conditions for plankton and fish species, and increase the biodiversity of the river.

5.11.3.1Biological Features of the 8 Aboriginal Fish Species Locating the Influenced River Segment

The river diversion works only distributed in eight species of fish, and there are no national protected species and any species included in the "Endangered Species of Wild Fauna and Flora International Trade Convention," Appendix I, Appendix II species. Two species are local provincial-level protected Jialing bare crack rump fish, re-port Schizothorax the same time, Jialing Schizopygopsis rump fish, re-port is Schizothorax river has a high economic value of the indigenous fish.

(1) Schizo pygopsis kialingensis Tsao et Tun

Local name：Mian Yu

Taxonomic Status：Cypriniformes, Cyprinidae, subfamily Schizothorax, naked fish split Tajiri

Geographic distribution：seen on the upstream of Jialing River, Yellow River and its main

Tributaries Yao River and the upstream of Wei River within the Gansu Province.

Main characters：Dorsal fin ii-iii, 8; anal fin ii-iii, 5; pectoral i ,14-19; pelvic fins i ,8-9; gill rakers 7-9; 2 rows of pharyngeal teeth 2.4/4.2 or 3.4/4.3; 1 gill arch gill rakers; outer 8-14, inner 13-19; spine 4 +46.

Body length is 4.2-6.9 times higher for head length 3.7-4.8 times as long caudal peduncle 5.4-6.5 times higher for the caudal peduncle 11.1-13.9 times; head length to snout length of 2.7-3.6 times the eye diameter of 3.0-6.3 times the distance of 2.7-3.8 times for the eye; caudal peduncle length of caudal peduncle 1.9-2.4 times higher. Total body length from the front dorsal fin of 48.1-52.2%.

Body is a long and slightly flat side. Blunt conical head, kiss a little circle. Lateral eye. Curved crack mouth, the next bit. Leading edge skin weak jaw. Mouth to be gaps. Lower lip thin, lip sulcus interrupted. Exposed body parts without scales only have 3-5 lines in the strap irregular scales. 16-24 pieces of hip scales on each side, the front ranks of pelvic fin base. Lateral line complete, slightly

bending toward the ventral anterior, middle back stretch caudal peduncle. Dorsal fin spines weak; dorsal fin from snout to caudal peduncle slightly smaller than the distance from the end. Starting point and the first dorsal fin branched rays 2-3 root relative. Ministry of anal fin than to point to the end of the caudal peduncle distance. Anal fin starting near the anus.

Swallow bone is narrow. Columnar thin pharyngeal teeth, top slightly curved, spoon-shaped chewing surface. Gill rakers short, the end bent inward. Bladder 2 rooms, room after room longer than before. Intestinal longer. Peritoneum black.

Dorsal dark brown, abdomen white; back, chest, abdomen, anal fin light gray; caudal fin slightly stained yellow-green or gray-green. Larger individuals have a few blocks back and lateral dark spots.

Habits and diet: more water habitat in the river bed gravel, activities in the water is clear and cold waters, particularly by water erosion and on the turf of the undercurrent of much of the skin developed by jaw scraping algae for food in the market, also eat aquatic vascular plants and debris, and aquatic insects fall into the water Lusheng Kun, spawning in the stones, with a slightly sticky sinking eggs.

(2) Schizothorax davidi (Sauvage)

Local name：Zhong Kou, Zhong Kou Thin Lin Yu (Wen County, Wu County)

Taxonomic Status：Cypriniformes, Cyprinidae, subfamily Schizothorax, Schizothorax

Geographic distribution：Bailong River, Baishui River, West Han River, Jialing River

Main characters: dorsal fin iii, 8 anal fin ii, 5 pectoral i, 18 ventral fin i,10.

Scale formula : $98\frac{17-19}{14-16-\nu}99$; ; 2 rows of pharyngeal teeth; 2.3.5/5.3.2; the first gill arch gill rakers: 15-17 outside, inside is 22-25; spine number 4 +42.

Length of body height is 3.7-4.0 times of the head length of 4.6-4.7 times the length of caudal peduncle 6.4-6.6 times; high caudal peduncle of 8.8-9.0 times; head length 2.5-2.9 times as long kiss, the eye diameter of 4.1-5.8 times the distance of 2.7-2.9 times for the eye; caudal peduncle length of caudal peduncle 1.3-1.4 times higher. Total body length from the front dorsal fin of 52.5-54.5%.

Long and slightly flat side of the body, head blunt cone. Mouth inferior, curved. Less horny jaws. Lower lip more developed, sub clover, small middle, left and right sides of leaves are wider, lip sulcus continuous. Be two pairs of eyes before they can stretch the leading edge of the end of the middle or the bottom of the eye; stretch after the end of the orbit to be below the posterior edge of gill cover bone or front. Small scales, arranged in neat rows, shoulder area, on both sides of a large anal fin and the anal scales, gills Gap from the chest after a significant scale. Lateral line complete. Dorsal fin spines developed, 8-12 on each side near the base of jagged pieces; dorsal fin to the snout than to caudal fin base distance. Dorsal fin beginning with the first one usually branched rays relative.

Swallow bone is narrow and curved. Pharyngeal teeth slender with sharp curved end, leaving spoon-shaped chew. Bladder 2 rooms, room after room of length 2 times before. Intestine short. Peritoneum black.

Dorsal is gray, silver-white belly, the back part of the smaller individual small black spots. Caudal fin pale is red.

Life habits and eating patterns：Cold water fish, often living in the fast-flowing river gravel substrate bending zone with a short distance migration. Settle down swimming underwater in a river or pit

caves in the winter. August-September breeding, the breeding season the male head of a white pearl stars, testis white or black, is a long strip of opaque; the female egg is orange yellow, dispersed in water to more abrupt discharge of gravel heap. Eat aquatic insects and their larvae, also eat small fish and algae fixation.

（3）Gnathopogon imberbis

Short Ju jaw is Cypriniformes Cyprinidae fish, found in the province's two when the Jialing River, Hui County, Cheng County, Kang County and other places, the locals also known as hemp idea fish. Habitat in the canyon streams, crystal clear slow flow of the river, tributaries, river bend, etc.. Benthic, aquatic insects, the staple food, but also eat aquatic algae and higher plants. June breeding. Small fish, meat, edible, but no major economic value.

（4）Pseudorasboraparva

Pseudorasboraparva are Cypriniformes Cyprinidae fish, widely distributed in the province, also known as wheat sub fish. Generally inhabit still water or slow flow of water than plants. Generally an old fish to sexual maturity, producing sticky eggs. Food for zooplankton rotifers, copepods, Cladocera, followed by the algae and grass, and drinking water hygiene Insect larvae. Small fish, meat, edible little value.

（5）Schizothorax(schizothorax)sinensis

Local name：Thin Lin Yu

Taxonomic Status：Cypriniformes, Cyprinidae, subfamily Schizothorax, Schizothorax

Geographic distribution：Bailong River, Wu County , Die County and Wen County of

Baishui River

Main characters: dorsal fin iii, 8 anal fin ii, 5 pectoral i, 17; ventral fin i, 9.

Scale formula：

$$102\frac{19}{12-13}104;$$

Pharyngeal teeth 2.3.5/5.3.2; the first gill arch gill rakers: 13-16 outside, inside is 18-19; the number of vertebrae 4 +43-45.

Length of body height is 3.9-4.4 times the head length of 3.6-3.9 times the length of caudal peduncle 6.2-6.9 times; caudal peduncle depth is 8.1-10.4 times higher; head length 2.5-3.0 times as long kiss, the eye diameter of 3.4-4.2 times the distance of 2.4-3.3 times for the eye; caudal peduncle length of caudal peduncle 1.3-1.6 times higher for the former to be 3.5 times longer. Total body length from the front dorsal fin of 51.0-56.4%.

Long and slightly flat side of the body, head blunt cone. Mouth inferior, transverse cracking, curved. Upper side of the eye. Lower jaw with sharp leading edge of the skin. Lower lip like a crescent, the surface of a small mastoid, lip sulcus continuous. Be two pairs of long, before they can reach or exceed the end of the lower middle of the eye; stretch after the end of the orbit to be below or until after the front edge of the gill cover bone edge. Lateral line complete, slightly curved front, back along the central axis of the body until the tail base. Small scales, since the chest after the isthmus was sweetlips. Dorsal fin spines thin, there are five teeth near base; dorsal fin to the snout than to tail end of the distance. Dorsal fin beginning at the starting point of the rear. Starting point in the anal fin to caudal fin base distance of the midpoint. Anal fin starting near the anus.

Pharyngeal bones narrow arc. Pharyngeal teeth small column length, the top tip and slightly curved, spoon-shaped chewing surface. Bladder 2 room after room 2 times long before the room. Intestine short. Peritoneum black. Dorsal dark gray or blue gray; abdomen gray or silver white; the back above the lateral line there are a lot of black dots. Caudal fin stained red, the rest of the fins gray.

Habits and diet: live on the upper reaches of the river canyon, the river water temperature is lower. Often into the water upstream against the current group. Omnivorous.

（6）Glyphothorax sinense(Regan)

Glyphothorax sinense in the province of the text is found in the Yangtze River County, Wudu, Cheng County, Hui County, Kang County and other places. Small benthic fish, living in shallow rapids and more gravel, chest wrinkles and flattened by the dual fins, wide and flat head attached to the rocks. Staple Diptera, Ephemeroptera, Odonata and other insects, larvae and Daphnia class. May-June breeding.

Loach and carp is a widely distributed species, their habits are in the second part with no introduction.

5.11.3.2 Impact Prediction on Provincial Protected Animals

Re-port is Schizothorax cold water fish, often living in the fast-flowing river gravel substrate bending zone, to a short distance migration. Settle down swimming underwater in a river or pit tunnels in the winter. August-September breeding, the breeding season the male head of a white pearl stars, testis white or black, is a long strip of opaque; the female egg is orange yellow, dispersed in water to more abrupt discharge of gravel heap. Eat aquatic insects and their larvae, also eat small fish and algae fixation. The completion of the dam, the formation of large surface, blocking their migratory routes, wintering their migratory disadvantage certain of its role in promoting feeding, changing its habitat water velocity, negative propagation; running water diversion project, lead away part of the water flow, resulting in reduced water flow downstream of the dam, watershed area is reduced, the survival of aquatic organisms to reduce its feeding, habitat, etc. have some adverse effects. However, because of its tributaries upstream of the river Jiro import, create the conditions for their winter migration, it spawning in the estuary also created certain conditions, it reduces its migratory and wintering of adverse effects.

Jialing Schizopygopsis rump medium-sized fish is as cold water fish habitat in the water than gravel bed, activities and water clarification and colder waters, especially by water erosion and on the turf of the undercurrent of much of the skin by the lower jaw in stone developed surface scraping algae for food, but also eat submerged plant debris, leaves of aquatic vascular plants, aquatic insects, and fall into the water Lusheng Kun. July and August each year breeding, mature orange eggs, about 3 mm in diameter, slightly viscous, produced in the crevice. Breeding male in the head, body back, back, anal beads on a white star. The construction of water diversion project, not to play short, the

formation of large surface, their habitat, breeding unfavorable, little effect on their feeding and overwintering. Operation of water diversion project, cited some of the water flow away, leading to reduced water flow downstream of the dam, watershed area is reduced, the survival of aquatic organisms to reduce its feeding, habitat, etc. have some adverse effects. However, because of its tributaries upstream of the river Jiro import, create the conditions for their winter migration, it spawning in the estuary also created certain conditions, it reduces its migratory and wintering of adverse effects.

5.11.3.3 Prediction of Impact on Cobitidae Fish Species

The segmental distribution of the Cobitidae fish only loach, according to the species of fish living habits, the construction of water diversion project, as long as the ecological discharged to maintain normal traffic, its impact is negligible.

5.11.3.4 Prediction of Impact on Other Cyprinid Fish Species

The segmental distribution of the six cyprinid fish, fish of the subfamily Schizothorax impact analysis has been done before. Other according to their habits, as long as the flow rate to maintain normal ecological discharged, their feeding, wintering there are some positive effect, little effect on other living habits.

5.11.3.5 Prediction of Impact on Glyphothorax sinense

Glyphothorax sinense lives in shallow rapids and more gravel, chest wrinkles and flattened by the dual fins, wide and flat head attached to the rocks. Staple Diptera, Ephemeroptera, Odonata and other insects, larvae and Daphnia class. May-June breeding. Diversion project up and running, the completion of the dam, its habitat, breeding disadvantage; as long as the discharged flow to maintain normal and its impact is negligible.

5.11.3.6 Prediction of Impact on Fish “Three-Yard”

The river segments which are influenced by this project are the tributary——Erlang River which is the breeding migration area and spawning ground for Schizothoracinae . There’s no other “Three-Yar” distribution for other species. With the completion of this project, the location of the spawning ground for Schizonthoracinae shall be changed in short time. As the living environment is same with that on the upstream, it’s easy for Schizothoracinae to find a new spawning ground to spend the winter and breed. When the species finds a new breeding area, this project will have no impact on it. With the precondition of ensuring the water discharge amount, no impact will be brought on the winter spending and breeding of the Schizothoracinae on the downstream.

5.11.3.7 Impact on the Exchange of Fish Species Materials

The completion of this project, the same species of fish diversion dam was divided into two populations of dam and dam, which is almost the natural exchange between the two populations of genes, over time, will result in inbreeding, decreased genetic quality of fish for fish germplasm exchange have some negative impact.

5.11.4 Prediction Assessment of Impact on Plankton

Plankton includes phytoplankton and zooplankton. By phytoplankton algae, bacteria and plants are composed of bacteria and algae, all living organisms is water consumption and an important source of production, which is the most important primary producers algae. Algae are a group with the chlorophyll and other photosynthetic pigments, can be low self-support plant photosynthesis, to make use of solar energy, water, carbon dioxide and dissolved nitrogen, phosphorus and other nutrients for the synthesis of organic matter and release oxygen in the water circulation plays an important role. Excessive proliferation of algae can cause eutrophication, deterioration of water quality, water produced smell and toxicity, thus losing the value of water use.

After the dam is completed, the formation of a water body of water flooded large tracts of land and vegetation, due to flooded soil leaching of nutrients, decomposition of flooded plants provide organic

matter, coupled with the erosion of the role of surface runoff for the growth of algae provide a lot of nutrients. After building a database and because the flow has slowed, more transparent, more conducive to algae growth, promote algal blooms. However, phytoplankton blooms, causing decreased water transparency, which in turn changes the conditions of optical radiation in water, through a period of time, the phytoplankton in the reservoir stabilized, the number to reach a new dynamic equilibrium of algae.

Reservoir zooplankton mainly rotifers, cladocerans and copepods. Zooplankton standing stock and production level is the impact on algae, bacteria and other microorganisms existing volume, an important factor in production, is another water reservoir of biological resources. Reservoir geographical location, climate, water temperature and water level changes on reservoir zooplankton is closely related to reproduction.

5.11.5 Prediction Assessment of the Impact on Bottom Fauna

The initial project is completed, dams upstream sediment deposition, surface expansion, zooplankton species, the number of individuals and biomass increase or increases, for the benthic animals provide a good growing environment and food sources of benthic organisms volume and density are increased, as many indigenous fish provide a rich food source; but over time, sludge thickening layer, destruction of benthic habitat on the growth and reproduction of benthic have some negative impact. Dam downstream to maintain the normal ecology, such as the discharged volume of benthic animals almost has no adverse effect.

5.11.6 Impact Assessment of the Whole Ecological Environment

5.11.6.1 Ecological Environment Assessment before Construction

According to the existing data and the actual survey on the local spot, the assessment range of Cheng County Moba Gorge water supply project is 1200hm². According to the regulated calculation methods in “Ecological Environment Situation Assessment Technical Specification (trial version)” (HJ/T192-2006) with the ecological environment quality current situation assessment by Shen Weimin and Qian Zhen, and the ecological environment quality assessment study by Zheng Shujuan, combined with satellite remote sensing materials, the ecological quality index of the project area EI=61.89 which belongs to good ecological environment quality assessment level. See more in Table 5-8. Related parameters can be found in Table 5-9.

Table 5-8 Ecological Environment Assessment List before Construction

Type	Biological abundance index	Vegetation coverage index	Water system density index	Land degradation index	Environment quality index	EI
Prediction result	86.6	78.8	40.41	7	100	61.89

Table 5-9 Ecological Environment Assessment Parameter Value List before Construction

Item	unit	value
Vegetation area	hm^2	891.8
Farmland area	hm^2	223
water wet land area	hm^2	40.6
Uncultivated land area	hm^2	44.6
Mild erosion area	hm^2	1200
Moderate erosion area	hm^2	0

Serious erosion area	hm^2	0
River length within the yard	km	6.3
Reservoir area within the yard	hm^2	0
Water resource amount within the yard	m^3	744
Discharge amount of SO2	t/a	0
Discharge amount of COD	t/a	0.32
Discharge amount of solid waste	t/a	46.7

5.11.6.1 Ecological Environment Assessment after Construction

After the completion of this project the ecological quality index EI = 61.69, which is good eco-environment quality evaluation; | △ EI | = 0.2 <2, indicating that the environmental quality before and after the construction was no significant change, the values shown in Table 5-10, parameters values after the construction are shown in Table 5-11.

Table 5-10 Ecological Environment Assessment List after Construction

Type	Biological abundance	Vegetation coverage index	Water system density index	Land degradation	Environment quality index	EI
Prediction result	87.8	75.1	41.61	7	100	61.69

table 5-11 Ecological Environment Assessment Parameter Value List after Construction

Item	Unit	Value
Vegetation area	hm^2	849.2
Farmland area	hm^2	211.21
water wet land area	hm^2	96.44
Uncultivated land area	hm^2	28.74
Mild erosion area	hm^2	1200
Moderate erosion area	hm^2	0
Serious erosion area	hm^2	0
River length within the yard	km	6.3
Reservoir area within the yard	hm^2	0
Water resource amount within the yard	m^3	744
Discharge amount of SO2	t/a	0
Discharge amount of COD	t/a	0.05
Discharge amount of solid waste	t/a	7.3

Overall, the proposed project does not involve any critical natural habitats, and will not result in significant degradation/conversion of natural habitats in the project area. Further more, the reservoir will create a much larger water body compared to the original mountain creek, which will provide a valuable aquatic habitat for plankton, benthonic life and certain fish species.

5.12 Reservoir Migration Impact Assessment

5.12.1 Migration Compensation Measure Assessment

5.12.1.1 Migrant Production Life Situation

According Cheng County “County Economic Manual in 2007”: the total land area of Cheng County was 1676.54km² among which farm land area was 411,900 acres, vegetation area was 1.1865 million acres and natural grassland was 155,000 acres. There were 12 towns, 15 villages and 245 administrative village with a total population of 265,200 people among which there were 218,000 farmers in the county. The project benefit district contains 3 towns and 38 administrative villages with a total population of 103,000.

In 2007, the economic income of Cheng County was 2.896 billion Yuan, among which the first industry increase value reached 0.479 billion Yuan, the second industry increase value reached 1.731 billion Yuan, the third industry increase value reached 0.685 billion Yuan, the financial income reached 0.552 billion Yuan and farmer’s net income reached 2320 Yuan.

According to the construction area in “Rural Society Economic Statistic Annual Report in 2009” of Chenyuan Town Longmen Village, Wudang Village, Shaba Town Niurao Village, Yanshsan Village, Paosha Town Moba Village, Lelou Village and Zhuanwan Village which are administrative villages: the average farm land per farmer of the 3 countries and 7 villages in 2009 were: 2.58 acres, 2.53 acres, 1.75 acres, 1.99 acres, 1.92 acres, 1.10 acres and 0.603 acres respectively; the farmer’s net incomes were: 1300 Yuan , 880 Yuan, 1254 Yuan, 1364 Yuan, 1417 Yuan, 1156 Yuan and 960 Yuan respectively; the average crop productions per farmer were:700kg, 511kg, 565kg, 682kg, 500kg, 603kg and 460kg respectively.

According to on-the-spot survey, the average living area of each villager involved in the construction area is 34.11m³/person and the average construction land area is 115㎡/person. The ratio of soil and wood (brick soil wood) structure houses accounts for 100% of the total housing area.

5.12.1.2 Prediction of Migtrant’s Income

Crop income: average crop amount for one person is 800kg or equals to the cash income of the crop value with same quantity.

Net income level: according to the planning standards, farmer’s net income shall be 4475 Yuan, which is obviously higher than the prediction of 3 farmers’ net income in 2015.

5.12.1.3 Prediction of Migrant’s Living Standards

（1）Land scale

According to the migrant moving planning standards, the construction land scale per migrant shall be: average housing land area: 200㎡ and other construction land area shall be 100㎡ which can meet the requirements of migrant arrangement planning goal.

（2）Domestic Electricity Use

According to the migrant moving arrangement planning standards, the average electricity per family shall be calculated by 2kw/house. During the electricity supply project planning, combined with the transfer specifications, the designed electricity load shall be a little more than the need, which means the electricity supply design shall be able to meet the requirements of migrant arrangement planning goal.

（3）Domestic Water Use

According to the migrant moving arrangement planning standards, the target water use for migrant

and animals is 80L/person. d which can reach the requirement of migration life.

From the living standards before and after the migration, it's easy for us to see that all the major indexes have met or exceeded the target goals which means the migration compensation measures accord with the principle of "ensure that the migrants are able to move and can live happily later" and the measure are reasonable and feasible.

5.12.2 Migration Arrangement Destination Assessment

The project resettlement points in the hospital Cheng County town of White Horse Chen Teramura, into the village from the county town of 6km, the village eight cooperatives, the existing residents of 391, population 1,600, the village a total of 2,800 acres of arable land per capita net income of 2200 million / year. Village from the nearest road about 0.5km, and convenient transportation. From the post office, shops, schools, kindergartens, theaters and other medical point and about 1km. Produced agricultural products are wheat, corn, soybeans, canola and tobacco and so on. Planning of agricultural settlements in the former school converted into a housing 20, an area of 13.5 acres and 76 acres of experimental fields on campus, the irrigation project has been implemented for the reservoir water-saving irrigation ditch Lu, can be relocated to meet Chen School of town and sand Nanba 2 towns 3 people in agricultural production, to ensure that about 2 acres of irrigated land per capita.

From the above analysis, we can see the resettlement points adequate housing arrangements immigrants live; sufficient arable land and good irrigation conditions to protect life and production needs of immigrants; resettlement sites have a more comprehensive municipal facilities, convenient transportation, among the migrants to carry out new life, resettlement to be reasonable and feasible.

5.12.3 Conclusion

From the above analysis we can conclude that: the migration compensation measures accord with the principle of "ensure that the migrants are able to move and can live happily later" and the measure are reasonable and feasible. There're enough houses for migrants to live in the arrangement site. Sufficient farmland and good watering conditions can meet the requirements of migrants' living and production. The resettlement site has improved civil construction facilities with convenient traffic. It's beneficial for the migrants to develop a new life there. The migration resettlement site can meet the requirement of migration compensation planning.

5.13 Different Part Compared with the Original Plan Environment Impact

Compared with the original plan, this project capacity is reduced and relative impact on the environment is different too. The difference mainly reflects on land coverage, cubic earth and stone, hydrology, impact on ecology, domestic pollution in operation period and production of domestic garbage.

After re-approvement, this project increases the area of the dam control project, three spoil yards with a total area of increased 26.63h m^2 were built, which permanently covers an area of increased 11.58h m^2, an increase of temporary land 15.05h m^2. The total amount of excavation to reduce the 149 400 m^3, the amount of fill to reduce 414,700 m^3, abandoned side increased by 46.73m^3, debit increased by 20.2m^3. As the project has changed the dam type, dam added the amount of disposable side, increased the temporary work area, increasing the amount of soil erosion, soil loss increases to 18038.86.

As the capacity of this plan is reduced, the flow speed is faster than the original plan which makes the average annual bed-load caliber is reduced for 31,000 ton compared with that of the original plan.

As the vegetation coverage and farmland area are increased in this plan, the biological loss increases for 43.21t/a which means the impact on the environment is increased accordingly. However, as the increasement amount is little and the ecological environment quality of this area is good, the impact increasement is little.

As the management station staffs are increased, the domestic waste water is increased by 0.4m³ daily and the domestic garbage is increased by 5kg per day. As the increasement amount of the domestic waste water and garbage is not too much and the treatment measures are improved, there's little impact on the environment.

6 Soil and Water Conservation

6.1 Status of Water Loss and Soil Erosion and Soil and Water Conservation

6.1.1 Prevention Region of Water loss and soil erosion

Cheng County belongs to the main stream section of the upper reaches of the Yangtze in *Gansu Soil and Water Conservation Regionalization*; the project area is the provincial key prevention and protection area of water loss and soil erosion according to *Announcement of Gansu Provincial People's Government about Partition of Key Prevention and Protection Area of Water loss and soil erosion*.

6.1.2 Status of Soil and Water Conservation

The Cheng Country Moba Gorge Water Project of Gansu Province belongs to the provincial key treatment area of water loss and soil erosion according to *Announcement of Gansu Provincial People's Government about Partition of Key Prevention and Protection Area of Water loss and soil erosion*. The allowable soil loss is 500t/km^2·a; the soil erosion modulus background value of the project area is 1800 t/km^2·a.

6.1.3 Prevention and Treatment Experience of Water Loss and Soil Erosion

The major experience of the soil and water conservation according to the same engineering investigation of the project area comprises:

(1) The legally compiled soil and water conservation plan is the premise of preventing and treating water loss and soil erosion in the developing and building project; the soil and water conservation plan approved by the water conservancy administrative department is not only a legal document of preventing and treating water loss and soil erosion in the developing and building project but also a design document of well doing the soil and water conservation work in the developing and building project.

(2) The newly increased water loss and soil erosion is taken place during the building period; the minimum disturbance is the maximum protection in the engineering building process, which is used as a principle in order to reinforce the management for the construction unit; the disturbance range is strictly prohibited from enlarging; the prevention in the first place is implemented in the whole construction process; therefore, the ecological environment is effectively protected; the water loss and soil erosion caused by the engineering building is effectively treated through carrying out the soil and water conservation measure.

(3) The effective preventive measure according to the investigations of the Gaofeng reservoir and the Xiamen reservoir in Cheng County comprises: reasonably transporting earthwork, temporarily heaping soil and preventing, regulating land, blocking slag, restoring vegetation and the like. A debris retaining dike is arranged in the riffle slag yard along the river; the land at top of the slag is regulated, covered with soil, greened or returned into the cropland so that the soil and water conservation function is returned; after finishing the engineering construction in the construction field, the field is leveled; the construction waste is removed; the field is originally restored; the office living areas are greened and beautified except for the hardened area and the building area, which can conserve the soil and water and beautify the environment.

6.1.4 Engineering Land Occupation and Earthwork Balance

6.1.4.1 Engineering Land Occupation

The total land occupation in engineering building is 95.36 hm^2; the disturbance land occupation in engineering building is 41.51 hm^2; the zone of reservoir inundation is 53.85 hm^2; the total land occupation in engineering building is divided into 12.92 hm^2 of cultivated land, 51.64 hm^2 of forest land and 60.8 hm^2 of unused land according to the land occupation type and divided into 71.91 hm^2 of permanent land and 23.45 hm^2 of temporary land according to the land occupation performance. See the table 6-1 for details.

Table 6-1 Statistical Table of Engineering Land Occupation Unit: hm^2

Project	Subarea		Area			Subtotal
			Cultivated land	Forest land	Unused land	
Permanent land	Major engineering	Moba gorge dam		5.13	1.27	6.4
		Management station		0.8	0.07	0.87
		Road for upper dam	1.07		2.61	3.68
		Water delivery road	4.4	0.58	2.13	7.11
	Land in zone of reservoir inundation		7.45	45.13	1.27	53.85
	Subtotal		12.92	51.64	7.35	71.91
Temporary land	Construction field and office living areas				8.2	8.2
	Residues place				10.9	10.9
	Construction road				2.25	2.25
	Quarry field				2.1	2.1
	Subtotal				23.45	23.45
Total			12.92	51.64	30.8	95.36

Compared with the original project, the total land occupation of the engineering building in the project is increased at 26.63 hm^2; the permanent land is increased at 11.58 hm^2; the temporary land is increased at 15.05 hm^2. See table 6-2 for concrete content.

Table 6-2 Comparison Sheet with the Engineering Land Occupation Amount in the Original Project Unit: hm^2

Project	Subarea	Floor area of the	Floor area of the	Increment compared
Permanent land	Moba gorge dam	6.4	2.6	3.8
	Management station	0.87	0.2	0.67
	Road for upper dam	3.68	2	1.68
	Water pipe	7.11	1	6.11

	Land road in zone of	53.85	54.53	-0.68
	Subtotal	71.91	60.33	11.58
Temporary land	Construction field and office	8.2	5.2	3
	Residues place	10.9	0	10.9
	Construction road	2.25	1.2	1.05
	Quarry field	2.1	2	0.1
	Subtotal	23.45	8.4	15.05
Total		95.36	68.73	26.63

6.1.4.2 Earthwork Balance

The total amount of excavation is 453600 m^3 (including 3200 m^3 of cofferdam dismounting material); the earth work is 123300 m^3; the filling quantity is 386300 m^3; the earth work fill is 44200 m^3; the gravel filling quantity is 2300 m^3; the rock block fill is 800 m^3; the sand gravel fill is 14000 m^3; the artificial aggregate rock is 325000 m^3; the using quantity is 61300 m^3; the waste quantity is 467300 m^3 (including 75000 m^3 of waste slag of the field mining and stripping layer); the borrowing quantity is 400000 m^3. Specifically see the table 6-3 and the chart 6-1.

6.1.4.3 Reasonable Analysis of Material Field

The natural building material field of the engineering is arranged in the Xiaozhuang material field; the material field is located on the right bank of South River on the downstream of the dam and on the west side of the Xiaozhuang village and is about 800 m to the dam and 650 mm to the Xiaozhuang village and connected with the Xiaozhuang village by the path and the simple highway, so the traffic is convenient.

The material field is a spur bulged toward the east; the terrains of east side and the north side are high, steep and klint-shaped; the slope is similar to be straight; the bed rock is exposed outwards; the altitude of the slope bottom on the north side is about 1100 m; the slope bottom on the north side is gradually lifted toward the slope bottom on the east side to 1125-1150 m; the height of the north side is about 100 m; the height of the slope on the east side is about 25-50 m; the south side is provided with a colluvium inclined slope whish is straight; the slope angle is 20 to 50 degrees; the terrain of the west side is highest; a wide ridge is extended in the east and west directions; the terrain of the wide ridge is from high to low from west to east directions; inclined slopes having slope angles of 30 to 35 degrees are arranged on the north and south sides of the ridge; the surface layer is provided with the colluvium gravel soil and 3-15 m in thickness.

The engineering characteristic of the rock in the material field is better; the saturated compression strength, the softening coefficient and the dry density of the rock can satisfy the requirement in the relevant specification about artificial coarse and fine aggregates; the colluvium and the eluvial-slope having thicknesses of 3 to 15 m are distributed at top of the slope; when the colluvium and the eluvial-slope need to be removed, 26000 m^2 of area can be excavated according to the calculations of 220 m of the mining length in the north and south directions and 120 m of mining length in the west and east directions. The thickness of the excavated usable layer is considered to be 50 m and calculated by the average thickness method; the reserves is about 1300000 m^3; the concrete coarse and fine aggregates for the rolling concrete gravity dam are about 327800 m^3, so the reserves satisfies the specification requirement.

There is not any resident in the mountain area of the material field; when constructing during the day, the produced noise can reach the standard out of 200 m of place; the construction is stopped at night; the noise effect for the Xiaozhuang village about 650 m away is in the acceptable range; the land occupation of the material field is unusable land. So, the material field lacks of the environment restraint effect.

6.1.4.4 Reasonable Analysis of Residues place

1# and 2# residues places are located in the construction area on the upstream of the left-bank dam; 3# residues place is located in the construction area on the upstream of the right-bank dam; 4# and 5# residues place are located in the construction area from the Xiaozhuang village on the right bank to the Gumu channel. See the table 6-3. The 1# residues place: the final altitude of the waste is 1060 m; the floor area is 21000 m^2; the 2# residues place: the final altitude of the waste is 1060 m; the floor area is 18000 m^2; the 3# residues place: the final altitude of the waste is 1056 m; the floor area is 5000 m^2; the 4# residues place: the final altitude of the residual is 1165 m; the floor area is 13000 m^2; the 5# residues place: the final altitude of the waste is 1050 m; the floor area is 52000 m^2. See the table 6-3.

Table 6-3 Table of Original Residues place Situation

Residues place	Area (hm^2)	Final altitude of dam top (m)
1#	2.1	1060
2#	1.8	1060
3#	0.5	1056
4#	1.3	1165
5#	5.2	1050
Total	10.9	

As the residue of the project is produced through excavating the dam; the primarily arranged residues place is excessively scattered so that the dam waste is delivered to four residues places; the unreasonably allocated earth work is optimized.

6.4.4.5 Repeatedly Optimized Residues place General Situation and Earth Work Allocation

(1) Residues place

Comprehensively consider the engineering residue quantity and the terrain condition; combine the primarily arranged 1# and 2# residues places as the optimized 1#, increase the area; cancel the primarily arranged 3# residues place; take the primarily arranged 4# residues place as the optimized 2# residues place; keep the area; reduce the area of the primarily arranged 5# residues place until to the waste height; take the primarily arranged 5# residues place as the optimized 3# residues place. See the table 6-4 and the chart 6-4.

Table 6-4 Table of Optimized Residues place Situation

Residues place	Area (hm^2)	Final altitude of dam top (m)	Design volume (ten thousand m^3)
1#	6.5	1060	33
2#	1.6	1165	8
3#	2.8	1040	7
Total	10.9		48

(2) Earth-stone Work Allocation

See the table 6-5 and the chart 6-2 about the repeatedly optimized earth-stone work allocation.

Table 6-3 Primarily Arranged Earth-stone Work balance Flow Direction Table **Unit: ten thousand m^3**

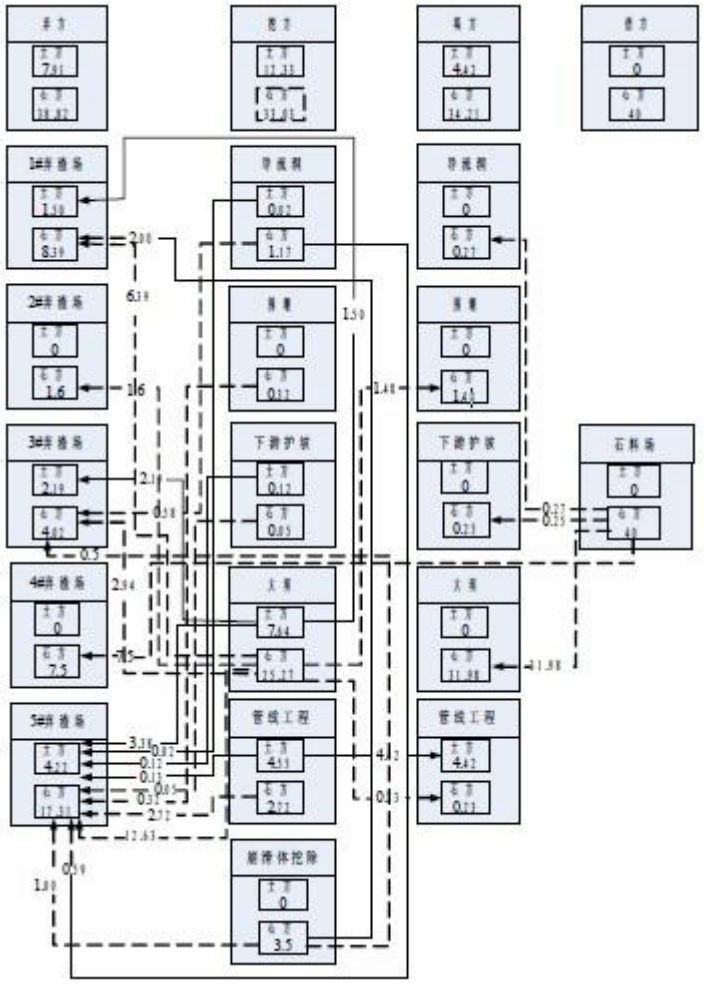
Project		Number	Excavating		Filling		Deliver-in				Deliver-out				Borrowing				Waste			
			Earth work	Stone work	Earth work	Stone work	Earth work	Source	Stone work	Source	Earth work	Target	Stone work	Target	Earth work	Source	Stone work	Source	Earth work	Target	Stone work	Direction
Dam pivot engineering region	Guide hole	①	0.02	1.17													0.27	⑦	0.02	5# residues place	1.17	3# and 5# residues places
	Dam	②	7.64	25.27									1.71	③⑤			31.98	⑦	7.64	1#,3# and 5# residues places	23.56	1#~3# and 5# residues places
	Cofferdam engineering	③		0.32					1.48	②											0.32	5# residues place
	Downstream retaining wall	④	0.12	0.05													0.25	⑦	0.12	5# residues place	0.05	5# residues place
Pipe engineering		⑤	4.55	2.72	4.42				0.23	②									0.13	5# residues place	2.72	5# residues place
Excavating and removing slumped mass		⑥		3.5																	3.5	1#, 3# and 5# residues places

Quarry	⑦											32.5	①②④						7.5	4# residues place
Total		12.33	33.03	4.42				1.71				34.21				32.5		7.91		38.82	

Table 6-5 Optimized Earth-stone Work Balance Flow Direction Table

Project		Number	Excavating		Filling		Deliver-in				Deliver-out				Borrowing				Waste	
			Earth work	Stone work	Earth work	Stone work	Earth work	Source	Stone work	Source	Earth work	Target	Stone work	Target	Earth work	Source	Stone work	Source	Earth work	T
Dam pivot engineering region	Guide hole	①	0.02	1.17													0.27	⑦	0.02	1 re p
	Dam	②	7.64	25.27									1.71	③⑤			31.98	⑦	7.64	1 re p
	Cofferdam engineering	③		0.32					1.48	②										
	Downstream retaining wall	④	0.12	0.05													0.25	⑦	0.12	3 re p
Pipe engineering	⑤	4.55	2.72	4.42				0.23	②									0.13	3# residues place	2
Excavating and	⑥		3.5																	

removing slumped mass																			
Quarry	⑦											32.5	①② ④						
Total		12.33	33.03	4.42				1.71				34.2 1				32.5		7.91	



弃方: Waste

挖方: Excavation

填方: Fill

借方: Borrower

1#弃渣场: 1# residues place

导流洞: Guide hole

2#弃渣场: 2# residues place

围堰: Cofferdam

3#弃渣场: 3# residues place

下游护坡: Downstream slope protection

石料场: Quarry

4#弃渣场: 4# residues place

大坝: Dam

5#弃渣场: 5# residues place

管线工程: Pipe engineering

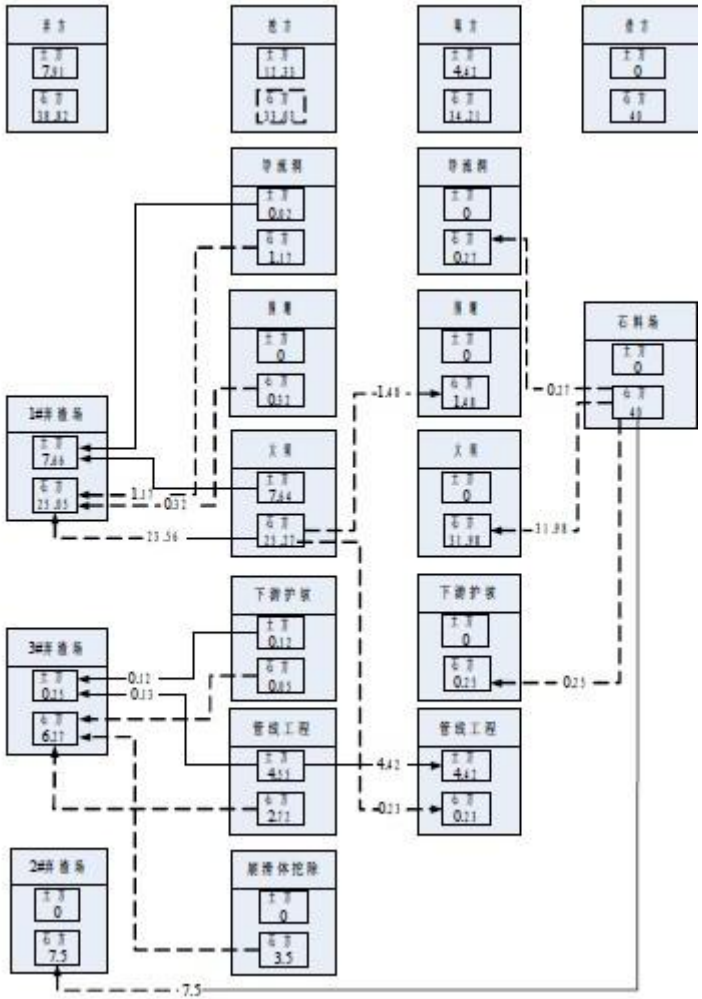
崩滑体挖除: Excavate and remove

土方earthwork

石方stonework

Note: Unit in chart is ten thousand m^3

Chart 6-1 Primarily Arranged Earth-stone Work balance Flow Direction Chart



弃方: Waste

挖方: Excavation

填方: Fill

借方: Borrower

1#弃渣场: 1# residues place

导流洞: Guide hole

2#弃渣场: 2# residues place

围堰: Cofferdam

3#弃渣场: 3# residues place

下游护坡: Downstream slope protection

石料场: Quarry

大坝: Dam

管线工程: Pipe engineering

崩滑体挖除: Excavate and remove slumped mass

Note: Unit in chart is ten thousand m^3

Chart 6-2 Optimized Earth-stone Work Balance Flow Direction Chart

6.2 Analysis of Water loss and soil erosion

6.2.1 Characteristic of Water loss and soil erosion

(1) The type of water loss and soil erosion in the project area includes surface erosion and gravitational erosion in the groove as the major; the project area belongs to the continental monsoon climate and has four seasons; the mean annual rainfall for many years is 620.88 mm; the rainstorm with short-duration is the direct factor for causing the water loss and soil erosion.

(2) The project area is located in the mountainous area of Paosha Town in Cheng County; the strength of the water erosion in the mountainous area is increased owning to the ups and downs of the terrain.

(3) The pipe network will damage the original terrain using type in the paving process so as to change the surface structure. The water loss and soil erosion caused by the anthropic factor comprises excavating, filling, residual abandoning, surface disturbing, vegetation damaging and the like during the engineering building period; the anthropic factor is the major factor for causing the water loss and soil erosion of the project.

6.2.2 Influencing Factor Analysis of Water Loss and Soil Erosion

The engineering can be divided into two periods: construction period and operation period according to the engineering characteristic and the natural economic condition of the project area; the construction period is divided into main engineering construction and water pipe pavement; the operation period includes the influence of the water loss and soil erosion caused by the main engineering. The influence of the water loss and soil erosion having the different situations is different; the influences of the water loss and soil erosion are analysed according to the project characteristic. See the table 6-6.

(1) The water loss and soil erosion is greatly affected during the construction period;

(2) The water loss and soil erosion is greatly affected through the main engineering construction and the water pipe pavement; the original earth surface damaging, excavating and the reservoir region clearing are the core problem of the prevention and control of water conservation for the newly increased water loss and soil erosion;

(3) The water loss and soil erosion caused by the construction field occupation in the construction process cannot be ignored;

(4) The water loss and soil erosion can be also controlled at a certain degree during the vegetation restoring period with the development of the soil and water conservation equipment function.

Table 6-6 Influence Analysis Table of Water Loss and Soil Erosion

Project content		Construction period		vegetation restoring period	
		Water pipe pavement	Main engineering	Water pipe pavement	Main engineering
Construction type or field	Excavation	√	√	×	×
	Fill	√	√	×	×
	Reservoir region clearing	×	√	×	×
	Temporary field	√	√	×	×

Influencing factor of water loss and soil erosion	Landform	-2	-2	-	-1
	Geological strata group	0	0	-	-
	Weather	-1	-1	-	-
	soil	-2	-2	-	-1
	vegetation	-2	-2	-	-1
control measures	vegetation measure	×	√	√	√
	engineering measure	×	√	×	√
	land reclamation	×	×	√	√

Note: √ stands for referring to the engineering or the project; - stands for not evaluation; × stands for not referring or basically not referring to the engineering; -1 stands for having a certain influence; -2 stands for larger influence.

6.2.3 Predication of Water Loss and Soil Erosion

6.2.3.1 Disturbance Surface Area

The action of disturbing the surface in the engineering construction process mainly comprises the actions of pivot foundation excavation, guide hole excavation, cofferdam filling and dismounting, material field mining, residual placing, construction enterprise, office living land leveling, construction road building, water pipe embedding and mounting and the like. The engineering building will disturb 41.51 hm^2 of surface are. See the disturbance surface area of each area of the table 6-7.

Table 6-7 Statistical Table of Disturbance Surface Area of the Engineering **Unit: hm^2**

Land occupation area	Land occupation type			
	Cultivated land	Forest land	Uncultivated land	Total
Pivot		5.93	1.34	7.27

Water pipe	4.4		0.58	2.13	7.11
Residues				10.9	10.9
Quarry				2.1	2.1
Constructio				8.2	8.2
Road	Road for upper dam	1.07		2.61	3.69
	Constructio			2.25	2.25
Subtotal	5.47		6.52	29.52	41.51

6.2.3.2 Predication of Amount of Water Loss and Soil Erosion

The total amount of the water loss and soil erosion of the engineering is 18645.96t; the amount of the newly increased water loss and soil erosion is 13342.71t; the amount of the newly increased water loss and soil erosion during the construction period is 12609.27t; the amount of the newly increased water loss and soil erosion during the natural restoring period is 733.44t. See the table 6-6.

Table 6-8 Predication Table of Water Loss and Soil Erosion

Predication period	Predication area	Predication area (hm^2)	Predication time interval (a)	Original landscape		After disturbing		Newly increased erosion amount (t)
				Erosion modulus ($t/km^2 \cdot a$)	Erosion amount (t)	Erosion modulus ($t/km^2 \cdot a$)	Erosion amount (t)	
Construction	Moba gorge dam	6.4	2.25	1800	259.2	7200	1036.8	777.6
	Management station	0.87	2.25	1800	35.235	7200	140.94	105.705
	Road for upper dam	3.69	2.25	1800	149.445	7200	597.78	448.335

period	Water pipe	7.11	2.25	1800	287.955	7200	1151.82	863.865
	Land zone of reservoir	53.85	2.25	1800	2521.53	7200	10086.12	7564.59
	Construction field and	8.2	2.25	1800	332.1	7200	1328.4	996.3
	Residues place	10.9	2.25	1800	441.45	7200	1765.8	1324.35
	Construction road	2.25	2.25	1800	91.125	7200	364.5	273.375
	Quarry	2.1	2.25	1800	85.05	7200	340.2	255.15
	Subtotal				4203.09		16812.36	12609.2
Natural restoring period	Construction field and office living area	8.2	2	1800	295.2	3000	492	196.8
	Residues place	10.9	2	1800	392.4	3000	654	261.6
	Construction road	2.25	2	1800	81	3000	135	54
	Quarry	2.1	2	1800	75.6	3000	126	50.4
	Water pipe	7.11	2	1800	255.96	3000	426.6	170.64
	Subtotal				1100.16		1833.6	733.44
Total					5303.25		18645.96	13342.71

6.2.3.3 Possible water loss and soil erosion hazard

According to above the predictive analysis about water loss and soil erosion, water loss and soil erosion induced by Cheng Country Moba Gorge Water Project of Gansu Province have the characteristics of centralized influence coverage, long influence period, great influence strength and harm and so on. Therefore, the safety of the project will be threatened possibly and ecological environment of the land is influence if no comprehensive preventive measure is adopted during the construction period and operating period of the project.

(1) Land of pivot building

Vegetation coverage at two sides of the dam side is very high. Construction of the project will cause certain vegetation deterioration and the land surface is bare. Thus, the surface soil will run away fast even all run away because of rainstorms to form bare land without any grass and land resource will be destroyed in certain degree. Difficult for restoring the vegetation is increased and green area in engineering region is reduced because original earth surface is hardened for engineering buildings and excavated to form side slope in bare rock.

(2) Water pipe area

Forest land, barren land and cultivated land are occupied for the water pipe area because of long water pipeline, wherein the occupied cultivated land area is large relatively. If no proper blocking preventive measures is adopted, water loss and soil erosion appear easily under the conditions of heavy rains so as to bring nutrient elements in soil surface and reduce soil fertility.

(3) Residues place

1# residues place is a bottom slag yard and the slag height is lower than water level. Its residual activity duration is short relatively. The reservoir mainly occupied flood land and terrace before saving water. Water and soil will run away and channel sediment is increased after scoured by water if no proper blocking measure is adopted. What worse, construction for downstream dam will be influenced. After the reservoir stores water, regression of the reservoir will not influence the residual place on the whole because the residual place is arranged bellow the dead water level, but if the residual is not prevented or the side slope for stacking does not meet the requirements, collapse will occur because stability of the residual is changed caused by etching in water for long time to run off near the dam. Therefore, sand discharging facilities may be influenced in certain degree and sand deposit age limit will be also descended because residual occupies dead reservoir volume.

2# and 3# residual places belong to slope-typed residual places. Direct harm of residual is reflected as vegetation deterioration. After the residual is discarded, vegetation can be restored or reclaimed. If no blocking and drainage measure is adopted, productivity of the land is reduced and surrounding vegetation is destroyed.

(4) Quarry

The quarry is above 2# residual place and stone excavation will cause vegetation deterioration in earth surface. Hardening of original earth surface and excavated stone for engineering buildings increase the difficult for recovering vegetation and green area in engineering region is reduced.

(5) Construction road

The project area is located in hills region, so that construction difficult of road is very great. Excavation area of stone and vegetation deterioration area for road construction are large relatively, so that erosion intensity is enriched and productivity for local land will be influenced in certain degree.

(6) Construction affiliated enterprise and office living area

Construction affiliated enterprise and office living area of the project mainly locate at two sides of two South River channel. Site formation mainly affects the cultivated land (dry land) and vegetation. After construction is ended, the difficult for recovering vegetation is increased because of bare land and lack of surface soil. Foundation backfills of part construction affiliated enterprises result in lots of residuals. If no blocking preventive or drainage measure is adopted, the site foundation will be destroyed because the residuals run away via washing by water flows. Therefore, construction facilities safety is affected even the river is blocked so as to influence flood discharging safety of river channel.

(7) Prevention area for submerging reservoir

Terrain of the dam is high and precipitous and incising of river is strong. Bank slope is stable gradually in long-term washing and etching process of river. But local collapse or rock-fall occur sometimes, manual quarrying, blasting and exaction also cause bad influence on the stability of bank slope.

6.3 Preventive measures for water loss and soil erosion

6.3.1 Control objective for water loss and soil erosion

According to “Announce about Dividing Key Control Area of Water Loss and Soil Erosion Issued by Gansu People’s Government”, the project area belongs to the provincial key controlling area for water loss and soil erosion. Control objective for water loss and soil erosion executes standard II according to (GB50434-2008) “Control Standard of Water Loss and Oil Erosion for Developed and Constructed Project”. On that basis, the standard is corrected based on natural environmental conditions, water loss and soil erosion features and current controlling situation and other factors. Please see table 6-9 for details of corrected objective value.

Table 6-9 Controlling Objective Value for Water Loss and Soil Erosion Chart

Control objective	Standard		Correction based on	Correction based land	Correction based on	Adopted value after correction	
	Construction	Test	750.9	Light	Zhongshan	Construction	Test
Control rate of disturbed	*	95				*	95
Control degree for	*	87	+1			*	88
Control rate for soil loss	0.5	0.7		0.3		0.5	1.0
Slag-blocking	95	95			-5	85	90
Vegetation recovery	*	95	+1			*	96
Grass coverage rate	*	20			+1	*	211

6.3.2 Responsible zone for controlling water loss and soil erosion

Area of the responsible zone for controlling water loss and soil erosion of the project at this phase is decided as 107.88 h ㎡ based on the principle of “who develop and who protect; who cause water loss and soil erosion, who control” and the standard of (GB50433-2008) “Technical Specification for conserving water and soil of Developed and Constructed Project” via combining project layout, construction organization design, natural condition including terrain, landform and others in the engineering area, wherein the area for construction zone is 95.36 h ㎡, direct influence area is 12.52hm^2. See table 6-10 for details.

Table 6-10 Responsible Zone for Controlling Water Loss and Soil Erosion Chart Unit hm^2

Project	Region division ion		Occupied land for the project	Direct influence area	Scope for prevention responsibility
Permanent land	Main part of project	Moba gorge dam	6.4	0.5	6.8
		Management station	0.87	0.06	0.93
		Road for upper dam	3.68	1.42	5.1
		Water pipe	7.11	1.76	8.87
	Land road in zone of reservoir inundation		53.85	0	53.85
Temporary land	Construction site, office and living area		8.2	2.1	10.3
	Residual place		10.9	4.58	15.48
	Construction road		2.25	1.73	3.98
	Quarry		2.1	0.37	2.47
Total			95.36	12.52	107.88

6.3.3 Overall layout for water and soil conservation measures

Divide according to above water loss and soil erosion prevention. Aiming at the characteristics and hazard of water loss and soil erosion induced be construction activity, systematical, comprehensive and effective measures for preventing water loss and soil erosion are adopted properly based on the concrete situation generated during construction via combining the existing measures for the major project so as to combine engineering measures for conserving water and soil with plant measures organically and decide the overall layout for water and soil conservation measures reasonably for the purpose of good prevention effect by forming complete, scientific measure system for preventing water loss and soil erosion. And see table 6-11 for concrete content.

Table 6-11 Overall distributopon of Preventive Measures for Water Loss and Soil Erosion

Divided zone for preventing water loss and soil erosion		Preventive object	Water conservation for main project	New water conservation measures
Prevention zone for pivot buildings	Excavate side slope	Engineering measures	Rock bolting, surface concrete, sprayed concrete protection, sewage drainage, soil spraying protection, sewage channel	Reinforced stone cage block

		Planting measures		Excavate vertical green at side slope
	Cofferdam	Engineering measures	Masonry barricade	Reinforced stone cage block
Prevention zone for water pipe	Water pipe in dam zone	Engineering measures	Masonry barricade	Topsoil stripping and cover soil, land leveling
		Planting measures		Vegetation recovery by combing frutex and grass
	Water pipe along the line	Engineering measures	Masonry barricade	Topsoil stripping and cover soil, land leveling
		Temporary measures		Temporary block for soil drainage channel and temporary coverage
		Planting measures		Vegetation recovery by combing frutex and grass
Prevention zone of residual place	1# residual place	Engineering measures		Reinforced stone cage block, dry stone pitching, drainage channels for slag top and around
	2# residual place	Engineering measures		Masonry stone block, drainage channels for slag top and around, topsoil stripping and cover soil, land leveling sewage channel
		Temporary measures		Temporary block and temporary coverage
		Planting measures		Vegetation recovery for slag top and slope for piling slag
	3# residual place	Engineering measures		Reinforced stone cage block, topsoil stripping and cover soil, land leveling, drainage channels for slag top and around
		Temporary measures		Temporary block and temporary coverage
		Planting measures		Vegetation recovery for slag top and slope for piling
Prevention area of quarry		Engineering measures	Rock bolting, surface concrete, sprayed concrete protection, sewage, drainage hole on slop side, drainage channel at slope side	Topsoil stripping and cover soil, land leveling

		Planting measures		Vegetation recovery by combing frutex and grass
Construction affiliated enterprise and office , living area	Affiliated enterprise are in construction area	Engineering measures	Masonry block wall, reinforced stone cage block	Topsoil stripping and cover soil, land leveling
		Temporary measures		Temporary block and temporary coverage, soil drainage channel
		Planting measures		Vegetation recovery at construction site
	Office and living area	Engineering measures	Masonry block wall, reinforced stone cage block	Masonry stone drainage channel, topsoil stripping and cover soil, land leveling
		Temporary measures		Soil drainage channel, temporary block and temporary coverage
		Planting measures		Green and beatify by trees and grass, construction site vegetation recovery
Road prevention zone	Road for upper dam	Engineering measures	Masonry block wall, reinforced stone cage block	Masonry stone for part filling section, blocking wall, cover soil and land leveling
		Planting measures		Slope protection by combining tress and grass, vegetation recovery by sowing grass seeds
	Construction road	Engineering measures	Reinforced stone cage block	Masonry stone for part filling section, blocking wall, cover soil and land leveling
		Temporary measures		Soil drainage channel, temporary block and temporary coverage
		Planting measures		Vegetation recovery for construction site
Prevention area for zone of reservoir inundation		Engineering measures	Cut slope and clear slope	

6.3.4 Water Loss and Soil Erosion Measure

Soil and water conservation measures for the project arrange 1640m residual blocking wall, 1800m reinforced stone cage block and 600m dry stone slope protection. The drainage channel is 2514m in length; soil block in straw bag is 2340m in length; 96959 trees are planted; holly green fence is extended 116m in length (1m in width); 4477kg grass seeds are sowed; area for land leveling is 21.88hm^2; and green area is 17.16hm^2.

6.3.4.1 Prevention Zone for Pivot Building

Analyzing on the view of conserving water and soil, major project also has the function for conserving water and soil while play the original functions. Construction in dry land for pivot area is completed in the whole year via enclosing by the downstream/upstream cofferdam and temporary section of the dam body. And concrete slope protection, concrete slope protection, impervious curtain, drainage facilities and other measures are also adopted so as to relieve water loss and soil erosion.

In order to prevent the sand gravel accumulation from falling off, reinforced stone cage blocks are proposed for building at the slope toe facing water of the upstream cofferdam of the dam. The reinforced stone cage block is 60m in length.

Lespedeza and amorpha fruticosa are planted at each road above the slope toe in a row via mixing and the gap for planting is 2.0m. Red clover seeds are sowed under the trees and sowing area is about 0.74hm^2, along with 200kg/hm^2 sowing quantity

6.3.4.2 Prevention Zone for Residual Place

The residual place are equipped with 1030m reinforced stone cage, 4560m drainage channel, 600m dry stone slope protection, 420m soil block in straw bag, 5080m^2 cover in fiber cloth, 14100m^3 topsoil backfilling area, 6.5hm^2 land reclamation area and 3.4hm^2 greening area. This serial measures have good soil and water conservation function so as to minimize water loss and soil erosion quantity for the residual place.

6.3.4.3 Prevention Zone for Quarry

Vegetation which needs to be recovered for the quarry is about 1.0hm^2 and backfill area for covering soil is 3000m^3. Land treatment is implemented and the vegetation is recovered by combining trees and grasses. Lespedeza and amorpha fruticosa are selected to plant in mixing and tree gap is 2.0×2.0m(line space×column width)；grass seeds adopt blue grass, ryegrass and tall fescue to sow in mixing and mixing sow proportion is 2∶5∶3, along with 200kg/hm^2 sowing quantity. By adopting the method for combining engineering measures with planting measures, water loss and soil erosion brought by exploiting stone materials is resisted effectively and water conservation effect is good.

6.3.4.4 Prevention Zone for Waterline

When piling 27550m^3 topsoil temporary which is stripped because of waterline construction, 220m straw bags are used for blocking in total and the topsoil is covered by 2800m^2 fiber cloth. After construction is over, all topsoil is backfilled and 7.11hm^2 disturbed land is controlled. And lespedeza and amorpha fruticosa are adopted to plant in mixing, while blue grass, ryegrass and tall fescue are sowed in mixing so as to recover vegetation. The recovery area is 3.44hm^2, so that water loss and soil erosion are prevented effectively.

6.3.4.5 Prevention Zone for Construction Affiliated Enterprise and Office/Living Area

This zone provides 660m drainage channel 660m, 230m reinforced stone cage 230, 500m blocking wall in straw bags and 4200m^2 fiber cloth cover. Land reclamation area is 4.52hm^2 and greening area in the area is 4.52hm^2. The method for combining planting measures with engineering measures is not only good for conserving water and soil, but also beautifies the environment.

6.3.4.6 Road Prevention Zone

The zone newly adds 19320m soil drainage channels and 400m reinforced stone cage, 3.8 hm^2 and treating area and 4.06 hm^2 vegetation recovery area to combine with the designed drainage channels and masonry stone blocking wall of the major parts so as to achieve good water conservation effect.

6.4 Monitoring for Soil and Water Conservation

See table 6-12 and 6-13 for monitoring scheme for soil and water conservation.

Table 6-12 Fix-point Monitoring Scheme for Soil and Water Conservation

Monitoring	Monitoring region	Monitoring point	Monitoring content	Monitoring method	Monitoring
Construction period and natural recover period for the project	Prevention zone for residual place	Top of residual place	①Change of water erosion quantity	Measuring method for erosion gully	Residual place is monitored every 10 days and other areas are monitored every 30 days. monitor one time additionarily if 24-hours rainfall≥50mm, 50mm
		Top of residual place	②Change of water erosion quantity	Measuring method for erosion gully	
		Topsoil piling place	③Topsoil loss quantity	Measuring method for erosion gully	
	Prevention Zone for Pivot Building	Excavate side slope and pile soil temporarily	①Change of water erosion quantity	Measuring method for erosion gully	
			② Loss quantity for temporary soil piling	Measuring method for erosion gully	
	quarry prevention zone	Excavate side slope	①Change of water erosion quantity	Measuring method for erosion gully	
		pile soil temporarily	②Topsoil loss quantity	Measuring method for erosion gully	
	Prevention zone for construction road	Excavate road backfill the	①Change of water erosion quantity	Adopt survey monitoring method ,	
		Temporary residual	①Change of water erosion quantity	Adopt survey monitoring method ,	
	Prevention zone for water pipe	Excavate road backfill the	①Change of water erosion quantity	Adopt survey monitoring method ,	
		Temporary residual	①Change of water erosion quantity	Measuring method for erosion gully	
	Construction affiliated enterprise and office/living area	Disturbed face in construction area	①Change of water erosion quantity	Adopt survey monitoring method , measuring method for erosion gully etc.	

Table 6-13 Survey and Monitoring Scheme for Soil and Water Conservation

Monitoring section	Monitoring region	Monitoring content	Monitoring method	Monitoring frequency
Early preparation for construction	Prevention liability scope	① Influence factor feature for water loss and soil erosion, number, quality and prevention effect of soil and water conservation facility	Remote monitoring, combining general survey with sampling investigation	Check the background value completely once before the early preparation for construction.
		② Background value for water loss and soil		
Preparation period and	Construction area for the project	① Landform and vegetation change of construction area, number for damaging soil and water soil erosion facilities.	Remote monitoring, patrolling method	Patrol freely during construction

construction period		② Excavated and filled earthwork quantity, discarded soil and residual amount, position, occupied area, surface area of disturbed land and area and degree of destroyed vegetation.	Combine general survey with patrolling method.	Once respectively before, during and the end of the construction
		③ Implemented number and effect of engineering preventive measures	General survey and patrolling method	Once respectively before, during and the end of the construction
		④Harm of water loss and soil erosion	Combination of sampling investigation and questioning survey	Once respectively before, during and the end
	Zone of reservoir inundation	① Unstable side slope at the banks of the reservoir and landslide mass	Combination of sampling investigation and questioning survey	Once respectively before, during and the end of the construction
		② arm of water loss and soil erosion	Patrolling method	Once during construction
	Construction area for the project	① Change of water erosion in various areas	General survey and sampling investigation	Once respectively before, during and after the flood season
		② Tree and grass growth, survival rate, coverage and effect for preventing water loss and soil erosion and other situations	Quadrat investigation	Once respectively before, during and after the flood season
		③ Number and effect for implementing preventive measures, area for controlling water loss and soil erosion and reduced water loss and soil erosion quantity	Sampling investigation	Once respectively before, during and after the flood season
Natural recovery period	Zone of reservoir inundation	① Unstable side slope and sliding mass at reservoir bank and others	General survey or sampling investigation	Once respectively before, during and after the flood season

		② Harm of water loss and soil erosion	General survey or sampling investigation	Once respectively before, during and after the flood season

6.5 Budget estimate for investing soil and water conservation project

Total cost for this water conservation project is 11.1867 million RMB, wherein 6.1862 million RMB is used for soil and water conservation project; 662300 RMB is used for planting measures; and 454100 RMB is used for temporary projects. Independent cost is 3155100 RMB; basic reserve fund is 313700 RMB; and compensation for the harm of water loss and soil erosion is 415300 RMB. See table 6-14 for details.

Table 6-14 Budget Estimate Table for Investing Soil and Water Conservation

Unit: Ten thousand RMB

No.	Name for the project or cost	Total
I	Part I Engineering measures	618.62
1	Drainage measures	125.34
2	Slope protection project	67.88
3	Blocking measures	213.38
4	land reclamation area	212.03
II	Part II Planting measures	66.23
III	Part III Construction temporary project	45.41
1	Temporary protection project	38.56
2	Other temporary projects	6.85
IV	Part IV Independent cost	315.51
1	Management cost for construction	14.61
2	Supervising cost for constructing the project	39.20
3	Survey design charge	166.80
4	Monitoring charge for soil and water conservation	58.91
5	Completion acceptance charge for soil and water	36.00
V	Total from part I to part IV	1045.77
VI	Basic reserve cost (3%)	31.37
VII	Compensation for the harm of water loss and soil	41.53
VIII	soil and water conservation 总投资	1118.67

6.6 Comprehensive Analysis

After soil and water conservation scheme is implemented, by the final period of construction, treatment rate of disturbed land reaches 98.67%; treating degree for water loss and soil erosion reaches 98.07% and slag blocking rate reaches 100%; control rate for water loss and soil erosion reaches 1.03; vegetation recovery coefficient reaches 98.76% and coverage area of forest and grasses reaches 41.3%. Therefore, all indexes have been achieved which means soil and water conservation measures are reasonable and feasible.

7 Environmental Protection Measure

7.1 Protective Measures for Water Environment

7.1.1 Protective measures for water environment during construction

7.1.1.1 Measures for treating waste water in foundation pit

Drainage for foundation pit of this project mainly includes rainfall, water penetration, grouting with concrete, maintenance water, drainage for excavating the foundation pit. And the main pollutants include SS, pH and petroleum. According to previous experiences for treating the waste water of foundation pit from some large-scale hydropower projects, additional treatment facilities are adopted for drainage of foundation pit and only flocculating agent is added for the foundation pit. The water is pumped out after it is kept for 2h and part water is used for watering to reduce the dust. The rest water is locally discharged in peripheral drainage channel and the rest sludge is cleared away regularly. Because the mixture of copperas and polyacrylamide has good effect for disposing high SS, alkaline and petroleum waste water, this type flocculating agent is recommended.

7.1.1.2 Measures for treating waste water used for washing sandstone materials

One primary settling tank and one flocculation sedimentation tank are arranged in the construction area of Zuoan Small Village-Gumu Gou, which both are built in masonry-concrete structure and designed based on the maximum waste water discharge quantity 142m³/h. Water stays in the primary settling tank for 1h and flocculation sedimentation tank for 1.5h respectively, which both adopt horizontal flow. The flocculating agent chose aluminium polychlorid. Effective volume of the primary setting tank is 142m³, one tank one grid and size for each grid is 18.9m×5.0m×2.3m (length ×width × height). Effective volume of the flocculation sedimentation tank is 213m³, one tank one grid and size for each grid is 22.5m×6.3m×2.5m (length ×width ×height). The supernatant fluid after treated is reclaimed for production manufacturing and watering the site.

7.1.1.3 Measures for treating alkaline waste water

A concrete mixing system is arranged in the construction site of Gumu Gou. Washing water usage for the concrete mixing system is counted based on 6m³ for each sift and two shifts on each day. Sand grains which deposit easily is removed by depositing with the method of batch type plain sedimentation and adequate acid is added in the sedimentation pool for adjusting pH value. After the pH value is neutral and the waste water is deposited via standing, the clear fluid can be reclaimed for washing the concrete mixing system and also can be used for watering the construction roads. The sediment is manually cleared away regularly. Two sedimentation tanks are arranged near the concrete mixing system. The tank body adopts masonry-concrete structure and the internal wall is anticorrosive. And scale for the sedimentation is designed based on 6.0m³ valid volume. Internal sizes all are 3m (length) ×2m (width) ×1.2m (height). The sedimentation time is more than 7h.

7.1.1.4 Measures for treating waste water containing oil

According to discharge quantity, water quality and other characteristics of waste water for washing the construction machines and automobiles, a small scale simple oil separation tank is adopted for treating waste water containing oil. The treating method has the characteristics of simple in structure, low in manufacturing cost and convenient in management. Besides, the method only needs to clean the tank regularly and floating oil can be reclaimed. Small oil separation tank adopts two grids for one tank. Horizontal flow velocity is 0.005m/s and staying time is 10 min. Oil discharging period is 7d.

The project provides five machinery parking areas and 95 fuel construction machineries and vehicles which are required to be washed regularly in total. And each equipment is maintained and washed based on 0.6m³ water per time for once every day. For collecting conveniently, special area for washing is provided in the construction machinery parking area and channels for collecting waste water are placed around the special area. And then the collected water is treated in the oil

separation tank and reclaimed after reaching the standard. Meanwhile, inspection for oil leakage of construction machinery parking area is intensified and measures are adopted in time if any oil leakage problem is found. See table 7-1 for concrete size of oil separation tank

Table 7-1 Size List of Oil Separation

Construction site	Waste water quantity containing oil		Size for oil separation tank (length×width ×height) m	oil separation tank number
	Construction machinery number	Waste water quantity m³/d)		
Zuoan Majiaya Qiaotou Machinery Parking Area	15	9	3×0.38×1.3	1
Machinery Parking Area in Dam at left bank	15	9	3×0.38×1.3	1
Gumu Machinery Parking Area at right bank	25	15	3×0.64×1.3	1
Machinery Parking Area in quarrying area	20	12	3×0.51×1.3	1
Machinery Parking Area in Dam at left bank	16	9.6	3×0.41×1.3	1

7.1.1.5 Measures for treating domestic sewage

Temporary toilets are built for the construction camps to collect domestic sewage and local villagers are assigned to clean the toilets regularly.

7.1.2 Protective measures of water environment during operation

7.1.2.1 Protective measures of water quality in reservoir

(1) Strengthen to monitor water quality in the reservoir, clean the reservoir seriously and remove the floating things in water surface of the reservoir regularly.

(2) Determine a water source protection zone with clear boundary in upstream/downstream water area of water intake or depth land area; protect the water source strictly and adopt feasible, effective measures so as to prevent the water source from polluting.

(3) In order to assure water quality of the water source protection zone reaches the standards, “Regulations for Protecting Water Source of Moba Gorge” must be drafted according to relevant laws and regulations of the country and Longnan City so as to protect the water source effectively.

(4) Strengthen protection for natural vegetation and ecological construction in reservoir area; forbid to cut trees freely and reduce water loss and soil erosion via protecting natural vegetation and water conservation forest.

7.1.2.2 Protective measures for water source area

(1) After Moba Gorge water supply project is built, Construction and Management Office for Gansu Province Cheng County Urban Water Supply of Moba Gorge Water Supply project shall define water source protection zone for drinking water based on the requirements of “Administrative Regulations for Pollution Control of Water Source Protection zone for Drinking Water” and implement management strictly based on the regulations.

① In the first level protection zone

Forbid to newly build and expand construction projects which are unrelated to water supply facilities and protect the water source; forbid to discharge sewage in the water area and existing sewage draining exit must be pulled down;

Do not build any dock irrelevant with water supply and forbid to call any ships;

Forbid to stack and store industrial residual, urban garbage, excrement and other residuals;

Forbid to establish oil depot;

Forbid to cultivate and feed live stock and strictly control cage culture;

Forbid any traveling activity and other activities which may pollute the water source possibly.

②In the second level protection zone

Forbid to new build and expand the construction project discharging pollutants to water body. Reconstruction projects must reduce the discharge quantity of pollutant; original sewage draining exit must reduce the sewage discharge quantity so as to assure the water quality in the protection area meet the regulated water quality standards; forbid to set up any dock for loading/unloading garbage, excrement, oil and toxic goods.

③ In standard protection zone

(1) Direct or indirect waste water drainage to the water area must be line with national and local waste water discharging standards. When discharging total amount cannot assure the water quality in the protection zone meets regulated water quality standards, discharging load must be reduced.

(2) Construction and Management Office for Gansu Province Cheng County Urban Water Supply of Moba Gorge Water Supply project shall compile “Environmental Protection Plan For Drinking Water Source Area in Cheng County” based on “Compiling Technical Code of ‘Environmental Protection Plan of National Drinking Water Source Area’” (May, 2006).

(3) Strengthen the construction for water conservation area. Strengthen vegetation construction in Moba Gorge water source protection zone and plant more trees so as to reduce deterioration of forest and grass vegetation, improve forest coverage area and protect ecological water source.

(4) Strengthen the management about pesticides and chemical fertilizer utilization for farm field in the water source protection area. Ammonia nitrogen, nitrate nitrogen and nitrite nitrogen exceed standards obviously because the pesticides and chemical fertilizer used in large area will flow in surface water body following rainwater due to the fact that there is part cultivated land in upstream of Moba Gorge water source, which not only influence water quality in the reservoir area but also directly affect people’s health. Therefore, management about pesticides and chemical fertilizer utilization must be intensified so as to reduce source pollution in agricultural aspect.

(5) Compel two concentrating mills in upstream of the reservoir to close and seal up the gold mine. Handle residual problem and make perfect emergency plan.

(6) Intensify the monitoring for water quality of the water resource area.

7.1.2.3 Protective measures for river section influenced by transferring water

After the project over, 4m river section influenced by transferring water will be generated. In order to ensure ecological water supply of the river section influenced by transferring water, permanent drain holes are required to be provided when building the dam. The drain holes shall be lower than water inlets but higher than the sand flushing hole for flood discharge, which means the height for the

drain hole is among 1024m to 1065m and draining flow rate is 0.04m³/s so as to ensure minimum value of the ecological water supply of the river section influenced by transferring water.

7.1.2.4 Measures for treating domestic sewage from management station

Waste water discharged during operation mainly is domestic sewage produced by the administrative personnel in the management station. The management station proposes 35 and the maximum living water usage in production area is about 3.5m³/d via calculating based on 100L/per person. According to this, discharge quantity of domestic sewage is about 3.3m³/d. In order to assure the domestic sewage produced by the administrative personnel in the management station will not pollute the water source area, WSZ buried sewage disposal facility is suggested to dispose the domestic sewage produced by the administrative personnel. Discharging densities of CODcr, BOD5 and SS respectively are 60mg/L, 30 mg/L and 60 mg/L after they are disposed by the equipment, which can meet the first level standard of “Sewage Comprehensive Discharge Standard” (GB8978-1996). The domestic sewage after treating is used for green surrounding and deposited sludge is used as agricultural fertilizer. See table 7-1 for the treatment effect of WSZ buried sewage disposal facility.

Table 7-1 Treatment Effect Chart of WSZ Buried Sewage Disposal Facility

Project	CODcr		BOD5		SS	
	Discharge density	Discharge quantity	Discharge density (mg/L)	Discharge quantity	Discharge density (mg/L)	Discharge quantity
Before	300	0.20	180	0.18	200	0.20
After	60	0.04	30	0.03	60	0.06
Treating efficiency	80%		83.3%		70%	

7.2 Protective measures for atmospheric environment

Atmospheric pollutant of the project is mainly from construction period and operation period does not produce atmospheric pollutant basically. Thus, protective measures for atmospheric environment mainly aim at the construction period.

7.2.1 Dust prevention measures

Aiming at dust problem during construction, the following control measures are proposed to be adopted during construction of the project:

(1) During construction, barriers and envelopes are provided in the construction site so as to preventing dust from spreading; barriers and envelopes have apparent function on reduce the pollution of dust for environment and the influence distance can be shorted for 40% when the wind velocity reaches 2.5m/s. Barriers which are not lower than 2.5m are continuously built around the construction site and the barriers are firm and beautiful;

(2) The construction site is watered regularly by assigning one staff in the construction area so as to reduce dust quantity; watering times is determined according to the weather conditions. Generally speaking, one day waters 1 to 2 times and water times shall be increased properly for strong wind or dry weather. Whether the construction site is watered largely affects dust. If the site is watered, dust quantity will be reduced for 28% to 75% so as to largely reduce the influence for environment from dust;

(3) The vehicles which transport building materials and building residuals are covered by sheds so as to prevent the materials and residuals from falling off. Meanwhile, the wheels are cleaned

completely via washing by a water gun when the vehicle enters or leaves the loading/unloading place; and driving line for the vehicle should avoid residential area as much as possible;

(4) Adopt commercial concrete and try best to avoid constructing under strong wind condition. Beijing stipulates that earthwork construction is forbidden under the condition greater than Level 4 wind presently and this project also can adopt this regulation;

(5) Specifically assign one person to dispose, transport and stack discarded soil, building residuals and building materials in the construction site; and the stacking place is covered by sheds or watered so as to prevent secondary dust;

(6) The discarded soil and building residuals shall be disposed and transported in time so as to reduce occupied land, reduce dust pollution and improve the environment of the construction site;

(7) When implementing mechanical excavation in a tunnel, adopt discontinuous excavation so as to ventilate in time and the constructor shall wear a mask if necessary.

7.2.2 Waste gas control measures

Intensify the management for large scale fuel construction machinery and vehicle and execute the system for checking and maintaining regularly. Exhaust emission of all fuel machinery and vehicle provided by the contractor shall execute “Discharge Standard of Automobile Atmospheric Pollutant”. If exhaust emission does not reach the discharge standard, equipment for eliminating smoke and dust must be provided. The construction machinery adopts unleaded gasoline and other excellent fuels. Strictly implement “Discarding Standards for Existing Vehicles” and carry out the system for forcing to change and discard. The old vehicles of which motors consume more oil, efficiency is low and exhaust emission exceeds the standard seriously should be updated.

7.3 Disposal measures for solid wastes

7.3.1 Disposal measures for solid wastes during construction

7.3.1.1 Disposal measures for building residuals and cleaning vegetation

The project is required to clean the vegetation and building residuals in the inundation zone. By estimating, vegetation which needs to be cleaned is about 50000m³ and the building residuals cleaned out is about 14.13t. The part of which the vegetation is cleaned can plant again. Stacking freely not only affects the environment but also wastes the resource. It is suggested that the vegetation which can plant should be planted by the farmers around the village and the land cannot used for planting should be transported to Cheng County refuse landfill for burying. The building residuals cleaned out are transported to the residual places for the project.

7.3.1.2 Treatment measures of living garbages from constructors

Each construction area is provided with two trash cans and household wastes are kept in sealed trash cans uniformly. A special car is arranged to collect the wastes regularly and the wastes are transported to Cheng County refuse landfill for burying.

7.3.1.3 Disposal measures for residual

Residuals produced from the project are transported to the assigned residual place respectively based on the scheduling requirement of stones. The residual place shall prevent strictly based on the measures mentioned in water conservation scheme.

7.3.2 Disposal measures for solid wastes during operation

After the project is over, total administrative personnel for operating are determined as 35 persons. By calculating based on 0.8kg household waste per person on every day, 35 persons produce 10.22t household wastes every year. In order to prevent the household wastes from affecting the peripheral environment, the management station should provide trash cans to collect household

wastes and regularly transport household wastes to Cheng County household waste landfill for disposing in concentrate.

7.4 Noise control measures

Noise of the project is mainly from construction period and noise in operation period is low relatively. Therefore, noise control measures mainly aim at the construction period.

(1) Control based on sound source: When the construction unit signs contract with the unit for implementing construction, the major mechanical equipments shall be required as the mechanical equipment with low noise; meanwhile, the unit for implementing construction shall assign personnel to regularly maintain the equipments specially and train the constructors in construction site to operate various machineries strictly based on operation specification. Reasonably arrange the time for operating the pile driver, air hammer, hammer drill and other equipments with loud noise and reasonably arrange blasting time so as to reduce the noise generated during the equipment working unusually. Construction machineries (such as hammer drill and driller) with loud noise are forbidden from being operated at night because construction at night will affect Majiya and the small village largely due to the fact that Majiaya construction site is 400m from Majiaya and Small Village construction site is 650m from Small Village.

(2) During the structural phase of construction, external parts of the buildings should be equipped with barriers so as to reduce the influence on environment around caused by equipment noise.

(3) Individual protective measures for constructor: Intensify labor protection and improve working conditions for works. Continuous working time for the constructor working at the forefront of production under loud noise condition does not exceed 6 hours. Noise protection appliances are allocated to the construction works suffering from loud noise. The workers working at the construction site wear noise-preventing cotton so as to reduce influence from noise.

7.5 Protective measures for environmental geological hazard

Based on the principle of “Mainly depending on prevention and combining prevention and control” to reach the purpose of protecting geological environment, avoiding and reducing loss from geological hazard, the following preventive measures and suggestions are proposed for various geological hazards respectively:

(1) Temporary support or temporary retaining and other measures can be adopted for the geological hazard hidden risks of expanded soil body collapse or avalanche and so on which possibly exist when excavating dam abutment so as to ensure the safety and stability of dam abutment construction. Meanwhile, drainage for surface water and underground water should be carried out well.

(2) Temporary support or temporary retaining and other measures can be adopted for the geological hazard hidden risks of collapses or avalanche of accumulation at side slope and mantle rock and so on which possibly exist when excavating for construction about the entrance of water delivery tunnel, the side slope for the exit or prevent the hazards by combining with the permanent slope protection measures for the side slope of the tunnel face so as to ensure the safeties and stabilities of construction and operation. Meanwhile, drainage for surface water and underground water should be carried out well.

(3) When the tunnel crossing the fracture zone or the intercalated layer zone, collapse or roof fall and other geological hazards may be induced because the stability of surrounding rock is bad. Thus, the support must follow up in time when excavating; support immediately when excavating and waterproof for the tunnel body should be carried out properly.

(4) Engineering measures of temporary support or temporary retaining and other measures can be adopted for the geological hazard hidden risks of side sliding and collapses of the rock and soil body at side slope of the foundation pit which possibly exist during excavation of the dam foundation; the high side slop formed via excavating shall adopt step-typed side slope so as to ensure the safety of side slope for the foundation pit during construction.

(5) Earthwork project shall take the excavated soil as the soil for backfilling as much as possible so as to reduce unstable side slope formed by stacking discarded soil and residual; and relevant protective measures should be adopted for the residuals which must bed stacked.

7.6 Protective measures for landscape

(1) Waterlines should be laid under the precondition of meeting the requirements of the project. Try best to shield the waterlines depending on the terrain so as to reduce the influence on landscape;

(2) Intensify greening and improve the ecological environment and landscapes around the reservoir area;

(3) Strictly implement the water conservation measures proposed by the water conservation scheme; the temporary land is improved after the construction is finished and the vegetation is recovered if condition allows.

7.7 Protective measures for ecological environment

7.7.1 Protective measures for ecological environment during construction

During construction, education and advertising for ecological protection to the constructors are strengthened in the manners of announcements and distributing pamphlets and so on; forbid the constructor to cut trees out of the construction area without permission via institutionalization and also forbid the constructor to prey frogs, birds, snakes and other wild animals. 1-2 terrestrial vegetation and wild animals protection warning signs are arranged in Majiaya Qiaotou Construction area at the left bank, traveling area in the dam at the left bank, Small Village at the right bank-Gumugou Construction area, dam construction area among cofferdam, traveling area in the dam at the right bank, waterline construction area and other areas, 15 in total. The warning signs adopt thin steel plates, blue bottom with white character and the specification is 100cm×60cm (length × width). The signs are marked by the words that forbid destroying vegetation and capturing wild animals.

Reasonably arrange operational mode and time of construction machineries, select the mechanical equipments with lower sound level value to construct and reduce horning times of transportation vehicles so as to reduce disturbance for wild animals caused by construction noise.

7.7.2 Protective measures for ecological environment during operation

7.7.2.1 Plant protective measures during operation

The method for forest planting to replenish forest in the land capable of planting plants which is not utilized in this area via developing can be considered for biological loss quantity caused by occupying forest land and cultivated land for the project.

7.7.2.2 Protective measures for terrestrial animals during operation

Try best to gradually recover the various vegetations and biotope types destroyed by construction in the operation period via implementing ecological recovery measures so as to recover the habitat for wild animals partially.

7.7.2.3 Protective measures for aquatic animals during operation

(1) Must promise the down flow rate for the most basic survival of growth, breed, inhabitation, overwintering and others for aquatic organism (especially for fishes), in particular, the down flow rate must be enlarged in the breeding and overwintering seasons for fishes.

(2) Effectively carry out the spirit of “China Maintenance Executive Summary for Aquatic Organism Resource” and implement aquatic organism maintenance system of “protected by the developer, compensated by beneficial owner and recovered by the person who destroys”. Ensure each item of cost for aquatic organism resource maintenance, especially for exchanging germplasm resources and monitoring aquatic organism is fully funded.

(3) The business owner shall enhance the publicity efforts of the laws and rules related to aquatic organism protection, intensify management and coordinate local fishery supervision and administration department to severely punish the illegal behaviors of poisoning fishes, catching fishes by electricity, exploding fishes and excessive catching and firmly implement the announcement spirit of comprehensive ban for natural water area of Gansu so as to ensure the sustainable development and long-term utilization of fishes resource.

(4) Schizopygopsis kialingensis and Schizothorax davidi which are bought and bred via manual domestication are released to breed. After the hydropower project runs after completion, every 3 years is a releasing period and 2000 Schizopygopsis kialingensis and Schizothorax davidi in the specification of 3-4cm are released every time. Implement long-term releasing and releasing charge is counted in operational cost.

8 Environmental Monitoring and Management

8.1 Environmental monitoring task

8.1.1 Purpose for environmental monitoring

According to the environmental influence features of Moba Gorge Water Project, major environmental factors for the construction area and the reservoir area before/after the project is finished are monitored and change situation of various environmental factors in the range influenced by the project and the effect after the environmental protection measures are implemented are mastered so as to provide basis for discovering environmental problems in time and proposing related solutions, reduce bad influence caused by the project, strengthen environment management and project acceptance.

Focus for environmental monitoring task is different in different period. At early stage of project construction and storing water, the focus is mainly to monitor the change of environmental factors caused by construction activities, including change of environmental factors caused by building the dam and distributing the waterlines. After the project stores water and works, the focus is mainly to monitor the change of environmental factors surrounding caused by storing water, scheduling and project in operation period and ecological change in the area for laying waterlines.

8.1.2 Environmental monitoring organization and system

Environmental monitoring in construction period and operational period shall all be completed by authorizing the units with relevant monitoring certificate. Environmental monitoring during construction mainly aims at monitoring the influence on environment from three wastes, noise and ecological damage caused by construction activities. Environmental monitoring during operation mainly monitors the water quality, aquatic organism and terrestrial ecological environment of the reservoir aiming at the management station of the project.

8.1.3 Requirements of monitoring technology

(1) Monitor strictly based on the monitoring scheme made by the scheme.

(2) Strictly follow current national relevant environmental monitoring technical specification and environmental monitoring standard analysis method.

(3) The monitoring instrument should be checked before monitoring and the monitoring result should be correct and reliable and reflect the monitoring result truly.

(4) Calculate and analyze the monitoring result in time and give brief evaluation via contrasting carefully; feasible improving method is provided for the defects. The monitoring result is reported to the business owner and administrative supervision department so as to master environmental change development and control effect during construction and operation of the project conveniently and implement effective supervision and management.

8.1.4 Monitoring plan

8.1.4.1 Monitoring plan during construction

See table 8-1 for concrete monitoring points, monitoring frequency and monitoring content during construction of the project.

Table 8-1 Environmental Monitoring Plan List during Construction

Name	Monitoring content	Monitoring place	Monitoring frequency	Monitoring item

Water quality monitoring	Water quality change at upstream and downstream of the construction area and water quality pollution caused by the construction area	Establish one section at 500m away from the intersection of along river and Erlang River; establish one section in the reservoir area; establish one section at downstream of the reservoir area and four monitoring sections in total.	After beginning to construct, respectively monitor once in wet season, normal season and dry season and properly add 1 to 2 monitoring times at construction peak.	Water temperature, pH, dissolved oxygen, chemical oxygen demand, BOD5, total nitrogen, total phosphorus, suspended matter, ammonia nitrogen, copper, zinc, arsenic , mercury, cadmium, chromium (sexavalence), lead, fluoride, cyanide, volatile phenol, oil, anion active agent**,** sulfide and fecal coliform
Air monitoring	Influence on air caused by construction and traffic	Construction area	After beginning to construct, respectively monitor once every half year and every time continuously samples 3 days; samples once respectively at 07 o'clock, 12 o'clock and 18 o'clock; and properly add monitoring times at construction peak.	SO2, TSP and NO2
Noise monitoring	Noise produced by the construction machinery, blasting and traffic transportation	Respectively place one monitoring point at 1m away from the periphery of the construction activity area	Respectively monitor one period during construction at each season; properly add monitoring times at construction peak; every time continuously samples 3 days; sample once respectively at daytime and night.	Equivalent A sound level Leq
Terrestrial organism monitoring	Vegetation type, dominant species, grass group height, vegetation coverage degree	Grass land and forest land area related to the project	Respective once before/after construction	Vegetation type, dominant species, grass group height, vegetation coverage degree
Aquatic organism monitoring	Monitor plankon, benthos and native fishes.	Arrange two monitoring points respectively at 100m away from the upstream of dam and 300m away from the downstream.	Respective once before/after construction	Monitor varieties and numbers of plankon, benthos and native fishes.

Human health monitoring	Sanitary conditions of construction camps and health situation of construction	Each construction camp	Once every month	Sanitary conditions of construction camps and health situation of construction

8.1.4.2 Monitoring plan during operation

See table 8-2 for concrete monitoring points, monitoring frequency and monitoring content during operation of the project.

Table 8-2 Environmental Monitoring Plan List during Operation

Name	Monitoring content	Monitoring place	Monitoring frequency	Monitoring item
Water quality monitoring	Monitor the water quality in the reservoir area and downstream area	Respectively establish one section in the reservoir area and 100m away from downstream of the reservoir area.	Monitor the reservoir area once every day and respectively monitor downstream of the reservoir area once in wet season, normal season and dry season.	Water temperature, pH, dissolved oxygen, chemical oxygen demand, BOD5, total nitrogen, total phosphorus, suspended matter, ammonia nitrogen, copper, zinc, arsenic , mercury, cadmium, chromium (sexavalence), lead, fluoride, cyanide, volatile phenol, oil, anion active agent**,** sulfide and fecal coliform
Aquatic organism monitoring	Monitor plankon, benthos and native fishes.	Arrange two monitoring points respectively at 100m away from the upstream of dam and 300m away from the downstream.	One period every 3 years, monitor five periods in total and monitor aquatic organism once every period and every season.	Monitor varieties changes and organism quantity of plankon, and benthos, exchange germplasm resources change of proliferative and growth and breeding situations of native fishes.
Down flow rate monitoring	Down flow rate of dam drain holes	100m away from downstream of the dam	Once every month	Place water gauge board, monitor whether the water discharge of the dam meets the minimum ecological water supply.

8.2 Environmental management

8.2.1 Purpose for setting environmental administrative organization

The environmental administrative organization is established for the purpose of carrying out related laws and regulations of The Environmental Protection Law of the People's Republic of China, comprehensively implementing relevant regulations of "Decision of State Council Regarding Environmental Protection Issues" and monitoring discharges of "three wastes" produced by the project so as to assure project economy, environment and social benefit are in coordinated

development; and coordinate the jobs of local environmental protection department to provide guarantee for the production management and environment management of the enterprise. Therefore, the enterprise should set up environmental administrative organization and fulfill relevant responsibility to intensify and strict the management aiming at the concrete situation of proposed project.

8.2.2 Principle of environmental management

Relevant environmental protection laws, regulations, policies and standards issued by the state are the administrative regulations and the guidelines which must be obeyed for implementing environmental management; different solutions are adopted for the contradictions in different properties and correct management principle shall be decided for environmental management so as to seek coordinated development of society, economy and environment. And those principles include:

(1) Persist in the principle of sustainable development;

(2) Persist in the principle that “Promote protection by exploitation and protection is for exploitation”;

(3) Persist in the principle of coordinating and uniting “three benefits” of economy, society and environment;

(4) Persist in the principle of legal system.

8.2.3. Setting environmental administrative organization

8.2.3.1 Organization members

The engineering headquarter shall assign a person for the environmental protection specifically during construction according to the actual situation of the project; after the project is put into operation, the environmental administrative organization is in the charge of logistics management department; affiliated environmental management team is responsible for the environmental management and environmental monitoring of this project and the team is supervised and guided by the project governing unit and local environmental protection bureau.

8.2.3.2 Staff for environmental protection organization

1 to 2 environmental managerial personnel are assigned in the engineering headquarter during construction period. During operation, a special environmental protection organization belonging to the logistics management department is set up specifically and full-time environmental managerial personnel are assigned.

8.2.4 Duty of environmental administrative organization

(1) Implement the environmental protection guidelines, policies, laws and regulations and relevant environmental standard of the state.

(2) Establish environmental management system, environmental technical and economic policy and development plan for environmental protection.

(3) Supervise and inspect the implementation of “Three Simultaneity” regulation of the project and monitor qualified emission of “three wastes”.

(4) Regularly check, repair and maintain the environmental protection equipments so as to assure the environmental protection facilities work stably for long time by reaching the standard.

(5) Draft and implement environmental management plan and environmental monitoring plan of Moba Gorge Water Supply Project.

(6) Be responsible for handling various environmental protection accidents during construction and operation of Moba Gorge Water Supply Project in time.

(7) Take charge of environmental protection complaint from the residents and receive supervision and management from local environmental protection department.

(8) Take charge of daily management and filing of relevant environmental protection document and technical materials; and popularize and apply advanced technical experience related to environmental protection and organize and implement clean production.

(9) Carry out advertising education and training about environmental protection so as to improve environmental protection consciousness of whole staff.

8.2.5 Environmental protection plan

8.2.5.1 Environmental protection plan during construction

(1) For implementing the project effectively, smoothly, all the staff, in particular to the constructors must be trained for environmental protection knowledge and skills.

(2) The environmental management organization is fully responsible for environmental protection during construction and fulfills environmental management duties at various phases during construction.

(3) Responsibility management is implemented for the construction team to require civilized construction of the construction team and do well in supervision, check and education.

(4) Integrally arrange the construction procedures and sites based on the requirement of the environmental protection governing department and relevant environmental protection measures mentioned in the report.

(5) Civil engineering requires land for excavating and transporting earthwork, ditching for channel and construction building materials machineries and so on; and water in time for produced dust and clean the discarded soil in time so as to avoid raising dust secondarily.

See table 8-3 for environmental management plan during construction of this project

Table 8-3 Environmental Management Plan Chart during Construction

Task			Schedule	Implementation unit	Supervision unit	Capital source
Item	Content of environmental protection	Relief measures adopted by the project				
Water quality protection	Management of waste water for washing stone materials	Treat the waste water by the sedimentation tank.	Finish in advance before utilizing the stone materials system.	The unit for implementing construction	Supervised by Cheng County environmental protection bureau and Construction and Management Office for Gansu Province	From the investment of major parts of the project
	Management of waste water containing oil	Treat the waste water by the oil separation	Finish when arranging construction site.	The unit for implementing construction		

		tank.			Cheng County Urban Water Supply of Moba Gorge Water Supply project	
	Domestic sewage	Build toilet pit in the construction camp for collecting construction waste water in concentration.	Finish before the constructors enter the construction sites.	The unit for implementing construction		
Sound environment quality control	Noise from the construction machinery and traffic transportation	Control working time of equipments with loud noise and traffic transportation, reduce influence on the residential area caused by noise and strengthen individual labor protection for the constructors.	Implement synchronously when the equipments are put into operation.	The unit for implementing construction		
Environmental air quality control	Powder dust, dust raise and tail gas from fuel machinery	Adopt enclosed sand-making equipments to make sand; adopt wet method when implementing construction excavation and blasting; concrete mixing systems all are equipped with dust removal equipments. Cement is transported by adopting sealed container and transportation for raw materials and products implements	Implement synchronously when the equipments are put into operation.	The unit for implementing construction		

		mouth to mount closed delivery.				
Solid waste disposal	Collection, transportation and disposal for household wastes	Provide trash cans and other collecting device for household trash in the construction living area.	Finish before the constructors enter the construction camp.	The unit for implementing construction		
Human health protection	Body health of constructor	Regularly check the bodies of the constructors and disinfect the construction area so as to prevent communicable diseases	Finish before the constructors enter the camp and regularly implement during construction	The unit for implementing construction		
Soil and water conservation	Water loss and soil erosion	Recover the construction land in time and adopt relevant temporary prevention during construction.	Finish before the constructors enter the camp and regularly implement during construction	The unit for implementing construction		
Terrestrial ecology	Terrestrial plants and animals	Try best to keep away from activity of wild animal, forbid catching wild animals and prevent destroying the vegetation out of the project area during construction.	Implement following construction phase and gradually implement in the process.	The unit for implementing construction		
Personnel training	Training is required for construction technology and management.		Before construction	The unit for implementing construction		

8.2.5.2 Environmental management plan during operation

Environmental management plan during operation mainly focus on the managements for the geological environment, aquatic organism, water quality and solid waste disposal and so on. The

environmental management personnel during operation shall establish environmental management rules ad systems and discharge index for various pollutants of the project during operation based on the national environmental protection policy, standards and environmental monitoring requirements and assure normal operation of each system and do well in environmental monitoring job and others.

See table 8-4 for details of environmental management plan during operation.

Table 8-4 Environmental Management Plan Chart during Operation

Task			Schedule	Implementation unit	Supervision unit	Capital source
Item	Content of environmental protection	Relief measures adopted by the project				
Geological environment protection	Geological hazard	Implement slope protection and banket protection for the section of the reservoir bank that landslip occurs easily and strengthen earthquake detection in the area.	Finish before storing water	Construction and Management Office for Gansu Province Cheng County Urban Water Supply of Moba Gorge Water Supply project	Supervised by Cheng County environmental protection bureau	Water supply income during operation
Water quality protection	Water quality change	Keep down flow rated suitable for survival conditions of aquatic organism and reasonably introduce exotic species to release so as to increase fishery resource based on scientific verification	Release fries very April to June.	Construction and Management Office for Gansu Province Cheng County Urban Water Supply of Moba Gorge Water Supply project		
Solid waste disposal	Collection, transportation and disposal for household wastes	Provide trash cans and other collecting device for household trash in the construction living area.	Finish before completion acceptance.	Construction and Management Office for Gansu Province Cheng County Urban Water Supply of Moba Gorge Water Supply project		
Personnel training	**Training for environmental foundational concept and monitoring method, compiling monitoring report and post training**		**Before operating the reservoir**	**Construction and Management Office for Gansu Province Cheng County Urban Water Supply of Moba Gorge Water Supply project**		

8.3 Environmental action plan during construction

According to the construction characteristics of this project, a monitoring plan during construction should be made and please see table 8-5 for details.

Table 8-5 Environmental Action Plan during Construction

No.	Monitoring	Monitoring content	Monitoring	Implementing	Monitoring

	power supply		time	organization	organization
1	Construction camp	Determine construction scope: Provide barriers around the construction site and built toilet pit in the site; provide 2 trash cans to each construction site; a primary setting tank and a flocculation sedimentation tank are provided for the small village-Gumugou at the left bank and two setting tanks are arranged near the concrete mixing system; one oil separation tank is arranged in the Majiaya Qiaotou machinery parking place at the left bank, machinery parking place at the dam of the left bank, Gumugou machinery parking place at the right bank, the machinery parking place in quarrying area and machinery parking place at the dam of the right bank respectively; 1-2 terrestrial vegetation and wild animals protection warning signs are arranged in Majiaya Qiaotou Construction area at the left bank, traveling area in the dam at the left bank, Small Village at the right bank-Gumugou Construction area, dam construction area among cofferdam, traveling area in the dam at the right bank, drainage channels are arranged; masonry stone blocking wall and reinforced stone cage blocks are built.	Before construction	Construction unit	Cheng County Environmental Protection Bureau and Longnan Environmental Protection Bureau
		When working under loud noise condition, the constructors wear earmuff or earplug; when working under heavy dust condition, the constructors wear mask; regularly water to remove dust; and provide blocking walls in straw bags for temporary piling and cover with sheds.	During construction		
		Implement topsoil backfill, land reclamation and vegetation recovery	After the construction is finished		
2	Construction living area	Determine the scope of construction living area: Provide barriers and trash cans around the construction site and built toilet pit in the living area; drainage channels are arranged; masonry stone blocking wall and reinforced stone cage blocks are built; after the topsoil is stripped, provide blocking walls in straw bags when piling and cover with sheds.	Before construction		
		Regularly water to remove dust and clean and disinfect once every three months.	During construction		
		Implement topsoil backfill, land reclamation and vegetation recovery	After the		

			construction is finished		
3	Waterlines	Build masonry stone blocking wall; after the topsoil is stripped, provide blocking walls in straw bags when piling and cover with sheds.	During construction		
		Implement topsoil backfill, land reclamation and vegetation recovery	After the construction is finished		
4	Roads	Build masonry stone blocking wall and reinforced stone cage blocks; after the topsoil is stripped, provide blocking walls in straw bags when piling and cover with sheds.	During construction		
		Implement topsoil backfill, land reclamation and vegetation recovery	After the construction is finished		
5	Residual places	Determine the scope of residual places: reinforced stone cage blocks are built; arrange drainage channels around the residual places; provide blocking walls in straw bags for temporary stacking place and cover with sheds.	Before construction		
		Dry stone slope protection: blocking wall in straw bags; cover the residuals very after construction is over.	During construction		
		Implement topsoil backfill, land reclamation and vegetation recovery, build drainage channels at the residual top.	After the construction is finished		
6	Quarry	Determine the scope of the quarry: drainage channels are built around the quarry and provide blocking walls in straw bags for temporary stacking place and cover with sheds.	Before construction		
		Support by spraying concrete, rock bolting support and drain holes at the slope face	During construction		
		Implement topsoil backfill, land reclamation and vegetation recovery. Arrange drainage channels at top of the slope.	After the construction is finished		
7	Major project for the dam	Determine scope: dredging dam foundation and around drainage channels.	Before construction		
		Masonry stone blocking wall and reinforced stone cage blocks facilities; rock bolting support for the slope and support the surface by spraying concrete.	During construction		
		Excavate vertical green for side slope.	After construction		

			is finished		
8	Inundation zone	Dredge inundation zone	Before construction		
9	Diversion tunnel	Support by spraying concrete and rock bolting support; support the side walls for entrance and exit and top arch by scaffolds and build module by combining steel templates.	During construction		
		Plug the bottom gate of diversion tunnel	During operation of the project		
10	Cofferdam	Swing jet the wall for preventing leakage with high pressure and grout the sleeveless curtain for preventing leakage.	Before construction		
		Residuals for pulling down the cofferdam are transported to the assigned residual places.	During construction		
11	Ecological measures	1-2 terrestrial vegetation and wild animals protection warning signs are arranged in Majiaya Qiaotou Construction area at the left bank, traveling area in the dam at the left bank, Small Village at the right bank-Gumugou Construction area, dam construction area among cofferdam, traveling area in the dam at the right bank, drainage channels are arranged;	Before construction		
		Intensify management, poll; patrol regularly and prevent constructor from catching and fishing.	During construction		
		Reclaim the disturbed land and recover the vegetation.	After the construction is finished		
		Release fries from April to Jun every three years.	During operation of the project		

8.4 Partition for water source protection area

8.4.1 Partition requirements

8.4.2.1 Partition for the first level protection zone

(1) Water area scope

The first level protection zone shall not be smaller than the scope of sanitary protection zone. When parts of water areas of large and medium reservoir are defined as the first level protection zone, divide by adopting two-dimensional numerical model. Because there is sewage is discharged in the reservoir area, the scope for the first level protection zone can be determined by adopting analog experience method and track, check and monitor simultaneously. If the division result is unreasonable, please adjust timely.

(2) Land area

The land area within 200m above the normal water level at the side of water intake is the land area. Depth scope along the first level protection zone must not be smaller than scope of water source sanitary protection zone for drinking water.

8.4.2.2 Division for the second level protection zone

(1) Water area scope

Water area scope for the second level protection zone is that radial distance from the boundary of the second level protection zone to the first level protection zone is greater than the major pollutant or the distance that the water quality index is reduced to the density allowed by water quality standard of the first level protection zone from the density allowed by water quality standard of the second level protection zone. Adoptable analysis methods are stated as bellow.

① Adopt 2D water quality model or pollutant self-purifying distance to calculate.

② Adopt analog experience to determine water area scope of the second level protection zone, and track, check and monitor simultaneously. If the division result is unreasonable, please adjust timely.

(2) Land area

Land area scope for the second level protection zone shall be determined based on the environmental problems in drainage basin via combining the terrain conditions.

When area pollution source is the major pollution source, depth scope along the second level protection zone is mainly determined based on natural conditions, demands of environmental features and environmental management via analyzing the terrain, vegetation, land utilization, forest exploitation, catchments conflux characteristics of surface runoff, catchments range and so on. Land boundary of the second level protection zone does not exceed corresponding water-shed range of river basin. When the water quality of the protection zone is affected seriously by the pollution source near the protected zone, the region at which the pollution sources locate in concentration shall be taken in the management scope of the second level protection zone so as to control those pollution sources effectively.

Scope of the second level protection zone for mountain-type medium reservoir is with the ridge line (out of the first level protection zone) and the watershed basin backing 3000m from the river entering the reservoir.

8.4.2.3 Division for standard protection zone

According to the basin ranges of lakes and reservoirs, distribution of pollution source and the

influence degree for the water quality of drinking water source, the watershed apart from the second level protection zone can be determined as the standard protection zone.

8.4.3 Next plan for protection zone division

Make water source protection zone plan based on the division requirement combing the fact.

8.5 "Three Simultaneity"Acceptance for environmental protection facility

8.5.1 Acceptance range

(1) Various environmental protection facilities related to the project, including the facilities, devices built for matched with preventing pollutions and protecting environment, monitoring means and ecological protection facilities and so on.

(2) Other various environmental protection measures adopted in the report and relevant documents.

8.5.2 Acceptance list

Construction and Management Office for Gansu Province Cheng County Urban Water Supply of Moba Gorge Water Supply project shall submit the completion acceptance application for environmental protection facilities to the project environmental protection governing department to accept in time based on the relevant requirement from “Administrative Regulations for Environmental Protection Facilities of Construction Project”. Please see table 8-6 for environmental protection completion acceptance list.

Table 8-6 “Three Simultaneity” Acceptance List for Environmental Protection Facilities

Project	Content	Measures	Acceptance standard
Waste water	Domestic sewage	Adopt WSZ buried sewage disposal equipment to dispose domestic sewage.	Standard LI (GB8979-1996) of Comprehensive Sewage Discharge Standard
	Protection for water source area	Divide protection zone for drinking water source according to the requirements of “Administrative Regulations for Preventing Pollution of Drinking Water Source Protection Zone”.	The water quality in the reservoir area reaches the III standard of “Environmental Quality Standard of Surface Water” (GB3838-2002) and the boundary value of supplementary items.
		Compile “Environmental Protection Plan for Cheng County Drinking Water Source Area”.	
Solid wastes	Household wastes	Arrange two trash cans for the management station.	Properly dispose household wastes.
Water loss and soil erosion	Land reclamation	After the construction is finished, land reclamation is implemented for the quarry, the construction camp, construction roads and	The project proposed from the water conservation scheme

		waterlines.	
	Slope protection engineering	The material place and residual places are required to implement slope protection.	
	Drainage engineering	Drainage facilities shall be provided for the dam management station, the upper dam roads and construction material places.	
	Greening measures	After construction is finished, two sides of the dam management station, material places, construction camps, construction roads, waterlines and upper dam roads roadbed shall be greened.	
Resident relocation and ecological compensation		The residents are relocated properly; submerged cultivated land and forest land must be compensated.	Resident Relocation Plan and Land Compensation Plan
Landscape protection	Try best to shield the waterlines by the terrain conditions and avoid the residential area.	Prevent the waterlines from influencing the environmental landscapes.	
Aquatic organism	Release fries	Release fries from April to June every 3 years.	Release 2000 Schizopygopsis kialingensis and Schizothorax davidi in the specification of 3-4cm.
Water discharge quantity	Ecological water discharge quantity	The dam is equipped with permanent drain holes.	Water discharge quantity is 0.04m³/s.
Environmental monitoring and management			Work normally

9 Investment Estimate for Environmental Protection and Economic Profit and Loss of Environmental Influence

9.1 Investment Estimate for Environmental Protection

Investments for various environmental protection measures proposed in the evaluation report are estimated as 15.2673 million RMB, which takes 6.74% of total investment cost. Please see table 8-1 for details.

Table 9-1 Environmental Protection Investment

Variety of measure	Name of measure	Content of measure	Expected effect	Investment cost
Pollutant control during construction	Disposal for domestic sewage from constructors	Disposed by t6he toilet pit of each construction site.	Relieve the influence on environment caused by waste water.	6.54
	Waste water from the foundation pit	Add flocculating agent.	Relieve the influence on environment caused by waste water.	40.2
	Waste water containing oil	Oil separation tank	Relieve the influence on environment caused by waste water.	5.32
	Waste water for sand stone materials	Sedimentation tank	Relieve the influence on environment caused by waste water.	25.89
	Alkaline waste water	Sedimentation tank and the agent for adjusting pH value	Relieve the influence on environment caused by waste water.	6.37
	Watering construction area	Water construction area.	Relieve dust raise in construction site.	8.1
	Household waste from constructor	Arrange 28 trash cans and transport the waste in time.	Relieve the influence on the environment caused by household waste during construction.	10.8

	Barrier facilities around the construction site	Barrier facilities are arranged around the site.	Relieve dust raise and noise influence caused by construction.	5
	Preventive measures for constructor	Mask, earplug and so on	Relieve the influence for the constructor caused by construction process.	4
	Protection of human health	Disinfect the construction area, implement deratization and eradicate mosquito and fly.	Protect body health of constructor.	23.61
Waste water control	Domestic sewage	Adopt WSZ buried sewage disposal equipment to dispose domestic sewage.	Standard LI (GB8979-1996) of Comprehensive Sewage Discharge Standard	15.0
	Protection of water source area	Divide protection zone for drinking water source according to the requirements of “Administrative Regulations for Preventing Pollution of Drinking Water Source Protection Zone”.	The water quality in the reservoir area reaches the III standard of “Environmental Quality Standard of Surface Water” (GB3838-2002) and the boundary value of supplementary items.	50.0
		Compile “Environmental Protection Plan for Cheng County Drinking Water Source Area”.		
Household	Household	Arrange two trash cans for	Properly dispose	0.04

waste	wastes	the management station.	household wastes.	
Soil and water conservation	Engineering measures, planting measures and temporary engineering measures	Prevent and control the region in which water loss and soil erosion occur.	After soil and water conservation scheme is implemented, by the final period of construction, treatment rate of disturbed land reaches 98.67%; treating degree for water loss and soil erosion reaches 98.07% and slag blocking rate reaches 100%; control rate for water loss and soil erosion reaches 1.03; vegetation recovery coefficient reaches 98.76% and coverage area of forest and grasses reaches 41.3%.	1118.67
Ecological protection	Schizopygopsis kialingensis and Schizothorax davidi which are bought and bred via manual domestication are released to breed.	Every 3 years is a releasing period and 2000 Schizopygopsis kialingensis and Schizothorax davidi in the specification of 3-4cm are released every time.		10
	Set ecological protection signs	Warning signs		0.9

Environmental monitoring	Water quality monitoring		Work normally	137
	Environmental air monitoring			216.6
	Noise monitoring			5.4
	Human health monitoring			6.4
	Ecological survey and monitoring			22
Other charge				127.17
Total				1526.73

9.2 Economic Profit and Loss of Environmental Influence

9.2.1 Economic Profit

Annual average water supply quantity of the project is 16510000 m³. Static total investment of the project is 226563000 RMB and operational cost is 731000 RMB. Average water supply cost is 1.17 RMB/ m³.

9.2.1 National Economic Evaluation Index

National economic internal profit rate of the project is 10.39% and is higher than social discount rate; economic net present value is 74930000 and is more than zero; and economic benefit cost ratio is 1.22 and is more than 1. Therefore, national economic profit of the project is good relatively and the project is feasible and reasonable in economy.

9.2.1.2 Economic Sensitivity Analysis

In order to check the stability of national economy evaluation conclusion of the project, two aspects of investment and profit are selected to implement sensitivity analysis for the factor largely affecting the national economic evaluation index and see table 9-2 for concrete content.

Table 9-2 Economic Sensitivity Analysis Result Table

Evaluation index / Solution	Economic internal profit rate (%)	Economic net present value (0000 RMB)	Economic benefit cost ratio
Basic solution	10.39	7493	1.22
Project investment is increased by 10%.	9.23	4109	1.11
Project investment is increased by	8.20	725	1.02

20%.			
Project investment is reduced by 10%.	9.11	3359	1.10
Project investment is reduced by 20%.	7.74	-774	0.98

Sensitivity analysis result reflects that economic internal profit rates of the project all are greater 8% than social discount rate, the economic net present values are more than 0 and economic benefit cost ratios are also more than 1 whatever the investment is increased by 10% or 20% or the economic profit is reduced by 10%; economic internal profit rate of the project is less 8% than the social discount rate a little, the economic net present values are less than 0 and economic benefit cost ratios all are less than 1 when the economic profit is reduced by 20%. In a word, the project has certain economical anti-risk ability.

9.2.1.2 Comprehensive Evaluation for Economic Profit

The project has good national economic profit and is reasonable, feasible in economy. When the project investment is changed in certain range, the economic internal profit rate trends to be more than the social discount rate and the project owns certain economical anti-risk ability. Overall economic benefit of project is good.

9.2.2 Social Benefit

Implementation of the project can fundamentally solve the problems of domestic water and productive water of urban residents and industries/enterprise in Cheng County. Meanwhile, the project also can create investment environment for western development so as to prepare for establishing and perfecting market economy well. Thus, the project has great significance for sustainable development about overall economy of Cheng County.

9.2.3 Environmental Benefit

Environmental benefit of the project is mainly embodied in ecological benefit. After the project is built, the reservoir can control the water quantity in this river basin to play the economic benefit and social benefit. What's more, greater ecological benefit can be produced simultaneously. Because the project mainly provides reliable water source for the urban water supply, drinking water of man and beast in villages, industrial water supply, management department for water source area must formulate strict administrative systems and regulations to prevent the upstream of the water source area from being polluted and strictly controls the villages, village appearances and environmental sanitation in this basin so as to protect the water source. Promote the concepts of converting cultivated land into forests and planting grass and trees; adjust the industrial structure, develop livestock breeding and breeding on water surface and traveling on water to develop and make full use of the water area of the project reasonably. Meanwhile, control water loss and soil erosion and forbid exploiting mountains, mining and draining freely in this basin so as to improve the ecological environment and promote the continuous expansion and development of ecological benefit in this basin.

9.2.4 Comprehensive Evaluation

To sum up, the project is feasible in economy and has good social and environmental benefits, so that the project can not only improve the quality of life of people, but also owns certain environmental benefit.

10 Environmental Risk Analysis

10.1 Identification for Environmental Risk Source

Building reservoir can bring benefit to the people, but it also can cause serious consequence resulting from damage of the dam due to some occasional factors possibly. According to the statistic in “Hazard Lesson of Dam” published by International Commission on Large Dam in 1974, reservoir wrecking rate is about 5%, wherein the dam failure occupies about half. Dam failure situation in China is similar with the international situation, wherein the main part is small-sized reservoirs most of which are concrete dam. According to the characteristics of the project, major risk sources of the project include: (1) dam is broken; (2) the waterlines are fractured.

10.2.1Maximum Credible Accident and Source Item

10.2.1 Determination for Maximum Credible Accident

According to “Technical Guidelines for Environmental Risk Assessment on Projects”, the maximum credible accident refers to the grave accident with the most serious harm for the environment (or health) among the accidents that all prediction probabilities are not zero. The maximum credible accident of risk assessment for the project is regarded as dam failure based on the property and feature of this project.

10.2.2 Probability of Maximum Credible Accident

According to reason statistic for two successive two dam failure (40 dams in total) at early 90th of 20 century in our country, the dam failure caused by low flood control standard or the flood exceeding the standard takes up 37.3%~51.5%; the dam failure caused by poor quality of the reservoir project takes up 35.9%~38.5%; dam failure caused by poor management for the reservoir takes up 4.2%~15.9%; and dam failure caused by other reasons takes up 4.6%~11.39%. According to the preliminary statistics, in recent 40 years in China, there are about 1100 reservoirs (the reservoirs which wrecked because the dams are broken by overtopping caused by scheduling and operating wrongly are not involved) wrecked because the dams are broken by overtopping, wherein there only 300 reservoirs wrecked because the dams are broken by overtopping caused by exceeding the designed flood standard, which takes up about 1/3. And most of other dam failures are caused by error survey and design or because survey and design were not carried out essentially, while those problems which do not belong to the flood standard take up more than 2/3 of the total.

10.2.3 Source Item of Maximum Credible Accident

By the research for dam failure risk evaluation problem in environmental assessment of reservoir project made by Li Qijiang, Ren Lixin and other persons, dam failure can be divided into instantaneous full-breakage and local dam failure. Rigid dams such as concrete gravity dam, arch dam, stone masonry dam, buttress dam and so on generally suffer from instantaneous full-breakage and much local breakages appear. Because the material dams in scattered grains such as soil dam, core earthrock dam, and rock-fill dam and so on have poor erosion resistance abilities, scouring pits in small sizes appear in the dam bodies firstly and then the scouring pits are expanded quickly. Thus, the dam bodies are broken locally and the breaking range is expanded fast because the dam bodies are unstable resulting from reducing mechanical property. For the material dams in scattered grains, the dam bodies are broken fast and the breakage point reaches a stable section or breaks completely in a short time after the breakage scale reaches certain degree, although there is a time process for scouring by water flows. Dam structure of the dam is concrete gravity dam, so that the dam failure source strength is calculated based on instantaneous full-breakage.

(1) Maximum flow at the dam address:

$$Q_m = 0.9Bh_0^{1.5}$$

Wherein, Q_m : the maximum flow (m³/s) at the dam address when the dam is breaking;

B: average width of the section for the dam address;

h_0: r water depth (m) in the front of dam before the dam is broken;

Dam height of the project is 91.4m and dam length is 136.5m. Total reservoir volume is 1790m³. According to calculation, the maximum flow at the dam address is 89671 m³/s.

(2) Emptying time:

$$T = KW / Q_m$$

Wherein, T: the water emptying time (s) of the reservoir;

W: the water release quantity (m³) after the dam of the reservoir is broken;

K: the ratio between the maximum flow and average flow and 1.5 is taken for evaluation at this time.

According to calculation, if the project suffers from dam failure, the emptying time of the reservoir is 299s, i.e. 5 min.

10.3 Cause Analysis for Environmental Risk

According to domestic and abroad research achievements about the safety of reservoir dam, there are many causes inducing dam damage and dam failure and those cause also area very complex, including natural factors, human factors, and correlations and compound impact thereof. The major causes via analyzing probably include:

(1) Violent Earthquake

The small earthquakes would induce reservoir damage and breakage uneasily, but strong earthquake can induce reservoir damage and breakage easily (earthquake magnitude≥7.0). The earth-crust of the region where the project locates is stable relatively and anti-seismic and prevention measures are adopted based on degree Ⅷ of seismic basic intensity. What's more the reservoir is not very large (dam height＜100m), which will not easily cause earthquake. Thus, the possibility for causing damage of the reservoir dam in large scale and high strength caused by earthquake is very small.

(2)Temperature Variation

The local damage accidents of the reservoir dam caused by temperature variation are common for concrete soil arch dams. The reason is that dam thickness of arch dam is thinner relatively and the arch dam is built in multiply redundant which the boundary is restricted, so that surrounding temperature variation will easily generate temperature stress in the body of the arch dam during operation of the reservoir dam and the reservoir dam will fracture because of excessive stress under certain conditions. But generally speaking, temperature variation only can induce local damage for the reservoir dam while will not cause sudden dam breaking for the reservoir dam.

(3) Mountain Landslide

Large-scaled instability of reservoir bank and fast slumped mass with high potential energy may cause huge surge so as to induce flood hazard for downstream of the reservoir dam and around the reservoir and endanger the safety of the reservoir dam. In particular, large-scaled fast

landslide at two sides of the upstream/downstream near the dam body would cause dam damage and breakage easily. Although, the project has a hidden risk of small-scaled bank instability, the possibility for huge surge flood and dam breaking accidents in large scale caused by reservoir instability and fast slumped mass with high potential energy is very small because earth-crust activity of the region where the project locates is stable relatively and the engineering geological conditions for the reservoir area, dam address and plant address are good on the whole. Which must be emphasized is that multiple small-sized unstable geologic bodies at side slopes of two banks of the internal/external river sections in the reservoir area shall be reinforced and prevented via aprons and retaining engineering so as to avoid inducing large-scaled bank instability caused by small-sized reservoir bank instability. Besides, forbid bombing stones and fishes in/out, near or around the reservoir area freely stacking a lot of materials and buildings in the reservoir area or two side slopes of the section near the dam during operation of the reservoir dam so as to prevent slumping.

(4) Dam Foundation Damage

Deformability, permeability and stability of the dam foundation are greatly related to the safety of the dam body. A good dam shall has enough deformation resisting and bearing abilities, small permeability and stable and integral rock body so as to avoid damaging the dam foundation caused by large deformation, exceeding the limit of the uplift pressure caused by excessive permanent water pressure and sliding instability of dam body or the dam rock. Only scientific engineering processing technology and strict consolidation seepage-proofing measures adopted so as to reinforce and improve the stability to eliminate the hidden risk of the dam foundation completely, dam failure of the reservoir caused by dam deformation, dam crack, dam slide and permanent because of instability can be avoided.

(6) War and Terrorist Attack

If the dam of reservoir project is destroyed instantaneously caused by suffering from a war and a terrorist attack, then the flood hazard is serious and may lead to basin hazards. But considering on the view of military affairs, the possibility for taking the dam as a military attack target is very small.

(7) Extraordinary Flood

Generally, when extraordinary flood occurs, a rainstorm follows always. Erosion pits appear in the downstream dam caused by heavy erosion action of rainstorm. But under the promotion function of wind waves in the reservoir area, the chance for flood overtopping to span the dam is increased. These small erosion pits will be expanded gradually via etching by the overtopping flood and local instability would be induced for the dam when these erosion pits are expanded in certain scale. And then dam breaking occurs.

(8) Wrong Survey Design

If preliminary work is not done carefully, detailed hydrologic survey and geological exploration are not implemented, water account is not calculated correctly and design is not considered thorough, then result in aimless construction hidden risk for the safety of reservoir dam is planted in the future. And reservoir dam breaking wreckage is caused easily. Therefore, for flood prevention safety of the reservoir dam, correct survey design and reasonable scheduling operation shall be stressed except reasonable flood prevention standard is selected. The project had done a great number of preparations so as to provide scientific basic for assuring design quality.

(9) Quality Defect of Dam Body

There is the opportunity for quality defect always because local quality is not controlled strictly during the construction process of the dam and cause dam failure under external bad dynamic load action. The quality weak link is the very place for centralized seepage and piping. Thus, engineering management shall be strengthened during construction; supervision, inspection, assessment and acceptance for construction quality shall be carried out; and dispose the rest

finishing problems properly.

(10) Poor Management during Operation

During managing the dam, the probability for human careless omission or equipment failure exists always, which would affect the real-time monitor for the operation status of the dam body. And working status of the dam body cannot be reported in time so as to cause dangerous situation of the dam body or dam failure. Thus, technical management for the reservoir shall be intensified during operation of the project so as to ensure the safety of the reservoir dam.

For all these reasons, the human factors such as low flood prevention standard for the reservoir, bad engineering quality, and poor management and so on are the major causes leading to dam failure. But the project seriously carries out No.77 Command of State Council "Administrative Regulations of Dam Safety on Reservoirs" and implements careful survey design strictly following the specifications. Under the preconditions that engineering quality and reservoir technical management are strengthened and obey reservoir safety operation code, safety of the reservoir dam is assured absolutely so as to reach the purpose of bringing benefit and abolishing harm.

10.4 Consequence Analysis of Environmental Risk

Once the dam is broken, upstream and downstream of the dam are affected largely. In upstream of the dam, the water body, in particular to the water level in front of the dam are reduced suddenly because large amount of water is discharged downward and the reservoir bank loses stability easily, which can lead to bank failure. Major risk of dam failure is in the downstream district. Surge wave for dam failure is formed because large amount of water in the reservoir is discharged downward suddenly, which can cause server damage for downstream personnel and assets. So, the maximum flow quantity when the maximum flow quantity for dam failure flows to the dam address L flow path is calculated by the following formula based on the dam failure source density:

$$Q_{Lm} = Q/(W/Q_M + L/KV_M)$$

Wherein, Q_{Lm} : the control section dam failure maximum flow quantity (m^3/s) from the dam address;

Vm: the maximum flow velocity (m/s) of river section during flood and 3.0m/s is adopted in this calculation;

K: experience coefficient. The experience coefficient for this calculation is 1.2 and the rest parameters are the same as above.

According to the topography and geomorphology of downstream of the project and distribution situation of residents, suitable predicted distance is selected. See table 10-1 for the predicting result of control section dam failure maximum flow quantity (m^3/s) from the dam address L.

Table 10-1 Control Section Dam Failure Maximum Flow Quantity from Dam Address

L (m)	100	200	300	400	500	600	700
QLm (m^3/s)	40507.19	26979.95	20225.71	16176.13	13477.64	11550.76	10105.92
L (m)	800	900	1000	1500	2000	2500	3000
QLm (m^3/s)	8982.36	8083.63	7348.39	5051.23	3848.24	3108.04	2606.65

The submerged range of dam failure maximum flow quantity is calculated according to above predicting result depending on the following formula:

$$A_{LM} = Q_{LM} / V$$

.Wherein, A_{Lm} : corresponding flow crosssection area (m^2) ;

According to the elevation which is measured actually, please see table 10-2 for the details of submerged range of dam failure maximum flow quantity.

Table 10-2 Flow Crosssection Area List

L (m)	100	200	300	400	500	600	700
QLm (m^3/s)	40507.19	26979.95	20225.71	16176.13	13477.64	11550.76	10105.92
ALm	3375.60	2248.33	1685.48	1348.01	1123.14	962.56	842.16
L (m)	800	900	1000	1500	2000	2500	3000
QLm (m^3/s)	8982.36	8083.63	7348.39	5051.23	3848.24	3108.04	2606.65
ALm	748.53	673.64	612.37	420.94	320.69	259.00	217.22

Flow crosssection for 8 villages in downstream district which may be affected is estimated via the prediction of table 10-2 and see table 10-3 for concrete content.

Table 10-3 Flow Crosssection Estimation List for Each Village

Village	Distance from the dam address	Flow crosssection area (m^2)
Majiaya	800	748.53
Jianjiagou	1600	394.63
Zhuanwan Village	3500	186.19
Ganlu Temple	4500	144.81
Small Village	1300	471.05
Zhangjia Mountain	1800	350.78
Nuangoumen	3300	197.47
Niujiaya	4300	151.55

According to the estimation result of table 10-3, the inhabitants who live in low terrain and near the river among the 8 village will be submerged totally and parts of villages may be submerged completely.

10.5 Management Measures for Environmental Risk

In order to ensure the safety of the dam of this project, bring benefit and abolish harm, prolong the service life of the reservoir dam, make full use the efficiency and strive to avoid hazard risks, the project shall adopt various effective prevention and emergency measures in the whole processes of survey, design, construction and operation to reach the purpose of taking extra precautions and a stitch in time saves nine. According to the cause analysis result of environmental risk for the reservoir dam of this project, by referencing domestic and abroad research achievements about reservoir dam safety and aiming at the major causes which may result in damage of reservoir dam and dam failure, the following prevention and emergency measures are given.

(1) Seriously carryout No.77 Command of State Council “Administrative Regulations of Dam Safety on Reservoirs”. The regulations provide clear provisions and strict requirements for the construction, management and risk disposal of reservoir dam of which the height is more than 15m and the volume is more than 1000000 m^3.

(2) Handle affairs strictly based on the management process of hydropower process. In order to prevent the dam of the reservoir from breaking and damaging, do well in survey, design, construction, acceptance, operation, verification and reinforce sequentially.

(3) Strengthen geological survey of the project. The engineering geological conditions for the reservoir area, dam address and plant address of this project are complex relatively, so that specific engineering geological and underground hydrologic survey shall be implemented carefully so as to ascertain the situation continuously.

(4) Strictly follow the specification to design carefully.

(5) Intensify the management for the construction management of this project. In order to ensure safe operation of the reservoir, the concept of “Long-term project, quality first” must be set up during the construction of the reservoir for the project. Strengthen the supervision for engineering construction and organize supervision, inspection, assessment and acceptance for the project quality so as to reach the purposes of standard construction technology, reasonable utilization of construction materials and strict construction. And do well in the rest finishing problems to ensure quality of the project and completely eradicate jerrybuild project.

(6) Strengthen the management for reservoir operation technology. For assuring the reservoir works safely, reservoir operation scheduling and safe operation technical system must be established and perfected when the reservoir dam is put into operation so as to improve the technical management level; flood prevention plan for the reservoir and scheduling operation plan are compiled reasonably and the regulations for reservoir safe operation are followed. Attach importance to monitor and identify safety of the dam; strengthen the protection and reinforcing for the dam body of reservoir bank and the maintenance for the gate crane; and build observational facilities meeting the safety of the dam to frequently check and regularly observe the safety status of the dam. The flood data is rechecked and measures are adopted in time as soon as any problem is found so as to completely eradicate the reservoir works in bad conditions. Pay attention to the constructions for reliable predication, warning system and improvements of traffic and communication facilities. Emergency flood prevention plan is made to prepare before the flood comes and provide measures when flood coming. Standby power supply and equipments for starting up/shutting down the gate are provided so as to assure the flood can be discharged in time. Harsh flood discharging measures shall be prepared in advance for the extraordinary rainstorm flood exceeding the standards and the downstream shall be informed for preparing for emergency flood fighting in advance.

(7) Forbid the work which can induce slump in the reservoir area. Forbid bombing stones and fishes in/out, near or around the reservoir area freely stacking a lot of materials and buildings in the reservoir area or two side slopes of the section near the dam during operation of the reservoir dam so as to prevent slumping.

10.6 Emergency Arranged Plan

The emergency arranged plan for dam failure risk of Moba Gorge Water Project adopts “APELL Plan” (Awareness and Preparedness for Emergencies at Local Level).

See figure 10-1 for the information and organization flow diagram of “APELL plan”.

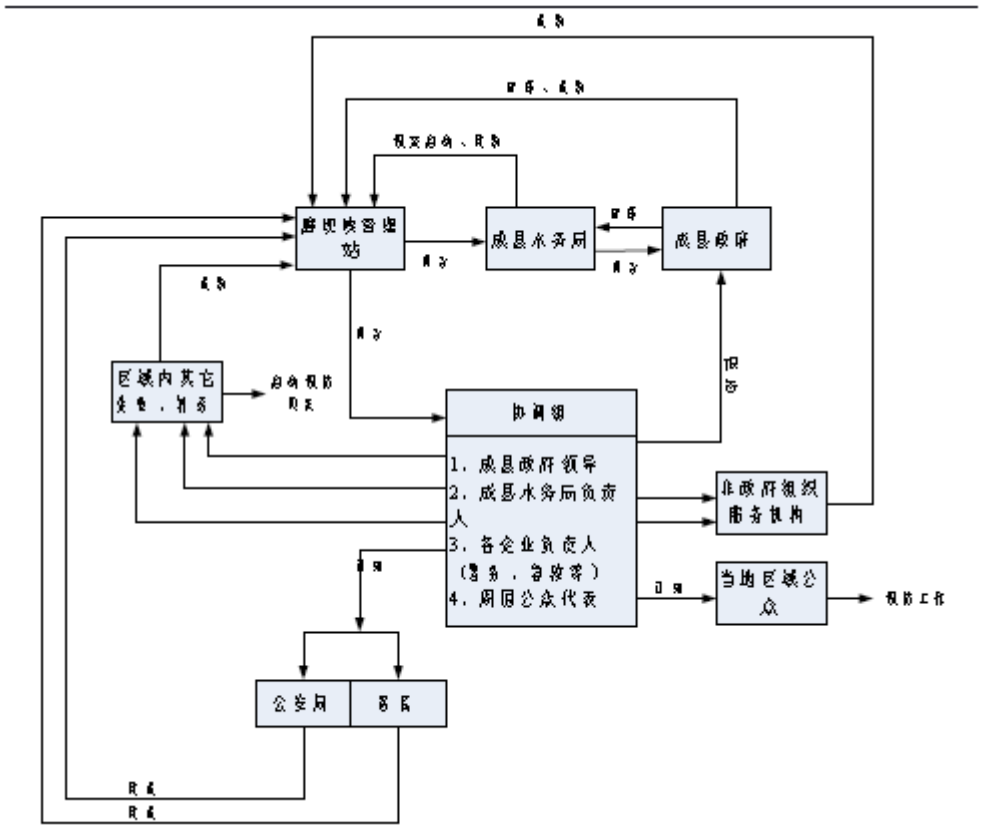


Figure 10-1 APELL Information and Organization Flowchart

10.6.1 Basic Content of Emergency Arranged Plan

10.6.1.1 Organizations

"APELL Plan" Coordination Group consists of local government departments, Construction and Management Office for Cheng County Urban Water Supply of Moba Gorge Water Supply and the resident representatives nearby. See figure 10-2 for the duty range of coordination group.

Meanwhile, the departments of polices, medical treatment, rescue, environmental protection, traffic, Red Cross Society and communication and so on in Cheng County shall join in the emergency support plan also and undertake relevant responsibilities.

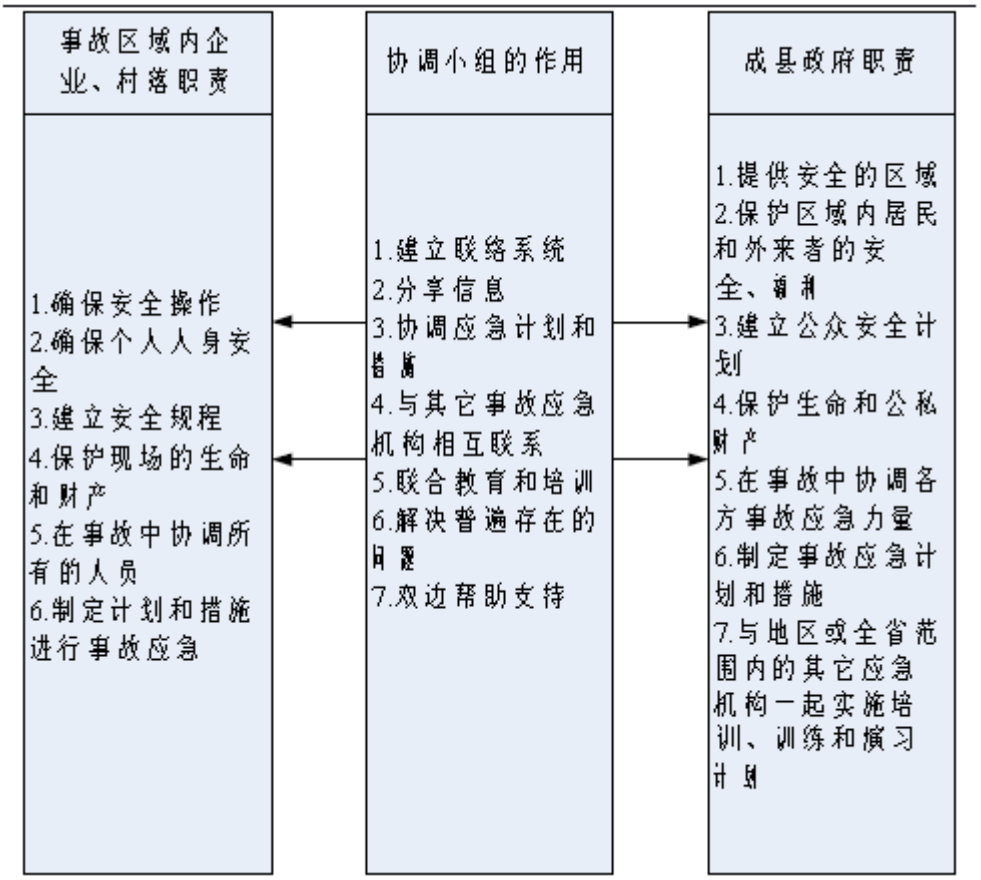


Figure 10-2 Responsibilities for Each Emergency Arranged Plan Group of Cheng County Moba Gorge Project

Responsibilities of the enterprises and villages in the accident region

1. Ensure safe operation.
2. Ensure individual personal safety.
3. Establish safety specifications.
4. Protect the lives and assets at the field.
5. Coordinate with all personnel in the accident.
6. Make plans and measures to deal with the accident.

Function of the coordination group

1. Establish a contact system.
2. Share information.
3. Coordinate emergency plans and measures.
4. Mutually contact with other accident emergency organizations.
5. Combine the education with the training.
6. Solve the common problem.

7. Provide bilateral help and support.

Responsibilities of Cheng County Government

1. Provide safe area.

2. Protect the safety and benefit of the residents and foreign in the area.

3. Establish public safety plan.

4. Protect lives and public assets.

5. Coordinate accident emergency powers from various parties in the accident.

6. Make emergency plans and measures for the accident.

7. Be trained and practice together with other emergency organizations in the area or the whole province.

10.6.1.2 Emergency Rescue Scheme

(1) Once urgent accidents happen, set up emergency rescue headquarters based on “APELL Plan” and try best to protect the life and property of the people and environmental safety in the dangerous area so as to minimize the loss;

(2) The duty of Construction and Management Office for Cheng County Urban Water Supply of Moba Gorge Water Supply Project comprises: conclusion fast, delivering relevant information and harm estimation for the accident, publishing warning information, and organizing evacuation quickly and leaving from the dangerous region;

(3) Duty of Moba Gorge management station: Responsible for reporting the nature of the accident, strength, consequences and so on; adopting urgent measures for the accident spot so as to preventing the accident from spreading and reducing dangerous; and rescuing the casualties in the accident region;

(4) Rescue from professional team: Organize personnel evacuation and rescue actions of medical treatment and other professional teams;

(5) Traffic control: Implement traffic control for the diffusion zone to effectively evacuate;

(6) Assurances from transportation, materials, communication, advertising and so on;

(7) Provide specially-assigned personnel and instrument medicines for rescue;

(8) Rescue recovery: Include releasing the warning, cleaning the site, aftercare disposal and accident investigation.

10.6.2 Plan Exercise

In order to enhance scientific, pertinence, effectiveness and operability of the arranged plan, anti-accident exercises are implemented in the regions which may be affected by the accident possibly, including the enterprises, villages and residential areas and so on in the region. Meanwhile, contact with the environmental emergency organizations of other reservoir construction projects to organize and participate local rescue activities and promote related communication and cooperation. The purposes of detecting the arranged plan, exercising the team and improving capability are achieved via exercises. What’s more, the exercises all promote to link between the emergency plan for Moba Gorge Water Supply Project and emergency plan of Cheng County Government and consistently perfect the emergency plan.

11 Public Participation

11.1 Significance and Purpose of Public Participation

11.1.1 Significance of Public Participation

Public participation is an important element of environmental influence evaluation, but also is an effective way to perfect scientific decisions. Public participation of construction project is an important mean for promoting mutual exchange and communication among the project construction units, the environmental influence evaluation units and the public. Through wide public participation, the public which are affected directly or indirectly by construction of the project would fully understand the possible environmental influence, the environmental protection measures adopted for relieving the influence and economic and social profits brought by the construction project and the pubic also can propose various opinions and suggestions simultaneously, contribute ideas to the project construction actively and seek a way for solving the problems together so as to minimize the influence on the environment, avoid pollution dispute during construction and operation of this project and coordinate development and environmental protection better.

11.1.2 Purpose of Public Participation

(1) Comprehensively analyze the public suggestions and implement in the supervision measures for environmental protection; and take the public opinions as the action guideline in future project construction process.

(2) Communicate with two-way opinions from the pubic and the construction unit; introduce the project summary, pollution condition, control measures, environmental influence evaluation prediction result and so no in detail to the public. The opinions and suggestions from the public shall be reported to the unit for implementing construction also and a revision plan is given so as to realize the bridge function between the public and the unit for implementing construction.

11.2 The First Public Participation

11.2.1 Methods for Public Participation

In order to comprehensively, correctly reflect public opinions and based on the requirements of World Bank, the public participation for this environmental influence evaluation adopts ration investigation, public notification and forum.

11.2.2 Public Participation Investigation

The investigation questionnaires for this environmental influence evaluation are divided into two types: governmental organ questionnaires and public questionnaires; and the content for the questionnaire is designed based on the characteristics, sale and possible influence degree of the proposed project.

11.2.2.1 Individual Public Participation Investigation

(1) Investigated Range and Object

This public opinion investigation provided 100 questionnaires in total, wherein 10 questionnaires are distributed to the migrants in the reservoir area. 100 effective questionnaires are reclaimed and the recovery is 100 %.

(2) Investigated Content

See table 11-1 for the concrete content of questionnaire for this public participation.

Table 11-1 Public Participated Questionnaire for Environmental Influence Evaluation of Cheng County Moba Gorge Water Supply Project

Name		Sex		Age		Degree of education	
Career		Phone		Contact			
1. How much do you know about the project construction? ☐Understand ☐Understand much ☐Do not understand							
2. Satisfaction for current situation of urban water supply in this district? ☐Satisfy very much ☐Satisfy ☐Do not satisfy							
3. Considering current water supply situation in Cheng County, do you think whether construction of this project is necessary? ☐Yes ☐No ☐Don't matter.							
4. What's your opinions about the environmental issue caused by the construction of this project ? ☐Air pollution ☐Water pollution ☐Solid waste pollution ☐Noise pollution ☐Ecological environment destroy							
5. Do you think whether the project is good for local economic development? ☐Yes ☐No ☐Have on influence.							
6. What's your opinion about the harm for environment caused by this project? ☐Serious ☐Large relatively ☐General ☐Small ☐Not very clear							
7. How about the location of this project? ☐Reasonable ☐Unreasonable							
8. Do you agree to the construction of this project? ☐Yes ☐No ☐Don't matter.							
9. Are you willing to be the volunteer supervisor of this project? ☐Yes ☐No							
10. Aiming at the construction of this project, do you have any suggestions and requirements on environmental protection?							

Project Profile:

Major construction content of Moba Gorge Water Supply Project includes building Moba Gorge Reservoir newly and laying waterlines. Normal impoundment level of Moba Gorge Reservoir is 1092.68m; the exceptional flood level is 1098.47m; and the total reservoir volume is 1787 0000 m^3. The dam body is decided concrete-faced rockfill dam. 5.04km waterlines are laid and total investment amount for construction of this project is 264453800 RMB.

Environmental Influence:

Major pollution source during construction: Construction noise produced by the construction machinery and transportation vehicles and so on, dust raise produced from earthwork excavation, materials transportation and other construction link, domestic sewage from the constructors and the influence on ecology.

The major pollution sources during operation: household wastes and domestic sewage from the administrative personnel of the management station.

Environmental Protection Measures

During construction: Strengthen construction management measures, adopt equipments in low noise and reasonably arrange construction time and so on; adopting watering method and other measures for solving dust raise problem; construction domestic waste water is collected and used for watering or greening surrounding after depositing; regularly clean the household wastes produced during construction and transport to the assigned place for disposal; and do well in prevention for water loss and soil erosion.

During operation: Adopt WSZ buried sewage treating equipment to dispose the domestic sewage produced by the administrative personnel of the management station; uniformly collect the household wastes and transport the wastes to Cheng County Landfill site for household waste to dispose; and regularly monitor the water quality in the reservoir area.

(3) Basic information of the investigated person

See table 11-2 and table 11-3 for the statics result of the investigated personnel.

Table 11-2 Personnel List for Respondents of Public Participation

No.	Name	Sex	Age	Degree of education	Career	Unit or address	Remark
1	Meng Caixia	Female	40	Junior college	Teacher	Cheng County No. 1 Middle School	
2	Zhang Zhiyong	Male	49	Junior college	Public servant	Cheng County Hydroelectric Board	
3	Feng Guanwang	Male	41	Junior college	Teacher	Cheng County No. 1 Middle School	
4	Ma Ling	Female	40	Junior college	Teacher	Chengguan Middle School	

5	Wu Xufei	Male	28	Bachelor	Teacher	Cheng County No. 1 Middle School	
6	Zhang Yankui	Male	26	Junior college	Teacher	Cheng County Hucui Middle School	
7	Zhu Kexin	Male	48	Junior college	Teacher	Cheng County Vocational Secondary School	
8	Wang Xiaohui	Male	35	Junior college	Teacher	Longnan Vocational Secondary School	
9	Han Min	Male	30	Junior college	Teacher	Chengguanshigou Primary School	
10	Su Lingjun	Male	41	Junior college	Teacher	Cheng County No. 1 Middle School	
11	Zou Cuixia	Female	29	Junior college	Teacher	Chengguan Middle School	
12	Yang Haiquan	Male	35	Junior college	Public servant	Road Transport Bureau	
13	Liu Xuhong	Male	43	Junior college	Public servant	National Development and Reform Commission	
14	Niu Peng	Male	37	Junior college	Public servant	Water Board	
15	Quan Pengyu	Male	35	Junior college	Public servant	Construction Bureau	
16	Zhang Yahui	Male	37	Junior college	Public servant	Construction Bureau	
17	Kang Pengbo	Male	31	Junior college	Public servant	Environmental Protection Bureau	
18	Fu Kang	Male	30	Bachelor	Public servant	Forestry Bureau	
19	Kang Xiaofei	Male	28	Bachelor	Public servant	Water Board	

20	Zhao Qi	Male	29	Bachelor	Public servant	Cheng County People's Hospital	
21	Tai Yaxi	Female	15	Senior middle school	Student	Cheng County No. 1 Middle School	
22	Zhou Hongjiang	Male	15	Junior middle school	Student	Cheng County Zhifang Middle School	
23	Wang Yuding	Female	13	Junior middle school	Student	Cheng County Chengguan Middle School	
24	Deng Jiu	Male	19	Senior middle school	Student	Cheng County No. 1 Middle School	
25	Zheng Qi	Female	12	Primary School	Student	Class One Grade Six of West Primary School	
26	Chen Yinong	Male	17	Senior middle school	Student	Cheng County No. 1 Middle School	
27	Xue Yasuo	Male	14	Junior middle school	Student	Chengguan Middle School	
28	He Zhao	Female	18	Senior middle school	Student	Cheng County No. 1 Middle School	
29	Zhang Yaqun	Male	14	Junior middle school	Student	Chengguan Middle School	
30	Zheng Chengyu	Male	16	Junior middle school	Student	Cheng County No. 1 Middle School	
31	Chen Zao	Male	28	Senior middle school	Peasant	Shaba Town Yanshan Village	
32	Yang Shucang	Male	38	Junior middle school	Peasant	Shaba Town Yanshan Village	
33	Yuan Bancheng	Male	43	Junior middle school	Peasant	Shaba Town Yanshan Village	

34	Niu Yanping	Male	39	Primary School	Peasant	Shaba Town Niuyao Village	
35	Niu Sanyong	Male	45	Primary School	Peasant	Shaba Town Niuyao Village	
36	Niu Zhisheng	Male	47	Primary School	Peasant	Shaba Town Niuyao Village	
37	Yao Erqiang	Male	24	Primary School	Peasant	Shaba Town Niuyao Village	
38	Niu Keqiang	Male	41	Primary School	Peasant	Shaba Town Niuyao Village	
39	Niu Laixin	Male	45	Junior middle school	Peasant	Shaba Town Niuyao Village	
40	Niu Jiansheng	Male	37	Junior middle school	Peasant	Shaba Town Niuyao Village	
41	Niu Yanyang	Male	39	Junior middle school	Peasant	Shaba Town Niuyao Village	
42	Yao Xiaoyuan	Male	35	Junior middle school	Peasant	Shaba Town Niuyao Village	
43	Niu Zaichang	Male	37	Junior middle school	Peasant	Shaba Town Niuyao Village	
44	Zhao Jiageng	Male	45	Junior middle school	Peasant	Shaba Town Niuyao Village	
45	Niu Shuangxiong	Male	26	Junior middle school	Peasant	Shaba Town Niuyao Village	
46	Niu Guichuan	Male	35	Junior middle school	Peasant	Shaba Town Niuyao Village	
47	Niu Haoqiang	Male	32	Primary School	Peasant	Shaba Town Niuyao Village	

48	Ma Guijie	Male	57	Primary School	Peasant	Shaba Town Niuyao Village	
49	Niu Yijun	Male	42	Junior middle school	Peasant	Shaba Town Niuyao Village	
50	Niu Baoqiang	Male	34	Primary School	Peasant	Shaba Town Niuyao Village	
51	Wang Shujun	Male	28	Junior middle school	Peasant	Shaba Town Yanshan Village	
52	Qiao Hong	Male	38	Senior middle school	Peasant	Shaba Town Yanshan Village	
53	Qiao Jiqiang	Male	41	Junior middle school	Peasant	Shaba Town Yanshan Village	
54	Li Wei	Male	40	Senior middle school	Peasant	Shaba Town Yanshan Village	
55	Yuan Pengfei	Male	27	Junior college	Worker	Shaba Town Yanshan Village	
56	Yang Shucang	Male	38	Junior middle school	Peasant	Shaba Town Yanshan Village	
57	Lu Jianjun	Male	46	Junior middle school	Peasant	Shaba Town Yanshan Village	
58	Yuan Fuqiang	Male	42	Junior middle school	Peasant	Shaba Town Yanshan Village	
59	Wang Shucheng	Male	50	Primary School	Peasant	Shaba Town Yanshan Village	
60	Niu Zhifeng	Male	43	Junior middle school	Peasant	Shaba Town Yanshan Village	
61	Niu Junfeng	Male	38	Junior middle school	Peasant	Shaba Town Niuyao Village	

62	Niu Lailu	Male	51	Junior middle school	Peasant	Shaba Town Niuyao Village	
63	Zhang Xianghui	Female	59	Junior middle school	Peasant	Shaba Town Niuyao Village	Migrant from reservoir area
64	Wang Zhiping	Male	34	Primary School	Peasant	Shaba Town Niuyao Village	Migrant from reservoir area
65	Wang Feng'e	Female	61	Primary School	Peasant	Shaba Town Niuyao Village	Migrant from reservoir area
66	Niu Xinjun	Male	38	Primary School	Peasant	Shaba Town Niuyao Village	
67	Niu Kuanshe	Male	48	Junior college	Peasant	Shaba Town Niuyao Village	
68	Ma Shuliang	Male	46	Primary School	Peasant	Shaba Town Niuyao Village	Migrant from reservoir area
69	Ma Xiaoping	Female	44	Primary School	Peasant	Shaba Town Niuyao Village	Migrant from reservoir area
70	Ma Penghui	Male	21	Junior middle school	Peasant	Shaba Town Niuyao Village	Migrant from reservoir area
71	Zhang Weiping	Male	30	Primary School	Peasant	Shaba Town Niuyao Village	
72	Niu Yanliang	Male	35	Primary School	Peasant	Shaba Town Niuyao Village	
73	Niu Xingliang	Male	38	Primary School	Peasant	Shaba Town Niuyao Village	
74	Ma Xingmin	Male	62	Junior middle school	Peasant	Paosha Town Moba Gorge Village	
75	Zhang Zhiwen	Male	58	Junior middle school	Peasant	Paosha Town Moba Gorge Village	

76	Zhang Xiaoyin	Male	45	Junior middle school	Peasant	Paosha Town Moba Gorge Village	
77	Wang Huiping	Male	38	Junior middle school	Peasant	Chenyuan Wushan Village	
78	Wang Deque	Female	48	Primary School	Peasant	Chenyuan Wushan Village	
79	Shan Guandi	Female	39	Primary School	Peasant	Chenyuan Wushan Village	
80	Li Guilin	Male	54	Junior middle school	Peasant	Chenyuan Wushan Village	
81	Wang Zheye	Female	36	Primary School	Peasant	Chenyuan Wushan Village	
82	Wang Chuping	Male	29	Junior middle school	Peasant	Chenyuan Wushan Village	
83	Wang Manxue	Male	36	Primary School	Peasant	Chenyuan Wushan Village	
84	Wu Guocun	Male	48	Primary School	Peasant	Chenyuan Wushan Village	
85	Wang Qiuyan	Female	42	Primary School	Peasant	Chenyuan Wushan Village	
86	Yao Yanru	Female	42	Primary School	Peasant	Chenyuan Wushan Village	
87	Niu Zhaoshan	Male	50	Senior middle school	Peasant	Chenyuan Wushan Village	
88	Wu Guoxue	Male	38	Junior middle school	Peasant	Chenyuan Wushan Village	
89	Wu Xuhui	Male	20	Junior middle school	Peasant	Chenyuan Wushan Village	

90	Wu Xiaokong	Male	35	Primary School	Peasant	Chenyuan Wushan Village	
91	Wu Yonghui	Male	30	Primary School	Peasant	Chenyuan Wushan Village	
92	Wu Cuixin	Male	40	Primary School	Peasant	Chenyuan Wushan Village	
93	Wu Changyin	Male	30	Primary School	Peasant	Chenyuan Wushan Village	
94	Wang Zhijun	Male	42	Senior middle school	Peasant	Chenyuan Wushan Village	Migrant from reservoir area
95	Wang Lifeng	Male	20	Junior middle school	Peasant	Chenyuan Wushan Village	Migrant from reservoir area
96	Xu Yingxiang	Male	73	Primary School	Peasant	Chenyuan Wushan Village	Migrant from reservoir area
97	Yuan Xingyun	Female	36	Primary School	Peasant	Chenyuan Wushan Village	Migrant from reservoir area
98	Wu Cao	Male	40	Primary School	Peasant	Chenyuan Wushan Village	
99	Wu Zhimiao	Male	65	Primary School	Peasant	Chenyuan Wushan Village	
100	Wu Weijun	Male	53	Junior middle school	Peasant	Chenyuan Wushan Village	

Table 11-3 Personnel List for Respondents of Public Participation

Project		Number of people	Percentage (%)
Sex	Male	88	88
	Female	12	12
Age distribution	18 years old bellow	8	8
	18～25 years old	5	5
	26～35 years old	28	28
	36～45 years old	40	40

	45 years old above	19	19
Degree of education	Primary School	32	32
	Junior middle school	38	38
	Technical training	0	0
	Senior middle school	8	8
	Junior college	18/	18
	Bachelor	4	4
Career	Teacher	10	10
	Public servant	10	10
	Student	10	10
	Worker	1	1
	Peasant	69	69

(4) Investigation Result Statistics for Public Participation

See table 11-4 for concrete investigation result for public participation and see table11-5 for migrant from reservoir.

Table 11-4 Investigation Result Statistics for Public Participation

Investigated content	Public opinion	Number of people	Percentage (%)
What do you know about the construction of this project?	Know	46	46
	Understand very much	53	53
	Don't know	1	1
Satisfaction for current situation of urban water supply in this district?	Satisfy	0	0
	Satisfy very much	29	29
	Do not satisfy	71	71
Considering current water supply situation in Cheng County, do you think whether construction of this project is necessary?	Yes	99	99
	No	0	0
	Don't matter	1	1
Do you think whether the project is good for local economic development?	Yes	99	99

	No	0	0
	Have on influence.	1	1
What's your opinions about the environmental issue caused by the construction of this project?	Air pollution	0	0
	Water pollution	0	0
	Solid waste pollution	15	15
	Noise pollution	10	10
	Ecological environment destroy	50	50
	Others	25	25
What's your opinion about the harm for environment caused by this project?	Serious	1	1
	Large relatively	0	0
	General	4	4
	Small	80	80
	Not very clear	15	15
. How about the location of this project?	Reasonable	100	100
	Unreasonable	0	0
Do you agree to the construction of this project?	Agree	100	100
	Do not agree.	0	0
	No matter.	0	0
	Not clear.	0	0
Are you willing to be the volunteer supervisor of this project?	Yes.	86	86
	No.	1	1
	Not answered.	13	13

Aiming at the construction of this project, do you have any suggestions and requirements on environmental protection?	Strengthen environmental protection and assure safety of drinking water.

Table 11-5 Investigation Result Statistics for Public Participation of Migrant from Reservoir Area

Investigated content	Public opinion	Number of	Percentage (%)
What do you know about the construction of this project?	Understand	10	100
	Understand a little	0	0
	Do understand	0	0
Satisfaction for current situation of urban water supply in this district?	Satisfy	2	20
	Satisfy very much	0	0
	Do not satisfy	10	100
Considering current water supply situation in Cheng County, do you think whether construction of this project is necessary?	Yes	10	100
	No	0	0
	Don't matter	0	0
What's your opinions about the environmental issue caused by the construction of this project?	Air pollution	0	0
	Water pollution	0	0
	Solid waste pollution	0	0
	Noise pollution	0	0
	Ecological environment destroy	10	100
	Others	0	0
Do you think whether the project is good for local economic development?	Yes	10	100
	No	0	0
	Have on influence.	0	0

What's your opinion about the harm for environment caused by this project?	Serious	0	0
	Large relatively	0	0
	General	0	0
	Small	10	100
	Not very clear	0	0
. How about the location of this project?	Reasonable	10	100
	Unreasonable	0	0
Do you agree to the construction of this project?	Agree	10	100
	Do not agree.	0	0
	No matter.	0	0
	Not clear.	0	0
Are you willing to be the volunteer supervisor of this project?	Yes.	10	10
	No.	0	0
	Not answered.	0	0
Aiming at the construction of this project, do you have any suggestions and requirements on environmental protection?	Speed up construction and assure safety of drinking water.		

(5) Investigation result analysis for public participation

Among the 100 investigated persons, 99% of them know some information about the project, wherein in all migrants from reservoir area understand the project; all the investigated persons do not satisfy with the current water supply of Cheng County, wherein all migrants from reservoir area do not satisfy with the current water supply of Cheng Count; 99% of them support the construction of this project, wherein the migrants from reservoir area support this project completely; 99% of them consider the project is good for local economic development, wherein the migrants from reservoir area consider the project is good for local economic development; and 99% of them consider the construction of this project generates small influence on the environment, wherein the migrants from reservoir area completely consider the project has small environmental influence. Most people think safety for drinking water shall be assured during operation of the project.

On the whole, the investigated persons support the construction of this project mostly and consider the project has small influence on environment, so that they think the operation of this project can promote the development of local economy and advantages of the project outweigh the disadvantages.

11.2.2.2 Governmental Organ Investigation

(1) Investigated object

The investigated governmental organs manly include 20 departments of Environmental Protection Board, Cheng County Land Resource Bureau, Cheng County Water Board, Cheng County Forestry Bureau, Cheng County Traffic Bureau, Cheng County Water Conservation Bureau, Cheng County People's Congresses Committee, Cheng County People's Government, Cheng County Development and Reformation Bureau, Cheng County Public Security Bureau**,** Cheng County Construction Bureau, Cheng County Planning Department, Cheng County Health Bureau, Cheng County Running-water Company, Chenyuan People's Government, Shaba People's Government, Cheng County Finance Bureau, County Office, Cheng County Education Bureau and CPPCC Cheng County Committee Office and so on. See table 11-6 for the questionnaire and see table 11-7 for the investigated governmental organs.

Table 11-6 Investigation Questionnaire of Environmental Influence Caused by Cheng County Moba Gorge Water Supply Project for Governmental Organs

Organization name:	Organization public seal:
Contact phone:	
1. Does your organization consider the address for Moba Gorge Water Supply Project is reasonable?	
2. Does your organization think which aspects should be noted during construction of the project?	
3. Does your organization think whether the construction of this project is necessary?	
4. Does your organization think whether local current water supply situation can be improved after the project is set up?	
5. On the view of industrial management, which major issues does your organization concern about the construction and development of the project?	
6. On the view of environmental protection, which suggestions or opinions for management of this project does your organization have?	
7. Considering on the view of environmental protection, which suggestions or opinions for construction of this project does your organization have?	
8. Does your organization think whether the project is good for local economic development after the project is set up?	
9. Does your organization agree with the construction of the project?	
10. Other suggestions or opinions and requirements:	
Project Profile: Major construction content of Moba Gorge Water Supply Project includes building Moba Gorge Reservoir newly and laying waterlines. Normal impoundment level of Moba Gorge Reservoir is 1092.68m; the exceptional flood level is 1098.47m; and the total reservoir volume is 1787 0000 m^3. The dam body is decided concrete-faced rockfill dam. 5.04km waterlines are laid and total investment amount for construction of this project is 264453800 RMB. **Environmental Influence:** Major pollution source during construction: Construction noise produced by the construction machinery and transportation vehicles and so on, dust raise produced from earthwork excavation,	

materials transportation and other construction link, domestic sewage from the constructors and the influence on ecology.

The major pollution sources during operation: household wastes and domestic sewage from the administrative personnel of the management station.

Environmental Protection Measures

During construction: Strengthen construction management measures, adopt equipments in low noise and reasonably arrange construction time and so on; adopting watering method and other measures for solving dust raise problem; construction domestic waste water is collected and used for watering or greening surrounding after depositing; regularly clean the household wastes produced during construction and transport to the assigned place for disposal; and do well in prevention for water loss and soil erosion.

During operation: Adopt WSZ buried sewage treating equipment to dispose the domestic sewage produced by the administrative personnel of the management station; uniformly collect the household wastes and transport the wastes to Cheng County Landfill site for household waste to dispose; and regularly monitor the water quality in the reservoir area.

Table 11-7 Investigated Governmental Organ List

No.	Governmental Organ	No.	Governmental Organ
1	Cheng County Environmental Protection Board	2	Cheng County Land Resource Bureau
3	Cheng County Water Board	4	Cheng County Forestry Bureau
5	Cheng County Traffic Bureau	6	Cheng County Water Conservation Bureau
7	Cheng County People's Congresses Committee	8	Cheng County People’s Government
9	Cheng County Development and Reformation Bureau	10	Cheng County Public Security Bureau
11	Cheng County Construction Bureau	12	Cheng County Planning Department
13	Cheng County Health Bureau	14	Cheng County Running-water Company
15	Chenyuan People’s Government	16	Shaba People’s Government
17	Cheng County Finance Bureau	18	Cheng County Education Bureau
19	County Office	20	CPPCC Cheng County Committee Office

(2) Investigation Result Analysis

The investigated organizations completely consider address of this projet is applicable and support the construction of this project because they think construction for the project is necessary and the project can improve local current situation for supplying water.

The opinions from the investigated organizations include: speed up the construction of the project so as to improve current urban water supply; and formulate specific vegetation recovery scheme in the reservoir area so as to make full use of ecological function in the reservoir area.

11.2.3 Public Notification

(1) Form of public notification

In order to make the public around the region where the project locates understand the possible influence on local environment cause by the construction of the project faster, correctly and comprehensively, the unit for implementing construction asked for public opinions via the form of newspaper. The public can contact with the unit for implementing construction and the environmental influence evaluation unit in the manners of written letters, phones and fax to offer a proposal.

(2) Date for public notification

The public notification was carried out in “Longnan Daily Newspaper” on January 9th, 2011 to ask for public opinions for the project.

(3) Public notification materials

Please see the attachments for public notification materials.

(4) Public notification result

No public opinion was received during public notification.

11.2.4 Forum

(1) Time and place

According to relevant requirements of World Bank, forums were respectively held in Shaba Town Niuyao Village on January 7th, 2011 and in Chenyuan Town Wujiashan Village on January 8th, 2011 and the talked content was recorded. Please see the attachment for the record materials of the forums.

Figure 11-1 Forum in Shaba Town Niuyao Village on January 7th, 2011

Figure 11-2 Forum in Chenyuan Town Wujiashan Village on January 7th, 2011

(2) Forum result

Specific circumstances of this project were told to local people via holding forums in Shaba Town Niuyao Village and Chenyuan Town Wujiashan Village which are largely influenced by the project through the governmental officer, so that local people primarily understood the project. In spot of forum, the governmental officer not only explained relevant circumstances of this project in details, but also answered the questions asked by the villagers patiently. The forums were over in a warm and peaceful atmosphere of a successful conclusion and all villagers support the construction of this project.

11.2.5 Conclusion of Public Participation

(1) The environmental influence evaluation unit comprehensively notified the opinions and requirements from the public to the unit for implementing construction and required the unit for implementing construction took the opinions and requirements from the public seriously. And the unit for implementing construction was expected to strengthen environmental protection treatment, the suggestions about environmental protection management and research carefully, as well as implement the suggestions during construction of various environmental protection measures.

(2) Suggestions for environmental protection of this project are given by the public and water quality monitor is required to be strengthened after the reservoir is established so as to assure the water source area is not polluted.

11.3 The Second Public Participation

According to requirements of World Bank, the second public participation is implemented again after environmental influence evaluation for the project is approved by domestic relevant departments.

11.3.1 Method for Public Participation

According to requirements of World Bank, this public participation adopts two forms of forum and environmental influence evaluation report and environmental management plan public notification.

11.3.2 Forum

(1) Time and place

According to relevant requirements of World Bank, forums were respectively held in Shaba Town Niuyao Village on September 16th, 2011 and in Chenyuan Town Wujiashan Village on September 15th, 2011 and the talked content was recorded. Please see the attachment for the record materials of the forums.

Figure 11-3 Forum in Chenyuan Town Wujiashan Village on September 15th, 2011

Figure 11-4 Forum in Shaba Town Niuyao Village on September 16th, 2011

(2) Forum result

In spot of forum, the governmental officer not only explained relevant circumstances of this project in details, but also answered the questions asked by the villagers patiently. Based on this, the villagers had several following requirements for the construction of the project:

① Ensure the relocation policy mentioned in environmental influence evaluation and resolve real difficulties during relocation in time.

② Strengthen the management, promise engineering quality and prevent jerrybuild project; strengthen patrol and prevent dam failure after the project is completed.

③ Strengthen monitoring for water quality and assure the water quality for water supply reaches the standard;

④ Implement environmental management plan, ensure civilized construction and prevent disturbing residents and environmental pollution during construction.

⑤ Speed up construction of this project and improve local water supply conditions.

11.3.3 Public Notification

The environmental influence evaluation report and the environmental management plan were published in Cheng County Xinhua Bookstore and library by Cheng County Water Board and the electronic version was uploaded to the initial page of the website (www.gscx.gov.cn) of Cheng County People's Government so as to be consulted conveniently by the public.

Figure 11-5 Public Notification in Library

Figure 11-6 Public Notification in Xinhua Bookstore

Figure11-7 Website Public Notification

11.3.4 Conclusion

The environmental influence evaluation result and environmental management plan for this project were faithfully informed to the local people via the second public notification, so that local people could supervise the construction of this project together, which was good for finding and controlling the environmental issues in time during operation of this project.

12 Conclusion and Suggestion

12.1 Evaluation Conclusion

12.1.1 Project Profile

The problem of water storage in urban area is urgent because of insufficient water supply in urban Cheng County, so that Moba Gorge Water Supply project is decided for building newly. Major task of the project is to supply water to urban Cheng County. The project is constructed for the purposes of solving urban water supply problem, improving water quality, reducing cost for supplying water, realizing social and economic sustainable development of Cheng County and enhancing human health level of urban residents.

On June 10th, 2009, Lanzhou University compiled "Environmental Influence Evaluation Report for Gansu Cheng County Moba Gorge Water Project" and Gansu Environmental Protection Bureau replied "Environmental Influence Evaluation Report for Gansu Cheng County Moba Gorge Water Project" via No. [2009] 60 report of Gansu environment spontaneity on June 30th, 2009. And the environmental influence evaluation report was approved. At that moment, the designed scale of the reservoir was about 50000m³/d; normal water storage level was 1096.104m; exceptional flood level was 1101.70m; total reservoir volume was 20198040 m³; and 4.74km waterlines were laid. And then, the designed scale of the reservoir was changed as 47500m³/d; normal water storage level was changed 1092.70m; exceptional flood level was 1098.52m; total reservoir volume was changed as 17900000m³; and waterlines for laying was 5.15km via checking by relevant department of World Bank.

12.1.2 Current Environmental Quality in the Area

12.1.2.1 Current Environmental Quality of Surface Water

From August 8th, 2010 to August 10th, 2010, Tianshui Environmental Monitoring Station monitored the water quality of surface water for three days consistently. Six monitoring sections were established and the monitoring 29 items included: water temperature, pH, aluminum, iron, manganese, copper, zinc, volatized phenol, detergent composed by cationic anionic, sulfate, chloride, chemical oxygen demand, dissolved oxygen, arsenic, cadmium, chromium (sexavalence), cyanide, fluoride, lead, mercury, nitrate, selenium, potassium permanganate index, BODS, ammonia nitrogen, total nitrogen, total phosphorus, escherichia coli and oil and so on. Among all monitored items, density differences for all other items at various sections were small except arsenic in Erliangya Beicun Xiaogou was higher than other sections obviously. All monitored items did not exceed the standards at various monitoring sections for surface water. Therefore, the water quality of surface water meets the III standard of "Environmental Quality Standard of Surface Water" (GB3838-2002) and the boundary value of supplementary items.

12.1.2.2 Current Bottom Material Quality of River

From December 8th, 2010 to December 10th, 2010, Tianshui Environmental Monitoring Station monitored the bottom material quality of river for three days consistently. Three monitoring sections were established and the monitoring 9 items included: copper, zinc, hexavalent chromium, lead, total chromium, sulfide, mercury, arsenic and so on. Among all monitored items, density differences for all other items at various sections were small except arsenic at the dam was lower than other sections obviously. Except hexavalent chromium and sulfide have no evaluation standards, other index are all in accordance with I standard of "Environmental Quality Standard for Soil" GB15618-1995.

12.1.2.3 Current Environmental Air Quality

There is no air pollution source around Moba Gorge Water Project, along with good environmental air and the air can reach the standards of LII standard in "Ambient Air Quality Standard"(GB3095-1996).

12.1.2.4 Current Ecological Environment

In the project region, there are 178 varieties of common trees and wild animals contains wild boars, hare, pheasants, golden pheasants, goats, hedgepigs and so on; there is only fewer spices of fishes. Regional composition is simple relatively and does not have national species and species which are listed in Appendix I and Appendix II of “Convention on International Trade in Endangered Species of Wild Fauna and Flora” and “China Red Data Book of Endangered Animals”. But the region owns provincial key protected aquatic wild animals Schizopygopsis kialingensis and Schizothorax davidi. The Erlang River Southern Month in the river segment in the project region is the place for overwintering and breeding for Schizothorax subfamilies fishes. There no “three place” for other fishes. And the project region also has no mine area and historical relic and is not in the range of Jifeng Mountain Natural Protection Zone.

12.1.3 Project Profile

Major task Cheng County Moba Gorge Water Project is to supply water to urban Cheng County. The project is constructed for the purposes of solving urban water supply problem, improving water quality, reducing cost for supplying water, realizing social and economic sustainable development of Cheng County and enhancing human health level of urban residents.

The project locates at 1km from west of Cheng County and is 6km away from Paosha Town; and it locates at downstream of South River basin. The geographical position is: northern latitude 33°45 ´ ~33°38 ´ , eastern longitude 105°33 ´ 55″ ~105°57 ´ 60″ , belong to the Jialing River water system at upstream of Yangtze River.

Total reservoir volume is 17900000m³; utilizable reservoir volume is 10400000m³; normal water storage level is 1092.7m; maximum daily water supply quantity is 47500m³; annual average water supply quantity is 16510000m³; average daily water supply quantity is 45200m³. 5.15km waterlines are laid and backwater length of the reservoir is 3.5km. Construction period of the project lasts 27 months and static total investment cost is 226563000 RMB, wherein environmental protection investment takes 6.74%.

Total land for the project is 95.36hm^2, wherein 71.91hm^2 is permanent land; 23.45hm^2 is temporary land; 12.92hm^2 is occupied cultivated land; 51.64hm^2 is forest land; and 30.8hm^2 is unexploited. The total amount of excavation for the project is 453600m³; filling amount is 386300m³; discarding amount is 467300 m³; and borrowing amount is 400000 m³. One picking place for natural building materials is provided in Small Village material place. The material place locates at the right bank of the downstream South River. Straight distance between the west side of Small Village and the dam is 800m and the distance between the west side of the Small Village and the Small Village is about 650m. Finally, 3 residual places are provided via optimizing and allocating earthwork. 1# residual place locates in the construction area upstream of the dam at the left bank; 2# residual place locates near the place for picking material at the right bank; and 3# residual place locates in the construction area at downstream of the dam at the right bank. Address of the project is selected in accordance with the requirements of Eleventh Five-Year Plan, land use planning, water resource utilization plan and so on. Agreement of local environmental protection department and urban planning department and public support for the address selection of the project are gained because construction conditions for the site are good and in line with the requirements.

12.1.4 Major Pollution Source

(1) Waste water

① During construction

Production waste water caused by stirring concrete, processing sand gravel materials and drainage of foundation pit, wherein regular waste water discharge amount of foundation pit is 3300m³/d, is disposed by: adding flocculating agent (copperas and polyacrylamide) in the

foundation pit. The water is pumped out after it is kept for 2h and part water is used for watering to reduce the dust. The rest water is locally discharged in peripheral drainage channel and the rest sludge is cleared away regularly. And the maximum discharge strength of the waste water for washing the stone materials is 142m³/h and the waste water is treated by flocculating sedimentation method. The supernatant fluid after treated is reclaimed for production manufacturing and watering the site. And sediment is cleaned regularly. Alkaline waste water amount is 12m³/d and is treated by the method of batch type plain sedimentation and adequate acid is added for adjusting pH value. After the pH value is neutral, the clear fluid can be reclaimed for washing the concrete mixing system the sediment is manually cleared away regularly. The amount of the waste water containing oil is 54.6m³/d and is disposed by small-sized oil separation tanks; and the clear fluid is reclaimed after reaching the standard.

Domestic sewage amount is 24m³/d and is collected by building toilet pits; and the toilet pits are cleaned regularly by assigning personnel.

②During operation

Discharge amount of domestic sewage is about3.3m³/d and the major pollutants comprise CODcr, BOD5 and SS of which densities respectively are CODcr300mg/L, BOD5180mg/L and SS200mg/L. The domestic sewage is disposed by adopting buried sewage treating facilities. After treating, the densities are CODcr60mg/L, BOD530mg/L and SS60mg/L and water quality of discharged water meets the LI standard of “Comprehensive Sewage Discharge Standard” (GB8978-1996) .

(2) Waste gas

Air pollution during construction mainly includes construction dust raise and fuel waste gas produced by the construction machineries, wherein major components of the fuel waste gas produced by the construction machineries and transportation vehicles comprise CO, NOx and THC. The emission amount for each pollutant respectively is: CO148.1t, NOX95.78t and THC27.5t. Influence of waste gas during construction can be relieved effectively by reasonably selecting the position of mixing station, determining health protection distance, regularly watering, covering by canvas and updating the old vehicles of which motors consume more oil, efficiency is low and exhaust emission exceeds the standard seriously via implementing the discarding system of compel to update and other measures.

(3) Noise

Mechanical equipments for constructing the project mainly are hammer drills, bulldozers, excavators, blenders, drillers and so on and the noise density is among 84~100dB. Personnel shall be specially assigned to regularly maintain the equipments specially and be responsible for training the constructors in construction site to operate various machineries strictly based on operation specification. Reasonably arrange the time for operating the pile driver, air hammer, hammer drill and other equipments with loud noise and reasonably arrange blasting time so as to reduce the noise generated during the equipment working unusually. Arrange barriers around the construction site so as to reduce the influence on surrounding environment caused by noise.

(4) Solid waste

①During construction

Productivity of household waste is 0.8t/d and is collected by trash cans provided in the construction site to clean and transport regularly. And permanent residual amount is 467300m³ and is respectively transported to the assigned residual places; and the residual places adopt the preventive measure for combining planting measures with engineering measures. The cleaned vegetation in the reservoir area is about 50000m³ and is transported to Cheng County landfill site. There is 14.13t building wastes and is transported to the residual places arranged by the project.

②During operation

Household waste amount is 10.22t/a and the management station provides two trash cans to collect the household waste in concentration and clean and transport the waste regularly.

12.1.5 Environmental Influence Evaluation

(1) Hydrology and sediment

After the project is built, 4km river segment will be reduced. There are 8 villages of Zhuanwanli, Ganlu Temple, Majiaya, Jianjiagou, Small Village, Zhangjia Moutain, Luangou Mountain and Niujiaya in this river segment. Major water sources for the eight villages are local mountain spring and underground water but not the water in this river segment, so that the eight villages just are affected a little from the project. Down discharge flow amount is promised as 0.04m³/s and the ecological influence for the transfer influenced river segment is within the acceptable range.

After the project is established, the flow velocity is slowed down which is good for depositing sands and mud, so that sediment deposition in the reservoir area is quickened and mean total sediment discharge amount for several years is 16.9000t. The project discharges sediment regularly and the influence on downstream river segment during discharging sediment is within the acceptable range.

(2) Local climate

After the project is established, rainfall quantity would be increased a little and influence of reservoir low-temperature effect can lead to change for the rainfall distribution. Rainfall at leeward area overhead the reservoir and the air flow along the bank will be also reduced and rainfall for windward slope at the airflow direction will increase, while annual evaluated air temperature improves lightly.

(3) Water environment

The reservoir belongs to stable stratification type reservoir and flood has no influence on water temperature structure. After the reservoir is dredged, nutrient substance generated by the submerged soil is reduced and not too more nourishments are provided to algae growth. After the phytoplanktons grow for a period, dynamic balance of new

(4)Rationality for migrant from reservoir area relocation

There are 3 homes and 14 persons of migrant from reservoir area in total, who all arranged in the dorms of previous Cheng County Chenyuan Town Baima Temple Vocational Technical School and the 5.07hm^2 testing field of previous Cheng County Chenyuan Town Baima Temple Vocational Technical School is allocated to 3 homes.

The relocation and compensation measures are in accordance with the principle of “assuring the resident can move, relocate stably and become rich” and the principle is reasonable and feasible. Sufficient houses are provided in the relocation place for living; enough cultivated land and good irrigation conditions are provided so as to warrant living and production demands of the residents; the relocation places own impeccable municipal facilities and convenient traffic, where is good for developing new life; and the relocation place can the requirements of relocation compensation plan.

(5) Landscape

The project locates 11km away from west of Cheng County and 6km far away from Paosha Town, so that the project has mild influence on landscape because of long distance from the scenic zone and having no travelling line to the scenic zone.

(6) Evaluation for ecological influence

Before the project is set up, ecological quality index was EI=61.89 and the ecological quality index is EI=61.69 after the project has been built, which both are good ecological quality evaluations: $|\triangle EI| = 0.2 < 2$ and means there is no apparent ecological quality change before/after the construction of the project is implemented.

Construction of the project will change the overwintering place and the position for spawning site of Schizothorax subfamilies fish in a short time. But Schizothorax subfamilies fishes will find new overwintering place and spawning site quickly to finish overwintering and spawning process because of similar ecological environmental at its upstream. The project will not affect the new overwintering place and spawning site again after they are found. Under the condition of assuring down water discharge amount, overwintering and spawning of schizothorax subfamilies fishes at downstream will not be affected by the project.

(7) Evaluation for social influence

Construction for the project can not only solve water supply problem of Cheng County, but also can enhance the development of local economy, improve utilization rate of water source and promote sustainable development of economy.

12.1.6 Ecological Protective Measures

During construction, education and advertising for ecological protection to the constructors are strengthened in the manners of announcements and distributing pamphlets and so on; forbid the constructor to cut trees out of the construction area without permission via institutionalization and also forbid the constructor to prey frogs, birds, snakes and other wild animals. Terrestrial vegetation and wild animals protection warning signs are arranged in Majiaya Qiaotou Construction area at the left bank, travelling area in the dam at the left bank, Small Village at the right bank-Gumugou Construction area, dam construction area among cofferdam, travelling area in the dam at the right bank, waterline construction area and other areas. Reasonably arrange operational mode and time of construction machineries, select the mechanical equipments with lower sound level value to construct and reduce horning times of transportation vehicles so as to reduce disturbance for wild animals caused by construction noise.

Biological loss amount caused by occupying forest land and cultivated land for the project can be supplemented by making use of the uncultivated land in this region. After the project is established, 2000 fries of Schizopygopsis kialingensis and Schizothorax davidi are released based on the specification of 3cm-4cm by taking every 3 years as one period and implement long-term releasing.

12.1.7 Soil and Water Conservation Measures

Total amount of water loss and soil erosion for the project is 18645.96t and newly increased amount of water loss and soil erosion is 13342.71t, wherein newly increased amount of water loss and soil erosion during construction is12609.27t and newly increased amount of water loss and soil erosion during natural recovery period is733.44t. Prevention responsible area is 107.88hm^2, wherein the area for building zone is 95.36hm^2 and the area for direct influenced area is 12.52hm^2. Prevention zoning for water loss and soil erosion is divided as: dam prevention zone for pivot building, prevention zone for waterlines, prevention zone for residual place, prevention zone for quarry, prevention zone for construction road and prevention zone for construction affiliated enterprise and living office. Soil and water conservation measures adopt 1640m slag blocking water, 1800m reinforced stone cage block, 600m dry stone slope protection 600m; drainage channel is 25140m in length and soil block in straw bag is 2340 in length. 96959 trees are planted; holly green fence is extended 116m in length (1m in width); 4477kg grass seeds are sowed; area for land leveling is 21.88hm^2; and green area is 17.16hm^2. A soil and water conservation scheme is implemented, by the end of the construction, treatment rate of disturbed land reaches 98.67%; treating degree for water loss and soil erosion reaches 98.07% and slag

blocking rate reaches 100%; control rate for water loss and soil erosion reaches 1.03; vegetation recovery coefficient reaches 98.76% and coverage area of forest and grasses reaches 41.3%.

12.1.8 Environmental Monitoring and Management

In order to assure the influence on environment caused by the project is relieved and controlled effectively, regulated, scientific environmental monitoring and management must be implemented during construction and operation; environmental monitoring scheduling during construction and operation are carried out strictly and environmental protection measures are implemented. What's more, relevant personnel must be trained for environmental protection well.

12.1.7 Environmental Risk Analysis

Risk sources for the project include: 1. dam failure; 2. waterline fracture. In the evaluation, reservoir dam failure is regarded as the maximum creditable accident of risk assessment. And the causes, probability and accident consequence for dam failure are analyzed and reasonable, feasible preventive measures, emergency measures and reduction measures are proposed in the evaluation.

12.1.8 Public Participation

Public participation for this environmental influence evaluation adopts ration investigation, public notification and forum.

Public notification is carried out in "Longnan Daily Newspaper" on January 9th, 2011 so as to ask for public opinions for the project and public opinions are received during public notification.

Cheng County Water Conservancy Bureau held a forum in Chenyuan Town Wujiashan Village and Shaba Town Niuyao Village to introduce the details for the project to the villagers and the project was accepted by the villager.

The ration investigation of environmental influence evaluation adopted the methods for randomly delivering investigation questionnaires the passerby and delivering investigation questionnaires to Cheng County Government organ. In 100 investigation questionnaires distributed to the passerby, 99% of informants knew or basically knew the construction for the project and supported the construction for this project because they considered the construction of this project could improve the current situation for urban water supply and the address of this project was feasible. 20 investigations questionnaires were distributed to Cheng County Government; the units which were investigated completely agreed with this project because they considered address of this project was feasible, construction for the project was necessary and the project could improve current situation of local water supply.

After the environmental influence evaluation for this project was approved by relevant departments, a secondary public participation and investigation were implemented for the environmental influence evaluation report and environmental management plan and mainly included: holding forums in Chenyuan Town Wujiashan Village on September 15th, 2011 and Shaba Town Niuyao Village on September 16th, 2011. The environmental influence evaluation report and the environmental management plan were published in Cheng County Xinhua Bookstore and library and the electronic version was uploaded to the initial page of the website (www.gscx.gov.cn) of Cheng County People's Government so as to be consulted conveniently by the public.

12.1.9 Evaluation Conclusion

The project has good economic and social benefits and obtains supports from the social public and relevant departments. The project chooses a reason address and has no bad influence on the environment surrounding under the condition that down discharge flow is assured. The moved residents are relocated properly. Environmental protection measures are implemented based on the environmental protection plan so as to reduce environmental influences during

construction and operation effectively.

In a word, there are no apparent environmental restricting factors for the construction of the project and the project construction is feasible on the view of environmental protection.

12.2 Suggestions

(1) Perfect the administrative system for water source area of Moba Gorge Reservoir so as to ensure the safety for drinking water;

(2) Further strengthen the education for environmental protection personnel and enhance consciousness for environmental protection;

(3) Guarantee normal down discharge flow during operation and clean the sediment in the bottom of the reservoir timely;

(4) Intensify supervision and management; implement resident relocation plan and various compensation measures;

(5) Strictly carry out “Three Simultaneity” system and implement various environmental protection measures and suggestions proposed n the environmental influence evaluation;

(6) Strengthen the construction for water source conservation land.