People's Republic of China

Ex-Post Evaluation of Japanese ODA Loan Project

"Nanning Environmental Improvement Project"

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0. Summary

The objective of the Nanning Environmental Improvement Project is to construct a sewage treatment plant and improve the city's drainage channels, in order to improve the quality of its rivers and lakes, and the drainage system running center of the city, thereby contributing to improving capacity to control floods, and bolstering sustainable development of Nanning city, the provincial capital of Guangxi Zhuang Autonomous Region in the south-western region of China.

Since the time of project appraisal to the present, the project has been aligned with the Chinese national and city level development policies. It is also consistent with Japan's economic cooperation policy. Thus, its relevance is high. After the project was completed, the sewage treatment plant is operating smoothly, having achieved the expected effect of sewerage water quality improvement, and is a vital sewer water treatment plant in Nanning City. In regards to its effectiveness, the city's flood response capability by the development of drainage channels has achieved its planned level, and maintains this capacity to this day. Furthermore, local residents regarded the project as something that improved their living condition. Therefore, effectiveness and impact of the project are high. In regards to the efficiency, although the project cost was within budget, there were significant delays. Thus, the efficiency is fair. As for sustainability, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance of the project. Therefore sustainability of the project effects is high.

In light of the above, this project is evaluated to be satisfactory.

1. Project Description

Project Location

Photo 1: In Nanning city, revetments and bridges were constructed

1.1 Background

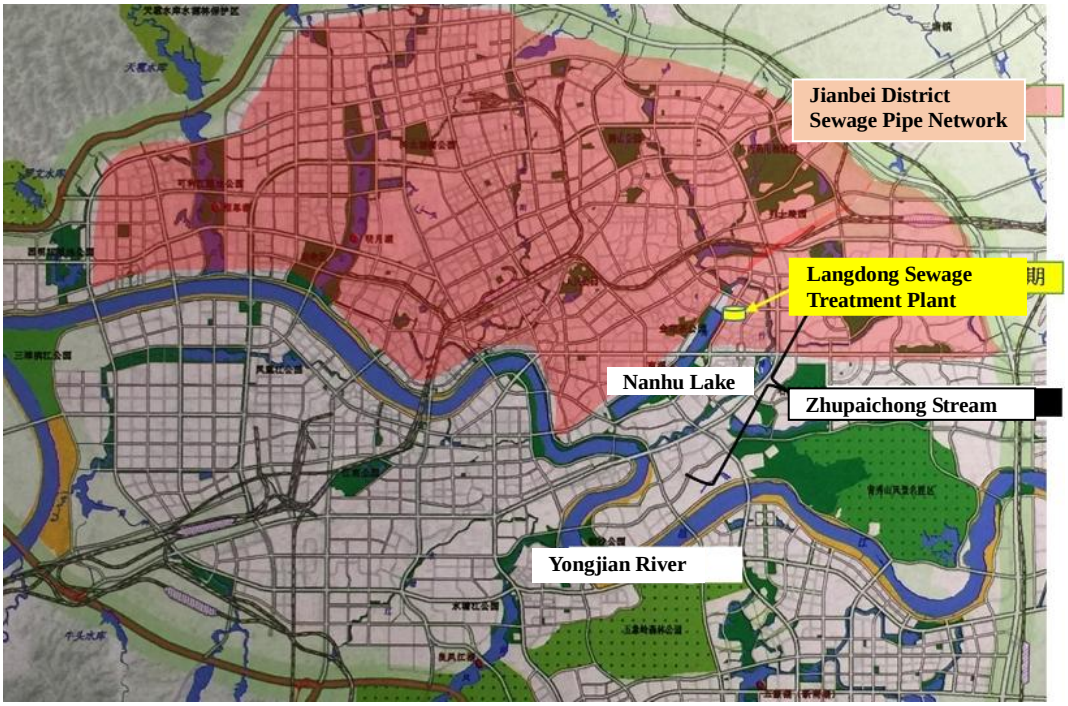
Though China had undergone a rapid economic development, industrialization and population growth led to environmental degradation. The Chinese government, in the late 1990s, strengthened its environmental protection policies and achieved certain amount of success. However, pollution was still considered very serious. A significant factor that contributed to this degradation was the rapid urbanization and improvement of living standards that caused a spike in waste water from homes. This treatment rate of urban areas remained at 36.4 %. Furthermore, among China's major rivers and lakes[1], the water sources below the national drinkable water standard (Water Quality Grade III) reached 49.4 %, with 23.4 % being at the worst quality (National water quality V and below V). Against this backdrop, the Chinese government in its 10th Five-Year Plan period announced the goal of increasing the sewage treatment rate in major cities to 60 % or more.

The Zhujiang River basin of southern China has historically been plagued by flooding. This flooding was exacerbated by rapid development without sufficient environment, natural protection measures in place. During 1988 and 1998, Guangdong and Guangxi provinces suffered economic damages of 183.7 billion yuan (about 2.75 trillion yen). Nanning City, located in the same watershed, suffered damages of 4,000 km^2, or about 10,000 households with economic losses topping 3 billion yuan (about 45 billion yen). In response, the Chinese government designated Nanning City as an important flood control city in its national policy. Henceforth, it had become urgent to develop the city's sewage treatment capacity and flood control facilities.

1.2 Project Outline

The objective of the Nanning Environmental Improvement Project is to construct a sewage treatment plant and improve the city's drainage channels, in order to improve the quality of its rivers and lakes, and the drainage system running through the city center, thereby contributing to the improvement of its capacity to control floods, and bolster sustainable development of Nanning city.

[1] Results are from the national water quality monitoring sites of seven major rivers, including Songhua River, Yellow River, Zhujiang River, the Yangtze River, with most significant pollution found at the Huaihe, Liaohe, Haihe Rivers.



Source: Nanning Urban Planning Museum

Figure 1: Distribution of the Three Subprojects in Nanning City

Loan Approved Amount/ Disbursed Amount	12,115 million yen / 9,907 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	March 2003 / March 2003	
Terms and Conditions	Interest Rate	0.75 %
	Repayment Period	40 years
	(Grace Period)	(10 years)
	Conditions for Procurement:	General Untied
Borrower / Executing Agency(ies)	Government of the People's Republic of China / Guangxi People's Government	
Final Disbursement Date	January, 2013	
Main Contractor (Over 1 billion yen)	• China Railway 18th Bureau (Group) Co., Ltd. (China) • The Fifth Engineering Company Of China Construction Engineering Bureau (China)	
Main Consultant (Over 100 million yen)	—	

Feasibility Studies, etc.	Beijing Municipal Institute of City Planning and Design (September 2001)
Related Projects	[Other Donors] France "Langdong Waste Water Treatment Plant First Stage construction" (1997) World Bank "Gangnam Waste Water Treatment Plant First Stage Construction" (2005)

2. Outline of the Evaluation Study

2.1 External Evaluator

Kenji Momota, IC Net Limited

Makiko Oleynikov, IC Net Limited

2.2 Duration of Evaluation Study

Survey period: August 2014 – November 2015

Field Survey: November 16, 2014 - November 26, 2014 and April 26, 2015 - May 1, 2015

2.3 Constraints during the Evaluation Study

Nanning Water Abstraction Company had been preparing for an Initial Public Offering to the domestic stock market, and was not able to disclose its financial information. Therefore, analysis of financial sustainability was based on a limited amount of data.

3. Results of the Evaluation (Overall Rating: B[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance to the Development Plan

1) Consistency with the Development Plans at the Time of the Appraisal

The main purpose of the project was (1) To improve the flood control capacity of Nanning and (2) To improve the city's sewage treatment capacity. The position of each in relation to policies and its needs will be verified.

1. Flood Control Measures in the Development Plan

The Chinese government in its "Ninth Five-Year Plan (1996-2000)" and "10th Five-Year Plans (2001-2005)", set goals on controlling flood damage and on achieving its national flooding standards by ensuring people's safety from water damage in the major cities and regions, and improving capacity for flood prevention around cities that are in the middle and downstream of the seven major rivers (including the Zhujiang River), tributaries and lakes, as it was important to ensure socio-economic

[2] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[3] ③: High, ② Fair, ① Low

stability. Under this rubric, specific measures proposed included, construction of dams and levees, strengthening unified basin management, protection of forests that retains water, thereby promoting water resources comprehensive development. In 1993, the "Zhujiang River Basin Comprehensive Utilization Plan" was formulated to expand Zhujiang River's[4] watershed water retention and improve Nanning city's utilization of urban drainage facilities and water resources.

2. Water Pollution Measures in the Development Plan

In the "10th Five-Year Environmental Protection Plan (2001-2005)", the Government set an ambitious target of reducing emissions of major contaminants by 10 % compared to the 2000 level. Regarding water quality, the Government set to achieve a sewage treatment rate of more than above 45 % in urban areas[5], water quality of the "Three Rivers Three Lakes" at the reference level, water quality improvement of the upstream of the Yangtze River, the midstream of the Yellow River, and the Songhua River basin through comprehensive measures. As described above, the flood control, water resources management, including water quality improvement were determined as high-priority areas in the national development plan at the time of the project plan. In the Guangxi Zhuang Autonomous Region including the Nanning city in particular, it can be observed that flood control and water quality management has been positioned as an important policy issue in urban development.

2) Consistency With The Development Plan at the Time of The Ex-Post Evaluation

1. Flood Control Measures in the Development Plan

In the "12th Five-Year Plan (2011-2015)", the Government puts priority on further strengthening of the country's flood prevention capacity, and formulated the "National Water Development Plan (2011-2015)." The plan calls for (1) Enhancing construction of regulating reservoirs to large rivers and lakes, (2) Comprehensively improving breakwater and estuaries construction, and (3) Repairing and reinforcing dams and water gates. In May 2011, the Guangxi Zhuang Autonomous Region released its "Environmental Protection and Ecological Construction 12th Five-Year Plan (2011-2015)." It promotes the plan to reinforce important rivers, tributaries and to establish a flood-drought mitigation system that connects important embankments and dams. Even after the completion of the project, there has been comprehensive development of small and medium-sized inland rivers such as Kelijiang River, Xinweijiang River for effective flood control.

2. Water Pollution Measures in the Development Plan

The "Circular Economy Promotion Law" came to effect in January 2009 that limits the expansion of polluting industries to the northern Gulf Economic Zone in Guangxi Zhuang Autonomous Region. According to the Nanning City Environmental Protection Bureau, the "Comprehensive Plan for Reducing Emissions of Saving Energy and Pollutants (2007)," promotes the construction of wastewater treatment facilities within companies and in urban areas, and setting of new emissions

[4] As one of the Zhujiang River tributaries, Yongjiang flows through the center of the city.
[5] Cities with population of over 500,000 are mandated to have a 60 % sewage treatment rate.

standards.

3.1.2 Relevance to the Development Needs

1) Consistency with the Development Needs at the Appraisal Phase

1. Water Resources Management (Water Pollution)

As the capital city of Guangxi Zhuang Autonomous Region, Nanning is the economic, political and cultural center, as well as the pivotal city of passage to the western region. In recent years, along with the rapid development of Nanning, the volume for urban sanitary waste and industrial waste water increased rapidly. However, the sewage treatment rate in urban district at the time in 2000 was only 17 %. Due to dumping into rivers and lakes, as well as illegal dumping of waste water, the pollution of two urban rivers such as Chaoyangxi River and Zhupaichong stream, and South Lake had become serious. At the time, the water quality of Nanhu Lake was below grade V and IV[6]. The water quality deterioration of the Yongjian River was of concern, and there was a need of upgrading the capacity of Langdong Sewage treatment plant located upstream.

2. Water Resources Management (Flood Damage)

The Zhujiang River basin of southern China has historically been plagued by flooding due to the rainfall level of the subtropical region to which it belongs. At the time the Project was planned, flood damage in the basin had become even worse. This flooding was exacerbated by rapid development without sufficient environment, natural protection measures in place. During 1988 and 1998, Nanning City suffered damages of 4,000 km^2, or about 10,000 households with economic losses topping 3 billion yuan (about 50 billion yen). The lack of investment in flood mitigation coupled with deforestation is seen to be the primary causes.

2) Consistency with the Development Needs at the Evaluation Phase

Nanning City recognizes the need for ongoing measures in the flood control measures and water environment.

1. Water Environment

The table below shows the water quality in the major discharge areas of sewage and treated water of the Yongjian River. There has been no significant improvement after the project, even though Nanning City has been strengthening water pollution measures. However, untreated sewage from upstream requires a response.

[6] The Environmental Quality Standard for Surface Water GB 3838—1998, came into force in 1988. It classifies water based on 30 pollutants, from grades I to V, with I being the highest. Chemical Oxygen Demand (COD) concentration is classified as grade I/II-15 mg/l or less, grade III-15 mg/l, grade IV-20 mg/l, grade V-25 mg/l. The COD level of the revised standard of 2002, the GB3838 – 2002, relaxed the threshold, as grade I/II being-15 mg/l or less, grade III -20mg/l, grade IV-30 mg/l, grade V-40 mg/l.

Table 1: Nanning City's River Water Quality (the Roman numeral denotes the grade)

	2006 (One year before project completion)	2009	2013 (At the time of project completion)	2014 (One year after the project completion)
Average (Yongjian River basin)	Ⅲ	Ⅲ	Ⅲ	Ⅲ
Laokou cross section	Ⅱ	Ⅱ	Ⅱ	Ⅱ
Shuitangjiang cross section	Ⅲ	Ⅲ	Ⅲ	Ⅲ
Pumiao cross section	Ⅳ	Ⅲ	Ⅲ	Ⅲ

Source: Nanning City Environmental Protection Agency

These river water problems have been a major issue in the city. In response, the city plans to expand the sewage treatment plant in the future, by expanding the current processing volume from 350,000 tons per day to 850,000 tons, and further strengthen the measures to improve waste water quality.

2. Water-resource management (Flood damage)

Although there have been few large-scale heavy rainfall causing a flood, there have been no major changes in the Zhujiang River basin that feed from large and small rivers, the River still poses a high flood risk. A study conducted by the Water Electric Power Research Institute of Nanning City recommends[7] an improvement in the flood control function of the canal and drain flowing into the Yongjian River, which is a tributary to the Zhujiang River. The study also points out that there is a lack of water flowing in the Yongjian River from surrounding rivers caused by rapid development, and that this has an adverse effect on the health of local residents through the stench, etc. The study further recommends that constructing artificial lakes, dams and dikes, as well as cleaning and dredging the riverbed would be beneficial. The needs to carry out these measures were corroborated by the interviews with the Nanning Environmental Protection Agency. This is an issue that required addressing ever since the project was appraised.

In view of the above, there is still a big need to strengthen the water environment and water resources management.

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal of the project, Japan's "Economic Cooperation Program for China" in 2001 focused on the conservation of ecosystems and environment affected by pollution and destruction, the improvement of living standards and social development in the inland regions, human resource development, institution building, and technology transfer, shifting away from its continued focus on infrastructure development of the coastal regions. Japan's ODA policy highlighted the following areas: (1) Cooperate to deal with global issues such as environmental issues, (2) Support reform and the open-door policy, (3) Promote mutual understanding, (4) Support poverty reduction,

[7] Nanning River Waterway Environment Comprehensive Improvement Project Analysis (2010)

(5) Support the private sector, (6) Enhance bilateral cooperation. The project is in line with priority area (1) which supports the pollution control in water and others and the sustainable use of water resources. The project is evaluated to be consistent with Japan's ODA policy.

This project has been highly relevant to the country's development plan, development needs, as well as Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The planned and actual output of the project is shown in Table 2 below.

Table 2: Planned and Actual Output

Subproject	Item	Plan (2004)	Detailed design (2005)	Performance (2012)	Plan implementation ratio (%)	Detailed design implementation ratio (%)
1.Zhupaichon Stream Environment Comprehensive Improvement	1.Sewage pipe network (km)	84 km	46.5 km	38.1 km	45 %	82 %
	2.Waterway repair (km)	9 km	10 km	7 km	78 %	70 %
	3.Reservoir remodelling (number)	2	1	1	50 %	100 %
	4. road (km)	45 km	45 km	45 km (18 km using yen loan, 27 km using domestic funds)	100 %	100 %
	5.Bridge construction and/or renovations (number)	Ten	Eight	5 (4 bridges using yen loan, 1 bridge using domestic funds)	80 %	63 %
2.Langdong Sewage Treatment Plant Phase 2	6.Pump station, sand basin, biological reaction pond, final sedimentation tank, sludge treatment facility, etc.	Same as left	Same as left	Same as left.	100 %	100 %
3.Jiangbei District Sewage Pipe Network	7.Sewer pipe (km)	117 km	72.3 km	57.4 km	49 %	79 %

Source: Planning value provided by JICA. Actual value gathered from the Executing Agency's answers to the questionnaire.

As shown above, the outputs had changed significantly from the original plan. Many of these changes came about when the city reviewed the designs during the detailed design stage. Their plan changed to use domestic capital. The reasons for the major changes are explained below.

(1) Subproject 1 Zhupaichon Steam

The length of sewage pipe network to be constructed decreased to about half, or 46.5 km, in the detailed design, due to the city's decision to fund the construction on the upstream side through a separate project, as it was excluded from an area financed by the yen loan project. Additionally, the

number of bridges was reduced to five from ten, because the city switched its source of financing to domestic. Regarding the construction of one of the three reservoirs, Luosanlin dam, was found to cost more than initially planned, and as a more efficient usage of the fund was agreed upon[8]. Therefore, it was cancelled.

(2) Subproject 3 Jiangbei District Sewage Pipe Network

The overall length of the sewage pipe network was initially expected to be 117 km, but during the detailed design phase, it was reduced to 63 km. Pump stations were added to the detailed design to pump up the sewage[9]. During the detailed study, the Nanning city plan was modified, where the priority areas for development shifted from the Jiangbei district to the south of the city[10]. There were also changes to the route of the sewerage network after detailed geological studies were undertaken. Furthermore, pumping of the sewage was required, something that had not been part of the original plan.

As seen above, major changes to the scope led to a significant delay. These changes may have not been avoided, as the sources of funding were switched from foreign to domestic, and as there were changes stemming from revisions to the city's master plan. Described in more detail in the Efficiency chapter, these changes have had little bearing on the effectiveness of the project. While this project was placed within the framework of Nanning city's overall development plan, there had been updates and changes to the plan, causing shifts in the scope of this project. The following information was collected through the interview with the Executing Agency:

- This project is a small part of an overall city development plan, and the range of the project outputs were not classified as strictly, but rather through the overall city planning. Since these adjustments were intended to be managed during the detailed design phase, the city did not scrutinize the scope sufficiently enough at the time of basic design (Feasibility Study).
- During the basic design phase, there was not enough coordination between the various municipal agencies, as sewage construction had to be carried out underground. Additionally, because the consultant lacked yen loan experience, it did not include contingencies in the plan with these unforeseeable changes. As a result, there was a gap between the actual and the planned project output, due to the modifications to the city development plan, modifications to the municipal regulations, etc. which caused scope changes and delays.

Some of these changes would have not been predicted, i.e. changes in government policies, etc. However, considering predictable adjustments, such as the delay in constructing on existing pipes and

[8] The Luosanlin dam was far from the city center, the water storage is small, and it was costly to construct an access road. The Huangmaoping dam was chosen as a more suitable alternative to Luosanlin dam due to its cost and efficiency. The construction to the Luosanlin dam was discontinued.

[9] The Keyuanlu area is low in elevation, making it difficult for the sewer water to drain naturally through gravity.

[10] In the Nanning City General Plan (2004-2020) announced in 2005, there was shift towards developing the southern part of the city. As a part of the Plan, there was a new development framework which included the Gozo district.

roads, there would have been room for improvement because it was possible to develop a more efficient project plan.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The plan called for a total project cost of 18,461 million yen at the time of the appraisal (yen loan 12,115 million yen, local currency 6,346 million yuan), while the actual total project cost was 17,696 million (yen loan of 10,517 million yen, local currency 7,179 million yuan). The actual planned cost ratio was 96%, which was lower the planned. As shown in Table 2, however, given that the scope of subprojects 1 and 3 were reduced by half, the actual output was not proportional to the actual cost. In other words, despite the reduction of scopes in both subprojects, it cost more to construct them due to factors that were found in the construction phase, such as the procurement of additional equipment and additional construction work. The main reasons for this are the following:

- Common causes between Subproject 1 and 3:

(Increases in cost) The increase in man-hours due to plan changes such as construction methods and routes, and in additional materials procured.

(Decrease in cost) The reduction in the length of the sewage pipe network and in the number of bridges and of reservoirs.

- Subproject 1 Zhupaichong Stream (actual to plan ratio 112 %)

(Increase in cost) Geological conditions were worse than expected, and necessitated the additional foundation treatment construction.

- Subproject 2 Langdong Sewage treatment plant Phase 2 Construction (actual to plan ratio 85 %):

(Increases in cost) Additional foundational work was required due to heavy rain at the time of construction. There were increases in equipment costs.

(Decrease in cost) Reduction in scope due to the design review.

- Subproject 3 Jiangbei district sewage pipes (actual to planned ratio 108 %):

(Increases in cost) Delays were caused by the procurement of additional pump stations, adjustments to the locations of pipes and changes in the materials for landfills which caused modifications to construction methods. These delays resulted in increased costs.

(Increases in cost) Rise in the material cost due to the delay, as well as due to the exchange rate fluctuations.

3.2.2.2 Project Period

The project period at the time of the appraisal was from May 2003 to December 2006 (44 months), while the actual period was from March 2003 to December 2013 and (a total of 128 months), with significant delay (291 % against the plan). Table 3 shows the project period of each subproject.

Table 3: Planned and Actual Project Period

Subproject	Plan	Actual (at the time of the ex-post evaluation)	Actual to Plan ratio
1.Zhupaichon Stream Environment Comprehensive Improvement	May 2003 - December 2006 (44 months)	May 2003 to June 2010 (84 months)	191 %
2.Langdong Sewage Treatment Plant Phase 2	May 2003 - December 2006 (44 months)	May 2003 to December 2008 (70 months)	159 %
3.Jiangbei District Sewage Pipe Network	May 2003 - December 2006 (44 months)	May 2003 to December 2013 (128 months)	291 %

Source: Planned values are taken from JICA appraisal document. Actual values are taken from the answers given by the Executing Agency.
*: The definition of the completion of the project is when the subproject is checked as complete.

The causes of the delay are explained below:

- Delay in processing the paperwork (30 months): delay in land acquisition procedures, delay in construction due to modifications and changes of the pipe network plan (example: difficulties in adjusting the pipe network construction period to the existing road).
- Delay in construction (approximately 25 months): additional adjustments that were required to strengthen the foundation, additional geological construction at the time of pipe network laying, a longer time spent on spring water measures during construction and the unforeseen interruption due to heavy rain and snow.
- The detailed design had to be modified because a subway line was also being constructed at the Daxuelu road (24 months).

As seen in the Table 3 above, the most delays occurred in the sewage network construction, exacerbating the construction delay to the entire project. Some sections even had delays that spanned 2-3 years of delays, though each cause differed from each other. There were many changes between the F/S to D/D, which required redesign and land acquisitions causing further delays. For the reasons described above, the project period had become longer than planned.

3.2.3 Results of Calculations of Internal Rates of Return (Reference only)

At the time of the appraisal, the economic internal rate of return (EIRR), and the financial internal rate of return (FIRR) which were calculated for Zhupaichong Stream and Langdong sewage treatment plant were 15.7 % and 2.9 %, respectively. For the former subproject, there has not been enough time elapsed to calculate the EIRR, and there have been no major floods, making the data collection difficult. The EIRR was not calculated. The re-calculation of the FIRR was performed on Langdong sewage treatment plant at the time of the ex-post evaluation was -5.7 %. As described in Sustainability chapter, current water fees levied onto consumers is set to maintain the current annual operation, but it is not sufficient to ensure the project profitability including the initial investment.

Both the project cost and project period significantly exceeded the plan. Therefore efficiency of the project is low.

3.3 Effectiveness[11] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

(1) Operational Status of the Subproject

The purpose of this project is to improve the city's capacity in flood control and water quality. For each of the following areas, comparisons will be drawn between the actual results to the expected effects.

1) Flood Mitigation (Subproject 1 Zhupaichong Environment Comprehensive Treatment Project)

There has been no torrential rain nor enough years passed to measure whether the project has had an effect on flood mitigation. For this reason, the potential effect has been measured by determining whether the flood mitigation capacity is still in place, whether the capability has been maintained, and whether there has been proper maintenance. Based on the city's flood prevention standards, the project aimed to develop the capability to control the damage even if a large flood occurs in the city, from the standard of the planned flood that occur "once every 20 years" to "once every 50 years."[12] As described earlier, the Zhupaichong sewage network was updated as planned, and this standard is still effective today. There has been an adequate maintenance management system established, to be described further in the Sustainability chapter. It can be said that this subproject has achieved the flood control capacity as originally planned.

Table 4: Flood Control Capacity in Nanning City

	Baseline	Target	Actual
	2002	2006	2013
	Baseline Year	Completion Year	Completion Year
Flood control levels	occurs once in every 20 years	occurs once in every 50 years	occurs once in every 50 years
Highest water level	74.0 m above sea level	70.0 m above sea level	70.0 m above sea level

Source: Documents provided by JICA and the city's response to the questionnaire.

At the time of the evaluation, not enough years had passed nor the rainfall to verify the effect of the subproject. In order to assess current drainage capacity functioning as designed, during the field visit an attempt was made to check items such as the maintenance status and discharge capacity of the stream. Also, it was not possible to check the discharge capacity and the annual maximum flow since the Executing Agency had not been measuring discharge rates. Therefore, the evaluation of the capacity was based on the operational methods and the conditions of the operations and maintenance

[11] Sub-rating for Effectiveness is to be put with consideration of Impact.

[12] The Nanning City "Urban Flood Prevention Standards (CJJ50-92)" set the highest water level of Zhupaichong Stream for flood prevention at 69 m or less, by taking the maximum of 24-hour rainfall (263 mm) over the years 1936-1998.

of the stream.

Photo 2: A revetment built on the Zhupaichong Stream

Photo 3: A park built under the project

Zhupaichong sewage network regulates the water level of the Yongjian River, which is the biggest factor of flood in Nanning city. In order to maintain this function, the city conducts regular maintenance. Daily patrols of the river banks, inspection of flood reference points, cleaning and dredging from May to August before the water level swells are conducted (described in 3.5 Sustainability in detail). Although for the time being, since the construction, the reduction of flood damage could not be confirmed, the stream has maintained the required flood prevention standard, as construction was completed as planned and adequate maintenance has been carried out. Therefore, it can be said that the project has a high probability of achieving the intended effects on flood control.

2) Sewage Treatment Capacity Improvement (Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network)

The following table illustrates the operational capacity of the Langdong sewage treatment plant Phase II. Even though the utilization rate during the first year of operation was slightly low, it steadily increased after year two. At the time of the ex-post evaluation, it was operating at nearly its designed capacity.

Table 5: Operational Indicators of Langdong Sewage Treatment Plant Phase 2

	Target value	Actual value					
	2006	2009	2010	2011	2012	2013	2014
		1 year after completion *				5 years after completion	
Sewage treatment amount (m^3/day)	100,000	64,200	80,900	91,600	88,700	91,000	95,400
Utilization rate (%)	75 %	64 %	81 %	92 %	89 %	91 %	95 %
Treatment rate (%)		100 %	100 %	100 %	100 %	100 %	100 %
City sewage treatment rate		76 %	78 %	81 %	83 %	84 %	86 %

Source: Data provided by JICA, Executing Agency's responses to the questionnaire. Since the construction was completed in December 2008, the data from 2009 was used.

Photo 4: The biological reaction pool of the Treatment Plant

Photo 5: The central control room of the Treatment Plant

Because the construction of the sewage network was behind schedule, the utilization rate was low during the first year. As the sewage network was constructed under this project, the rate has been incrementally improved, and at present it is being maintained at the expected operational level.

The demand for sewage treatment increased as the city urbanized, and the construction of Phase III was undertaken. At the time of the evaluation, the three phases had a capacity to treat 300,000 m^3 per day, with a planned expansion of increasing the capacity by 50,000 m^3 in the future. The city further has plans to increase the processing capacity to 850,000 m^3 per day by 2020, as this demand is expected to continue.

(2) Effect of the subproject

1) Flood Mitigation (Subproject 1 Zhupaichong Environment Comprehensive Treatment Project)

During the planning phase, a reduction of flood area was set as an indicator. This effect could not be confirmed because no torrential rain or flooding had happened since project completion. However, for the time being, it can be concluded that, along with the city's comprehensive efforts in flood control

such as the construction of a sewage pipe network and embankments, the expected capacity has been developed, as it was confirmed that waterway construction has been progressing so as to cope with flood levels of every 50 years, and its capacity has been maintaining its planned capacity.

2) Sewage Treatment Capacity Improvement (Subproject 2 and 3 Langdong Sewage Treatment Plant/Jiangbei District Sewage Pipe Network)

The effect of reducing pollutants is shown in Table 6. The water treatment facility had reduced the major pollutants beyond the national standard and the target set by the project. The BOD level in 2013 was 95 % less than the level at the time of appraisal. For other substances including SS, the level was reduced by more than 90 % compared to that at the time of appraisal. The effect of the project was significant.

Table 6: Langdong Treatment Facility's Reduction in Pollutants

Quality of water discharged		Baseline	Target value	Actual values				
	National standards	2002	2006	2009	2010	2012	2013	2014
		Appraisal	Project Completion	1 year after Project completion	2 years after Project completion	3 years after Project completion	4 years after Project completion	5 years after Project completion
BOD emissions (t/year)		4,380	730	166.33	220.1	259.0	229.0	206.5
BOD concentration (mg/l)	20	120	20	7.1	7.45	8.0	6.9	7.1
COD emissions (t/year)				351.4	472.7	980.6	937.2	841.2
COD concentration (mg/l)	60			15	16	30.3	28.2	29
SS emissions (t/year)		7,300	730	559.9	839.05	485.5	481.9	423.5
SS concentration (mg/l)	20	200	20	23.9	28.4	15	14.5	14.6

Source: Data provided by JICA, Executing Agency's responses to the questionnaire.

At the sewage treatment plant, treated water was monitored daily. When the treated water was inspected during the field visit, the pollutant measurements did not vary significantly from what was reported. The effect of the plant on effused water quality was well sustained.

Photo 6: Treated water monitors

Photo 7: The water after treatment

3.3.2 Qualitative Effects

The Langdong Sewage treatment plant was planned to recycle the sludge and treated water in the following manner.

- The treated water would be used for greening of the city, cleaning roads and official vehicles.
- The sludge would be reused as greening and agricultural fertilizer after testing.

However, the current ways of usage are as follows:

1) Because the treated water had not been processed further to be apt for use in the city, i.e. plant watering, road cleaning and official vehicle washing, it is used in water sprinklers within the plant, diverted to the Zhupaichong Stream and Nanhu Lake. The plan is to carry out further processing of the water. They have already secured a space for this process in the second plant premises.
2) After testing, the sludge will be crushed to make pellets as soil improvers used for road construction.

Though there have been slight changes in its usage from the original plan, a recycling system has been established. It is expected that there will be further effective use in the future.

3.4 Impacts

3.4.1 Intended Impacts

The intended impact of the project was "to reduce damage by improving water quality and controlling floods in the lakes and rivers." Furthermore, the higher level goal was to promote urban development through these improvements. As mentioned in Relevance, there have been no significant improvements from a statistical standpoint in the water quality of the Yongjian River. The City's Environmental Protection Agency personnel gave some insight on the current condition of the impact.

- There has been a certain degree of progress made in the reduction of pollutants emitted. The COD emission in 2010 was 135,600 tons, while in 2014, it decreased to 122,300 tons. As a result, the water quality downstream of the Yongjian River at the Pumiao cross section improved from grade IV to III. However, no significant improvement has been seen in the Yongjian River basin as a whole at the time of the ex-post evaluation.
- There has been an improvement in the COD concentration at the conflux of the Zhupaichong Stream to the Yongjian River. Nonetheless, the Stream itself is categorized as grade V. This is due to the fact that the sewage treatment rate has not reached 100 % yet, and there is a fair amount of untreated sewage discharged directly into the Stream.
- The municipal government announced a "Three-year Sewage Plan (2013-2015)" investing 13.5 billion yuan to build 700 km of sewer pipes, improve 18 areas of waterways, and construct additional waste water treatment plants. By the end of 2013, 524 million yuan had been invested to build 139 km of sewer pipes, the Santang and the Wuxiang sewage treatment plants. Thus, the water quality is expected to improve further.

Due to the fact that the indicator of "damages reduced by flood control" could not be verified as a result of the direct impact thanks to the project because there have been no major damages, the beneficiary survey in which the 100 residents of Nanning were asked about the changes that have taken place since the construction of the subprojects, supplemented the information. They verified the positive effects of the sewage treatment plant, as well as the secondary effects and socio-economic changes brought about by the project[13]. Regarding improvement of the living conditions compared to 4-5 years ago, about 60 % or more responded that stench and the untreated sewage was reduced. In addition, 71 % said that there have been no sewage and drainage problems in their area. Also, 75 % responded that the water quality of Zhupaichong Stream improved. The residents positively view the improvement of the water quality and waterways as well as the efforts related to environmental improvement in Nanning. The improvements to Zhupaichong Stream and its surrounding parks and fixtures have been clearly recognized, because it flows through the middle of the city and residents have many opportunities to be in contact with the stream.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

The project was categorized as "B"[14] during appraisal as it was expected to have limited adverse social and/or environmental impacts. In regards to the sediment discharged by the exit drain at the Langdong sewage treatment plan, it was eliminated by reinforcing the discharge area by concrete. Regarding exhaust and waste water associated with the treatment plant, the following measures have been taken:

- Exhaust is processed in an underground deodorizing machine, and is then released after the odor meets the standard.
- Wastewater flows to the interior of the processing facility, and is discharged into the Stream after it meets the standard of treated water.
- Solid waste is properly disposed of at the Nanning Environmental Health Office.

The Environmental Protection Agency monitors the effluent water quality online, and the EPA adheres to a strict monitoring system by performing regular site inspections. All of the treatment plants have an enclosed treatment pond that sufficiently removes odor, and no complaints have been filed by local residents so far.

[13] Interviews with 100 local residents (59 % male, 41 % female / age composition 20-29 years (15 %), 30-39 years (37 %), 40-49 years (19 %), 50-59 years (20 %) 60-69 years (7 %) 70-79 years (2 %) were conducted at various districts of Nanning City in January 2015. The breakdown is as follows: Qingxiu district (46 %), Xixiangtang district (28 %), Xìngning district (16 %). 25 % of the respondents experienced some flood damage experience while 75 % did not.

[14] The Environmental Impact Assessment of the project was approved by the National Environmental Protection Agency in August 1999. Projects are assigned a category of A, B, or C, in descending order of environmental and social sensitivity, Projects with "B" ratings are expected to have limited adverse social and/or environmental impacts that can be readily addressed through mitigation measures.

(2) Land Acquisition and Resettlement

The project expected a land acquisition of 42ha, while the actual land acquired was 17 hectares. Land acquisition was carried out as planned in both the Zhupaichon Stream Environment Comprehensive Improvement and the Langdong Sewage Treatment Plant Phase 2, and no resettlement took place in either of these subprojects. Since the Jiangbei district sewage pipe network had underground construction work, temporary resettlement measures were taken. For this reason, no compensations were given. All acquisition paperwork were filed according to domestic regulations by the time of the appraisal.

(3) Unintended Positive/Negative Impacts

This project not only improved the flood control and urban wastewater standards, but the City also self-financed the construction of reinforcing embankment, improving the greenery and landscaping, developing the pedestrian walkway. In fact, five new parks were constructed along the Stream. These facilities improved the living conditions of the local residents.

The effectiveness and impact of this project can be evaluated as follows.

In regards to water quality improvement, it was observed that the sewage pipe network expanded and water treatment plants were effective in the reduction of pollutants as they were constructed as planned and achieved its intended capacities as planned. However, the water quality of the Yongjian River basin nor the Stream has not improved. To achieve quality improvements in all of the waterways, it is important to implement comprehensive measures continuously. The project has been functioning as the center of the city's sewage treatment while the citywide sewage treatment demand has been increasing, and has contributed to curbing the water quality deterioration.

Regarding flood control, it was difficult to evaluate the capacity because there were no floods that occurred after the project completion. However, structures were constructed as designed, and the city flood control measures were implemented in parallel. Therefore, it can be said that the mitigation measures were put in place against future flood damage.

This project has mostly achieved its objectives. Therefore effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance

(1) Operating System in Project Implementation

As planned, the project office was established within the Guangxi Zhuang Autonomous Region People's Government's Bureau of Finance. The project office oversaw the entire operation, being comprised by the Planning Bureau, the Construction Bureau, the Environment Protection Agency, the Water Affairs Bureau, and the Finance Bureau. The Nanning Investment and Development Company

was responsible for the construction in, and the operation and maintenance of the Zhupaichong Stream Environmental Improvement subproject. The Nanning Water Abstraction Company was responsible for the construction in, and the operation and maintenance of the Langdong Sewage Treatment Plant Phase II subproject and Nanning Sewage Network Construction subproject. These are state-owned enterprises, wholly owned by the municipality.

(2) Operation and Maintenance After Project Completion

Nanning Investment and Development Company is responsible for the maintenance of the Zhupaichong Stream Environmental Improvement subproject. The Nanning Water Abstraction Company was responsible for the subprojects 2 and 3, though in 2006, it was absorbed into the Guangxi Green City Water Affairs Company. The Guangxi Green City Water Affairs Company is responsible for the operations, and there is no significant change to the actual situation of the operating system.

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

Under the supervision of the Executing Agency, the city's Water Agency was in charge of the maintenance, water utilization in rural areas, irrigation canals, and dams, while the city's Waterway Management Agency was in charge of the drainage, artificial lake management, water volumes and the level of rainfall. The Waterway Management Agency staffs monitor the water levels, including the case where there is rainfall in at the reference points around the city. The Agency has six departments, including the project office, river management department, and there are a total of 54 staff members, including nine executives, 32 technicians, and 13 clerks.

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

The Green City Water Affairs Company is responsible for the majority of the sewerage water plants. It is responsible for the operation and management of seven water purification plants and the four sewage treatment plants. The current number of staff is more than 1,500, of which 62 work at the Langdong sewage treatment plant and 55 of them, the majority, are technical positions. The department in charge of the maintenance of the sewage pipe network is staffed with 78 people, including 70 technicians. The Langdong sewage treatment facility operates by teams with three shifts. The teams are comprised of sub-teams that play a role in dewatering the sludge, measuring water quality, and carrying out the maintenance and repair. The pipes are managed by the Pipe Management Agency specialists who carry out manhole inspections and regular pipe cleaning. According to the interviews conducted with the management of each agency, the current staff level was appropriate and adequate. The municipality directly manages the Zhupaichon Stream, and as described in the chapter on Relevance, given the importance of the measures for water environment in the city, it is believed that stable organizational functions will be maintained. In addition, regarding the sewage treatment plants and sewage pipe network, a state-owned enterprise is responsible for all of the water and sewerage operations of the city. It can be said that there are no issues pertaining to the actual staffing

or management structure.

3.5.2 Technical Aspects of Operation and Maintenance

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

The staffs of Waterway Management Agency are in charge of monitoring the water level in the waterways and are deployed as patrols during flood season and period of rain. The patrols remove small debris during their shifts. A full-fledged cleaning of the waterway is contracted to an external firm two to three times a year. The manager said that the work itself was not technically challenging, so through appropriate supervision they were able to sustain the required technical standards.

Photo 8: Periodic cleaning of the Stream

Photo 9: Discharge to the Yongjian River

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

Routine maintenance and inspection are carried out by the staff, while more serious issues are dealt with through monthly inspection and occasional technical guidance from Green City Water Affairs Company's head office. In the field visit conducted during the ex-post evaluation, the record of machines and water quality monitoring were stored. The maintenance is carried out well. The sewage treatment plant and sewage pipe network are headed by technical veterans with 16-17 years' experience, under which there are a stable number of placement of personnel. Green City Water Affairs Company is providing training and exchanges between facilities thanks to its large number of employees, which enables the stable supply of staff to the facilities.

In summary, as there have been no major technical issues observed, there is an appropriate level of technical skills and knowledge to operate each subproject.

3.5.3 Financial Aspects of Operation and Maintenance

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

The Nanning City Investment and Development Company did not disclose detailed financial information. The Water Conservancy Stations officials said that there were no issues with regular maintenance of the waterways, including the cleaning and water level monitoring. There were no

financial problems in carrying out such maintenance.

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

Although the Green City Water Affairs Company did not disclosed its detailed financial statements, as an alternative, the sales, revenue, ordinary income and fixed asset investment were obtained, as shown in Table 7. This table shows the changes in the key performance metrics and capital investments. With the growth of Nanning City, the demand for water and sewerage grows steadily. In 2013, the operating revenue is 900 million yuan (approximately 18 billion yen) up 30% from 2011 where the revenue was 700 million yuan.

Table 7: Green City Water Affairs Company Sales, Revenue, Ordinary Income and Fixed Asset Investment, years 2011 to 2013

Item	2011	2012	2013
Sales of water (ten thousand m^3)	27,710	29,620	31,477
Annual growth rate (%)		7 %	6 %
Operating revenue (ten thousand yuan)	70,341	84,663	90,900
Annual growth rate (%)		21 %	7 %
Ordinary income (ten thousand yuan)	17,714	21,190	23,800
Annual growth rate (%)		21 %	12 %
Annual fixed asset investment (ten thousand yuan)	78,875	40,215	50,500
Annual growth rate (%)		-49 %	26 %

Source: Data provided by the Green City Water Affairs Company.

The city has been continuing its active capital investment, and constructions to expand Henan water treatment plant phase 1, six water supply pump stations at Wuxiang, Yongwulu, Santang, Jiangnan, and others, the Wuxiang sewage treatment plant, and 29.6km of sewage pipe network are all ongoing. The sewage fee is 1.17 yuan/m^3 after a few rounds of rate increases. The rate is adequate, and is a stable source of revenue. The balance for the Langdong Sewage Treatment Plant was: income 54.7 million yuan, expenditure 53.06 million yuan, resulting in nominal revenue. According to the Facility Director, there is a balance of payments though the revenue is small. The City ratifies the sewage fee increases necessary in order to maintain its operations financially afloat. The subproject is financially sound.

In summary, though the financial disclosures were not made to the evaluators, there seems to be no major financial concerns with the Green City Water Affairs Company nor the Langdong Sewage Treatment Plant. The Green City Water Affairs Company has been growing rapidly as it has been maintaining a growth rate at a high level of ordinary income and operating revenues. In addition, there is an increase in capital investment to expand its facilities. Given the trend of increasing water and sewerage demand, the growth of the company is projected be high for the time being.

3.5.4 Current Status of Operation and Maintenance

1) Subproject 1 Zhupaichon Stream Environment Comprehensive Improvement

Problems such as sediments or trash accumulation in the stream are being solved through regular cleaning and daily patrols. According to the Executing Agency, the frequency of regular cleaning is sufficient and adequate, given the current state of dirt and sediment and flow. Conditions such as garbage deposits that would compromise the functioning of waterway was not observed during the field visit to the various points on the stream.

2) Subproject 2 and 3 Langdong Sewage Treatment Plant/ Jiangbei District Sewage Pipe Network

At the sewage treatment plant, the only problem that exists is the influent wastewater containing low levels of COD, prolonging the time it takes for the microorganisms to decompose the contaminants. However, this has not been a critical issue that affects the project's planned capacity. Regarding the sewage network, there are clogging of the sewer pipe by sediments such as trash and sediment that occur regularly and are not unusual. Based on the water level and flow rate that they monitor daily, the operation and maintenance of the two subprojects are carried out well.

No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of the Nanning Environmental Improvement Project is to construct a sewage treatment plant and improve the city's drainage channels, in order to improve the quality of its rivers and lakes, and the drainage system running center of the city, thereby contributing to improving capacity to control floods, and bolstering sustainable development of Nanning city, the provincial capital of Guangxi Zhuang Autonomous Region in the south-western region of China.

Since the time of project appraisal to the present, the project has been aligned with the Chinese national and city level development policies. It is also consistent with Japan's economic cooperation policy. Thus, its relevance is high. After the project was completed, the sewage treatment plant is operating smoothly, having achieved the expected effect of sewerage water quality improvement, and is a vital sewer water treatment plant in Nanning City. In regards to its effectiveness, the city's flood response capability by the development of drainage channels has achieved its plan, and maintains this capacity to this day. Furthermore, local residents regarded the project as something that improved their living condition. Therefore, effectiveness and impact of the project are high. In regards to the efficiency, although the project cost was within budget, there were significant delays. Thus, the efficiency is fair. As for sustainability, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance of the project. Therefore

sustainability of the project effects is high.

In light of the above, this project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

None.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

(1) Scrutinize the project Plan

Even though this project has been evaluated highly in many of the evaluation criteria, it was rated low in its efficiency. A major cause for this was the significant change in output. It is thought that there was a difference of ideas between the project plan and the implementation and supervision. The plan at the time of appraisal does change up to a certain degree after the detailed design is conducted. However, the basic design did not include additional construction of pump stations, further geological studies, significant reductions in the length of the pipes, to the point that there was a significant change in the costs and schedules. Geological surveys were not adequately carried out during the basic design. Local implementing agencies recognized that the plan of the basic design was not accurate enough, and it lacked the level of scrutiny they could have undertaken on contents and requirements. In order to reduce the delay due to the adjustments in the plans during implementation, there should be more guidance provided to the Executing Agency on how yen loan projects are carried out, and on the processes and time required to make changes, and provide supervision on the important requirements during the initial planning phase. A realistic project plan would have minimized these delays, and would have been effective for the entire project.

(2) Establish a Better Mechanism that coordinates each subproject to the overarching development plan

The planning of this project was mainly carried out by the Nanning Investment and Development Company, the Executing Agency of the time and the Nanning Water Abstraction Company. As described before, the project was treated as a project within the Nanning City's Master Development Plan. There was not sufficient coordination with other project offices and implementing agencies. The changes in the scope by the Chinese were also viewed from the perspective of achieving an efficient allocation of resources within the overall development plan. As a result, these adjustments caused delays in the construction of sewage pipes and affected the operational effectiveness of the Langdong sewage treatment plant, as mentioned in the chapter on Effectiveness. Regarding the core elements of the project that interacts with the expression of the effect, it would have been desirable to set certain

conditions during the project formation process from the point of view of the project purpose. In particular, road and sewage pipe constructions that are affected by the plans of other ministries and agencies could have been coordinated better by establishing among them a coordination function with those responsible for planning in each agency from the time the feasibility study was undertaken, and to create a project plan that incorporates the consistency of the entire city and its development plan as much as possible.

Comparison of the Original and Actual Scope of the Project

Item	Plan (detailed design from 2005)	Actual
1.Project Outputs **[Zhupaichon Stream Environment Comprehensive Improvement]** a. Sewage pipe network maintenance b. Waterway repair c. Reservoir remodelling (number of areas) d. Road construction 5 bridge construction and renovation (number of bridges) **[Langdong Sewage Treatment Plant Phase 2]** **[Jiangbei District Sewage Pipe Network]** a. Keng district and Zhaoyangxi district b. Nanhu, Zhupaichon stream district c. Xixiangtang	 84 km (46.5 km) 9 km (10 km) 2 (1) 45 km 5 bridges (1 bridge using domestic funds, and the remaining four places using yen loan) Pump station, sand basin, biological reaction tank, final sedimentation tank, sludge treatment facility Total 117 km 20.3 km 15.6 km 36.4 km (Subtotal 72.3 km)	 38.1 km 7 km 1 As planned (18 km paid for by the yen loan, the remaining 27 km domestic funds) As planned As planned 15.8 km 13.0 km 28.6 km (Subtotal 57.4 km)
2.Project Period	May 2003 - December 2006 (44 months)	May 2003 - December 2013 (128 months)
3.Project Cost Amount paid in Foreign currency Amount paid in Local currency Total Japanese ODA loan portion Exchange rate	 12,115 million yen 6,346 million yen (4,298 million yuan) 18,461 million yen 12,115 million yen 1 yuan = 15 yen (As of September 2002)	 10,517 million yen 7,179 million yen (2,852 million yuan) 17,696 million yen 10,517 million yen 1 yuan = 14.4509 yen (Provided by the Executing Agency)

End