Republic of Kazakhstan

Ex-Post Evaluation of Japanese ODA Loan

"Astana Water Supply and Sewerage Project"

External Evaluator: Nobuyuki Kobayashi, OPMAC Corporation

0. Summary

The objective of this project was to ensure a wider coverage of water supply and sewage services and to improve the quality of the water supply through the development of water supply and sewerage infrastructures in Astana City which has seen a remarkable increase in its population. As the project objective is consistent with the priorities of the development policy (both at the time of the project appraisal and the ex-post evaluation) and given the increase in demand for water supply and sewerage service, the relevancy of this project is high. The efficiency of the project is low. The project cost was substantially exceeded mainly because a construction boom caused an inrease in construction and labour costs in Astana. In addition, the project period was prolonged due to a delay in both procurement and civil works. In terms of water supply service, the volume of water supply and the water leakage rate achieved their target. Water supply volume per capita has decreased due to the diffusion of water flow meters as well as better awareness of water saving, both of which were brought about by this project. In terms of sewage service, although the quality has not been improved as much as projected, due to the population growth, the quality of discharged water satisfies both the discharge standard based on domestic regulations in Kazakhstan and the standard activated-sludge method in Japan. Approximately 70% of beneficiaries did not experience a suspension of water supply and sewerage services, and approximately 20-30% replied that the suspension of these services was not frequent. From this point of view, the effectiveness and impact of this project is considered high. As for the sustainability of the project, given the tariff level at the time of the ex-post valuation, it will be difficult to recover the investment costs and secure capital costs for any major repairs that become necessary. In terms of the current status of operation and maintenance, no definite plan on the final disposal of sludge from the sewerage treatment plant has yet to be worked out. Therefore, sustainability of the project effects is fair.

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

1. Project Description

Project Location

Water Intake Facility Constructed by the Project

1.1 Background

In December 1997 the Republic of Kazakhstan moved the capital from Almaty in the southeast part of the country to Astana City, which is located in the middle part of Kazakhstan. At the time of the capital's transfer, it was expected that the population would expand from 280,000 people to approximately 500,000 by 2010. Despite this population growth forecast, rehabilitation and renovation had not been undertaken since the facilities were installed at the time of the former Soviet Union. It was anticipated, therefore, that Astana City's existing water supply and sewage facilities would have difficulty in providing stable and qualitative public service in the future.

With regard to the water supply facilities, in addition to insufficient treatment capacity at one of the water treatment plants, aging water intake pumps at the Vyacheslavsky Reservoir and water leakage from old distribution pipes had reduced the water supply capacity. Moreover, because water flow meters were not installed on every house the water tariff was set at a fixed rate. This resulted in wasteful water usage since the principle of users responsibility did not work. With regards to the sewer facilities, equipment in the sewage treatment plant was remarkably obsolete and in pressing need of rehabilitation. Replacement of the old sewer pipes was also delayed and the pumps frequently broke down.

In response to the request from the government of Kazakhstan in regards to the development of the new capital, in 2001, JICA conducted the urban design model study for the development of the City of Astana and simultaneously conducted a feasibility study on the development of water supply and sewerage system. Based on this feasibility study, the project implemented the construction of a water treatment plant, the installation of water flow meters, the rehabilitation of the sewage treatment plant, and the replacement and installation of water distribution and sewer pipes.

1.2 Project Outline

The objective of this project is to reduce the leakage rate, control water supply per capita, and improve water quality by the rehabilitation and improvement of Astana City's water supply and sewerage systems, including installation of water flow meters, and thereby contributing to a wider coverage and better quality of water supply and sewerage services.

Loan Approved Amount/ Disbursed Amount	21,361 million yen / 21,253 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2002 / July 2003
Terms and Conditions	Interest Rate 2.2% (Consulting Service: 0.75%) Repayment Period 30 years (Consulting Service: 40 years) (Grace Period 10 years) Conditions for Procurement: General untied (Bilateral tide for consultants)
Borrower / Executing Agency	Government of the Republic of Kazakhstan / Astana City
Final Disbursement Date	January 2013
Main Contractor (Over 1 billion yen)	Ebara Corporation (Japan) / Alsim Alarko San. Tes. ve Tic. A.S. (Turkey)
Main Consultant (Over 100 million yen)	JV Nihon Suido Consultants Co., Ltd (Japan) / NJS Consultants Co., Ltd (Japan) / Consult Co., Ltd (Kazakhstan)
Feasibility Studies, etc.	"The urban design model study for the development of the City of Astana (F/S on Water Supply and Sewerage in the City of Astana)", JICA, 2001 / "Special Assistance for Project Implementation for Astana Water Supply and Sewerage Project" JBIC, 2005
Related Projects	Development Study "The detailed design study of the water supply and sewerage system for Astana City" 2002-2003

2. Outline of the Evaluation Study

2.1 External Evaluator

Nobuyuki Kobayashi, OPMAC Corporation

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted according to the following schedule.

Duration of the Study: August 2014 – October 2015

Duration of the Field Study: October 11, 2014 – October 24, 2014

February 21, 2015 – February 27, 2015

2.3 Constraints during the Evaluation Study

The project's sustainability rating is based on indirect evidence such as salary payments and staff member hiring trends because financial information could not be obtained from Astana Su Arnasy (ASA), which is the government agency responsible for the project's operation and maintenance.

3. Results of the Evaluation (Overall Rating: C[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance to the Development Plan of Kazakhstan

The national development plan at the time of the appraisal entitled "the Strategy for the Development of the Republic of Kazakhstan until the Year 2010" (2001), emphasized the improvement of the water supply service for maintaining people's health conditions as a part of the strategy of health care sector. Improving water quality and ensuring sufficient drinking water volumes were targeted as the main objectives of water resource management. In addition, at the time of the appraisal, the "Master Plan for the Development of the City of Astana" had been formulated and the development of water supply and sewerage infrastructure was included in a part of the mid-term plan until the year 2010. In this plan, the greatest importance was attached to (1) the installation of reliable water supply and sewerage facilities, and (2) the decrease in water leakage and wasteful water usage for the efficient use of water resources.

"The Strategy for Development of the Republic of Kazakhstan until the year 2020" (2010), which was the national development plan at the time of the ex-post evaluation, requires relevant government agencies to bear the responsibility for providing public services (water, electricity, gas, and heat) in accordance with regularory standards. Policy goals also include the, decrease of distribution loss for water, electricity, gas, and heat and the improvement in user satisfaction with each service. Moreover, in the "Regional Development Program to the

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

[2] ③: High, ②: Fair, ①: Low

Year 2020", the construction and rehabilitation of 212 km of distribution pipes and 128 km of sewer pipes are projected during the planned period between 2015 and 2019. This program has targeted 100 percent of the provision of water supply and sewage services by 2019.

From the time of the appraisal through the time of the ex-post evaluation, the national development plan's priority areas have been expanded from ensuring adequate quality of drinking water to the effective use of water resources. During this period, the greatest importance has been attached to the development of Astana City's water supply and sewerage infrastructures. This project regards the development of water supply and sewerage infrastructure as its outputs and also includes a countermeasure against water leakage and efficient water usage as a part of the project outcomes. Thus, the project objectives are consistent with priority areas of the policies both at the time of the appraisal and the ex-post evaluation.

3.1.2 Relevance to the Development Needs of Kazakhstan

The population of Astana City was 300,000 people in 1999, and at the time of appraisal, the population was forecasted to reach 490,000 people by 2010 [3]. Given such a substantial increase in population was expected, it was obvious that the capacity of water supply and sewage treatment would become insufficient. Astana City's, water resource is surface water and the water supply system had been established in the 1960's. The feasibility study of this project ("The urban design model study for the development of the City of Astana (F/S on Water Supply and Sewerage in the City of Astana)", JICA, 2001), anticipated that pumps of the water intake facility could not be operated by 2010 and that the existing water treatment plant would also not be operable by 2020. It was also pointed out that water leakage from distribution pipes was salient. Moreover, excessive use of water was an issue to be solved. As water flow meters were not equipped, it was difficult to measure the volume of water usage. At the time of the appraisal, water supply surpassed 400 liters/capita/day in Astana city. As the amount was larger than those in other cities, wasteful usage of water needed to be corrected[4]. In addition, the capacity of the sewage treatment plant, which was completed in the 1970's, had been lowered because of aging facilities and insufficient maintenance work.

In July 2014, the population of Astana City reached approximately 840,000 people. The rapid increase was not expected at the time of the appraisal. The City of Astana has become the second most populous city in the country after Almaty City. In order to accommodate the

[3] The population of Astana City reached approximately 700,000 people in 2010. This population was far larger than the forecast at the time of the appraisal.

[4] At the time of the appraisal, the amounts of water supply/capita/day were in 341 liters in London, 229 liters in Paris, and 206 liters in Singapore.

pronounced population growth, the water supply and sewerage system infrastructures have continued to be developed. The old water treatment plant, which was in operation before the project implementation, has been rehabilitated and a new sewer treatment plant (118,000 m^3/day) has been under construction.

At the time of the appraisal and the ex-post evaluation, it was concluded that there is strong demand for the facilities rehabilitated or enhanced by the project. Given a steep rise of population, it is ovious that there is strong demand for water supply and sewage services.

3.1.3 Relevance to Japan's ODA Policy

At the time of the appraisal, Country Assistance Program for the Republic of Kazakhstan had not been prepared. However, policy dialog on economic cooperation between Kazakhstan and Japan had been conducted, and great importance was attached to the development of economic and social infrastructures in the development assistance to Kazakhstan. In "Japan's ODA White Paper 2003" issued by Ministry of Foreign Affairs of Japan, a priority for development assistance to the Central Asian Region was placed on "development of economic and social infrastructures that is a foundation of self-supporting economic and social development". In the "ODA Data Book by Country 2002" issued by the Ministry of Foreign Affairs of Japan, infrastructure development was also mentioned as one of the priority areas for devlopment assistance to the Republic of Kazakhstan because "aging of economic and social infrastructures" was regarded as a development issue of the country.

In light of the above, this project has been highly relevant to the country's development plan and 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 project implemented construction and rehabilitation works for the water intake facility, a water treatment plant, and a sewage treatment plant (see Figure 1). Major differences between the initial plan and actual outputs are shorter lengths of transmission pipes, distribution pipes, and sewer pipes, decrease in the number of installation of water flow meters, and change of some specifications of the sewage treatment plant (see Table 1). As for the water treatment facilities of the plant, the scope of the project was maintained mostly as planned. As the cancelled parts of the project scope were handled by Astana Su Arnasy (ASA) with the government budget, it does not affect the incidence of the project effects. The number of installation of water flow meters was reduced because users have begun to install the meters on their own since the water rates based on a measured rate system was cheaper than the rates based on a flat rate system.

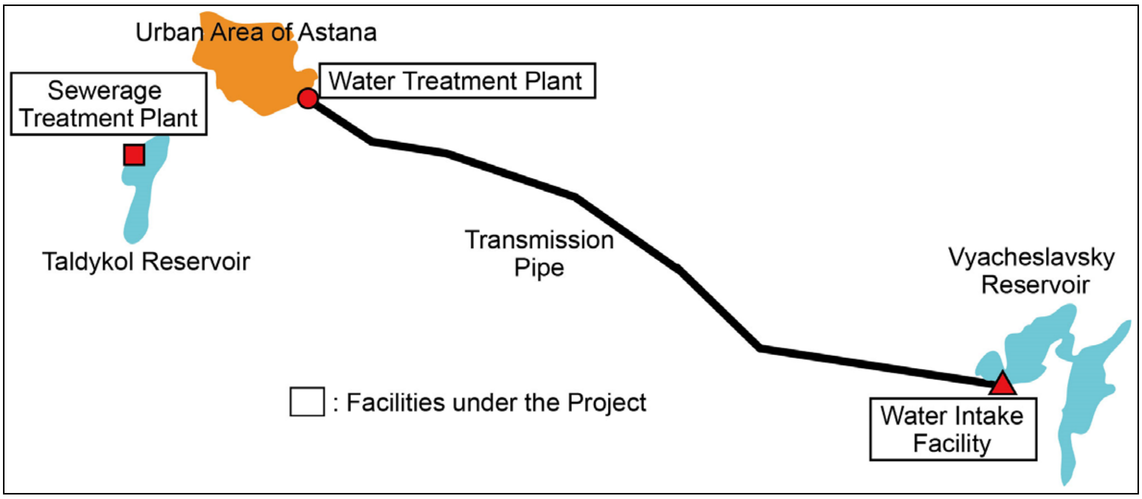

Figure 1: Project Site

Table 1: Project Outputs

Plan	Actual
Civil Works: • Construction of water intake facility (5 pumps) • Construction of a water treatment plant (capacity of water purification 100,000m^2/day) • Renewal (approx.99km) and new installation in the new city (15km) of distribution pipes • Installation of water flow meters (153,900) • Rehabilitation of sewage treatment plant • Renewal of sewer pipes (approx.21km, 44 pumps) • Introducing of sewage treatment machinery	Civil Works: • Construction of water intake facility (6 pumps) • Construction of a water treatment plant (capacity of water purification 105,000m^2/day) • Renewal (approx.98km) and new installation in the new city (approx.6km) of distribution pipes • Installation of water flow meters (85,333) • Rehabilitation of sewage treatment plant (repair works with concrete of aeration tank is out of the scope of the project) • Renewal of sewer pipes (approx.15km, 54 pumps) • Introducing of sewage treatment machinery (changed the construction of digester to rehabilitation)
Consulting Service: Overseas 207M/M Domestic 558M/M	Consulting Service: Overseas 442M/M Domestic 1,623M/M

Source: documents provided by JICA, the executing agency

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost is significantly higher than planned (194% of planned costs). The actual project cost was 55,329 million yen whereas the planned project cost was 28,481 million yen. During the period from the time of cost estimation for the project (January 2002) to the commencement of the construction (November 2006), both materials costs (steel materials, PVC pipes) and labour costs had steeply risen due to a construction boom in Astana City. The price escalation was the main cause of the increase in the project cost. During the project implementation, the project cost was amended in accordance with a price adjustment clause in the civil works contract.

3.2.2.2 Project Period

Project period is significantly longer than planned (184% longer than planned). The actual project period was 103 months whereas the planned period was 56 months (see Table 2). The commencement of consulting service was delayed by five months from the original plan and the commencement of civil works was delayed by 26 months. The major causes for taking a longer period to conclude a civil works contract were a delay in the preparation of tender documents, and prolonged contract negotiation due to the increase in the project cost. The actual period of civil works was 63 months compared to the planned period of 42 months. Major causes for a delay in civil works were: (1) civil works were sometimes halted due to the lack of budget in the executing agency, and (2) the sewage treatment plant needed to be rehabilitated at the site where existing facilities were installed and handing over of the site was often delayed.

Table 2: Project Period

	Planned Period	**Actual Period**
L/A Signing	July 2003	July 2003
Consulting of Construction Supervision	December 2003 - February 2008	May 2004 - January 2012
Civil works	September 2004 - February 2008	November 2006 – January 2012
Project Completion (Project Period)	February 2008 (56 months)	January 2012 (103 months)

Source: documents provided by JICA

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

With regard to calculating the Financial Internal Rate of Return (FIRR), the actual data of FIRR was 0.2% whereas the planned FIRR was 2.6% (see Table 3 for preconditions for the calculation). FIRR fell short of the planned rate mainly due to an increase in the construction cost and a delay of revising the water rates. When calculating FIRR at the time of the appraisal, the water rate for households was estimated to double the tariff level in real terms and the rate of industrial water to become four times higher. However, the actual rate has not reached these levels. In terms of calculating the project's Economic Internal Rate of Return (EIRR), the actual data of EIRR was 16.0% whereas the planned EIRR was 15.7%. The actual EIRR was almost equal to the planned EIRR because the increase in construction costs was offset by an increase in demand for water supply. At the time of the appraisal, it was anticipated that after 2020, 40% of household water supply demand would be purchased from other sources and avoiding this cost was considered a benefit of the project.

Table 3: Calculating Conditions of Internal Rate of Return

	FIRR	EIRR
Costs	Construction cost, O&M cost	Construction Cost, O&M cost
Benefits	Water Rate Revenue	Decreases of investment and O&M cost for existing facilities, reduction of water purchasing cost, that of labor of drawing water, and that of sewage treatment cost
Project Period	40 years after the completion	40 years after the completion
Preconditions	• O&M cost in the presumption at the appraisal reflected an increase in project cost. • Used actual data for water rate revenue and construction cost. • Demands for water supply and sewage service were on the presumption of 0.56% growth per year during the project period (in accordance with “UN Population Prospect 2012 revision”) • The rates for both water supply and sewage services are estimated double from the current level by the year 2024. • Calculated in real terms.	• O&M cost was on the same presumption as FIRR. • Used presumptions at the appraisal for the items which sufficient data was not available (decreases in investment in existing facilities and O&M cost, decrease in labour of drawing water, decrease in sewage treatment cost). • As for the decrease in water purchasing cost, only the volume was updated and other presumption at the appraisal for benefit unit were used. • The conversion factor was 0.8 times. • Demand forecast was on the same presumption as FIRR. • Calculated in real terms.

In light of the above, both the project cost and the project period significantly exceeded the plan. Therefore, efficiency of the project is low.

3.3 Effectiveness[5] (Rating: ③)

On an intervention theory of this project, it was expected that the project outputs, such as the development of water supply and sewage facilities and the installation of water flow meters, would bring about outcomes, such as an increase in the volume of water supply, a decrease in the volume of water usage per person, and the betterment of water quality. It was assumed that those outcomes would ultimately contribute to the incidence of impacts, such as accommodating a growing population and the betterment of the quality of the service.

3.3.1 Quantitative Effects (Operation and Effect Indicators)

(1) Water Supply Service

The volume of water supply two years after the project completion was higher than the target (see Table 4). It was forecasted that the capacity of water supply in the old water treatment plant would decrease to 82,000 m^3/day in 2010. Therefore it would have been difficult to ensure the current volume of water supply without this project, and it should be noted that this project played a significant role in increasing the volume of water supply. Also, the volume of water supply per person has decreased and achieved the target. Water flow meters were not widely installed at the time of appraisal. A water tariff incorporating a

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

user-pays principle was adopted after the installation of water flow meters and, as a result, wasteful water usage has been curbed. The water leakage rate has achieved the target and has continued to decrease in the period for which data was available (after 2009). As shown above, the incidence of the project effects is obvious in water supply service.

Photo 1: Inside of Water Treatment Plant

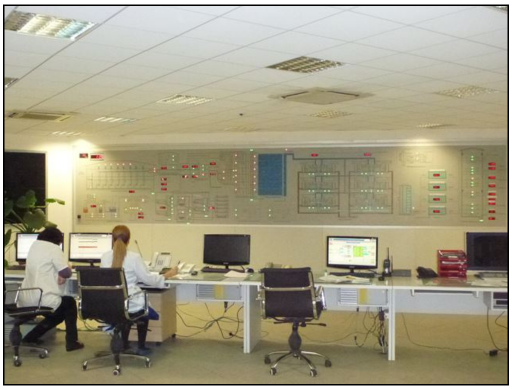

Photo 2: Control Room of Water Treatment Plant

Table 4: Operational and Effect Indicators for Water Supply Service

	Baseline	**Target**	**Actual**		
	1999 **F/S Implementation**	**2000** **2 Years After Completion**	**2012** **Completion Year**	**2013** **1 Year After Completion**	**2014** **2 Years After Completion**
Volume of Water Supply (m^3/day)	131,000	144,000	165,923	164,641	179,156
Volume of Water Supply by Person (litres/person/day)	436	294	214	208	215
Rate of Water Leak (%)	26.0%	20.0%	19.0%	19.9%	NA

Source: documents provided by JICA and ASA

Notes: the amount of water supply is the total supply amount from the existing plant (not assisted by yen loan) and newly installed plant (assisted by yen loan)

(2) Sewage Service

The amount of sewage surpassed the capacity of the sewage treatment plat (136,000 m^3/day) due to an unexpectedly high population growth. For this reason, the BOD5 of the outlet waste water from the sewage treatment plant has not achieved its target (6.0mg/litre) (see Table 5). The BOD5 of the outlet waste water is below the concentration level permitted for the plant (10.65mg/litre) in accordance with Kazakhstan regulations. Given the sewage treatment plant rehabilitated by the project uses activated-sludge method, its BOD5 of the waste water is within a permissible level in accordance with the standard in Japan (BOD5 of outlet waste water is 10-15mg/litre for standard activated-sludge method) and the EU standard (BOD5 of outlet waste water is below 25mg/litre for a sewage treatment plant in urban area)[6]. Although the target has not been achieved, the BOD5 of outlet waste water is below the concentration level permitted for the plant, which is stipulated in Kazakhstan regulations, and within a permissible level in accordance with the standards of other countries. It is concluded, therefore, that sewage service has a middle level of effect by the project.

Table 5: Operational and Effect Indicators for Sewage Service

	Baseline	**Target**	**Actual**		
	1999	**2000**	**2012**	**2013**	**2014**
	F/S Implementation	**2 Years After Completion**	**Completion Year**	**1 Year After Completion**	**2 Years After Completion**
Volume of Sewage Treatment (m^3/day)	NA	NA	149,822	168,701	161,572
BOD5 of outlet waste water (mg /litre) of Sewage Treatment Plant	8.3	6.0	8.4	9.5	8.7

Source: documents provided by JICA and ASA

Notes: Although the volume of sewage treatment was not set as an operational and effect indicator at the appraisal, it is stated as it is important for evaluation.

3.3.2 Qualitative Effects (Other Effects)

(1) Diffusion of Water Flow Meters and Better Awareness of Water Saving

Between 2000 and 2014, water flow meter coverage has increased from 9% to 76%. This project provided approximately 20% of the installed meters during this period. ASA continuously conducts campaigns for the installation of water flow meters. In tandem with an increase in the coverage of water flow meters, since August 2010, ASA has introduced a two-stage progressive rate system based on the volume of water usage. In this ex-post evaluation, a questionnaire survey was implemented in the Sary Arka District in Astana City. The residents and entrepreneurs who installed water flow meters in assistance with the project were interviewed (the number of valid responses was 181)[7].

[6] It is difficult for biological treatment (such as activated-sludge method) to achieve the target for BOD5 of outlet waste water. Value judgement reflected this difficulty and is based on an appropriate target for the same type of waste water treatment method.

[7] The Sary Arka District was chosen because this project installed the largest number of flow meters in the district.

Table 6: Better Awareness of Water Saving in the Sary Arka District

		Yes, very much	Yes, to some extent	No, not much	Not at all	Total
Do you consider your volume of water usage after the installation of a water meter?	Number of responds	98	40	31	12	181
	%	54.1%	22.1%	17.1%	6.6%	100.0%
Do you think a water meter makes you conserve energy?	Number of responds	75	47	42	17	181
	%	41.4%	26.0%	23.2%	9.4%	100.0%
Do you think that a water meter makes you save payment for water?	Number of responds	66	48	43	24	181
	%	36.5%	26.5%	23.8%	13.3%	100.0%

Source: Beneficiary Survey

The study showed that, after water flow meters were installed, approximately 80% of respondents (total of “Yes, very much” and “Yes, to some extent”) have become conscious of the volume of water usage, approximately 70% (total of “Yes, very much” and “Yes, to some extent”) have saved water usage, and 60% (total of “Yes, very much” and “Yes, to some extent”) have saved the water rate (see Table 6). The project has contributed to a wider coverage of water flow meters and the introduction of a water rate system that put the brakes on wasteful water usage, and has brought about an increase in the awareness of saving water in the target area.

(2) Introduction of Advanced Monitoring Flow Meter

In many cases, individual users read a water flow meter and declare the volume of water usage by themselves. Occasionally users intentionally declare a low usage amount which prevents an appropriate charge for water usage. In addition, in some cases involving individual flow meters, meters have been artificially manipulated to reduce payment for water. The project installed 3,500 advanced monitoring flow meters on a trial basis in addition to the usual water flow meters (80,325 meters for individual users, 1,508 bulk flow meters). Since the advanced monitoring flow meter automatically sends volume usage data, ASA is able to accurately measure water usage. For the introduction of the advanced monitoring flow meters, the project provided training to five ASA staff in charge, and one of them had training out of the country. The small number of staff (five employees) could precisely measure water usage in 3,500 locations with the installation of the advanced flow meters. Since there are few places where advanced monitoring flow meters are introduced in the country, the project provided some advanced assistance for determining an appropriate water usage charge.

3.4 Impacts

3.4.1 Intended Impacts

(1) Increase in Population for Water Supply

In 2014 the population of Astana City was approximately 840,000 people. The increased volume of water supply between and "before" and "after" the project implementation was 48,156m^3, which is equivalent to the volume of water supply for 224,000 people (approximately 30% of the total population) based on the volume of water supply per person in 2014 (215 litres/person/day). This project has played an indispensable role in providing water supply service in the City which has seen its population grow rapidly.

(2) Stability of Water Supply and Sewage Services and Residents' Satisfaction

In the aforementioned survey of the beneficiaries, people were asked their opinions about the stability of water supply and sewage services. At the time of the ex-post evaluation, approximately 70% of respondents answered that there was no suspension of water supply and sewage services and approximately 20-30% replied that the suspension was not frequent (see Table 7). With regard to suspension of water supply service, approximately 50% of respondents answered "No change" compared to 5 years ago, and the total answers of "Less frequent" and "Much less frequent" exceeded 40%. Additionally in regards to the suspension of sewage service, more than 50% of respondents answered "No change" compared to 5 years ago, and total answers of "Less frequent" and "Much less frequent" slightly exceeded 40% (see Table 8)[8]. While the number of respondents who replied that the stability of the services worsened is relatively small, the result generally suggests an improvement of service stability after the project implementation.

Table 7: Stability of Water Supply and Sewage Services in the Sary Arka District

		Very frequent	Frequent	Not frequent	Never	Total
Suspension of Water Supply Service	Number of responds	1	9	52	119	181
	%	0.6%	5.0%	28.7%	65.7%	100.0%
Suspension of Sewage Service	Number of responds	7	10	40	124	181
	%	3.9%	5.5%	22.1%	68.5%	100.0%

Source: Beneficiary Survey

[8] In Astana City, more than half of the residents have resettled in the last 10 years. It was difficult to obtain sufficient samples for the questions to compare "after" with "before" the project implementation. Thus, the study assessed the quality of water supply and sewage service in comparison with 5 years ago, taking into consideration of the January 2012 project completion date.

Table 8: Stability of Water Supply and Sewage Service in the Sary Arka District Compared to 5 Years Ago

		Much more frequent	More frequent	No change	Less frequent	Much less frequent	Total
Suspension of Water Supply Service	Number of responds	1	9	92	50	29	181
	%	0.6%	5.0%	50.8%	27.6%	16.0%	100.0%
Suspension of Sewage Service	Number of responds	2	5	99	54	21	181
	%	1.1%	2.8%	54.7%	29.8%	11.6%	100.0%

Source: Beneficiary Survey

In this questionnaire survey, the users were also asked about the degree of satisfaction of water supply and sewage services and installation of water flow meters. In response to the betterment of services, the total of “Very satisfied” and “Satisfied” exceeds 80% of all responses (see Table 9).

Table 9: Satisfaction of Water Supply and Sewage Services and Installment of Water Meters in the Sary Arka District

		Very satisfied	Satisfied	Unsatisfied	Very unsatisfied	Total
Water Supply Service	Number of responds	71	89	12	9	181
	%	39.2%	49.2%	6.6%	5.0%	100.0%
Sewage Service	Number of responds	48	96	27	10	181
	%	26.5%	53.0%	14.9%	5.5%	100.0%
Installation of a water meter	Number of responds	62	85	30	4	181
	%	34.3%	47.0%	16.6%	2.2%	100.0%

Source: Beneficiary Survey

(3) Water Quality of Tardykol Reservoir

The sewage treatment plant rehabilitated by this project discharges the treated water into the Taldykol Reservoir. BOD5 of outlet waste water of the Reservoir has increased from 6.0mg/litre in 1999 to 9.0mg/litre in 2014. The quality of water has become worse as the capacity of sewage treatment is not sufficient due to the growing population. However, the pooled water in the Reservoir has not been used, so that deterioration of water quality does not affect water usage.

At the time of ex-post evaluation, a new sewage treatment plant and a waterway was under construction to accommodate a rise in the water level of Taldykol Reservoir, and it is planned that the treated water will be discharged directly into the Ishim River after evaporation of the Reservoir in 2017. At the time of ex-post evaluation, ASA has monitored the water level of Taldykol Reservoir since drainage into the Reservoir has continued.

3.4.2 Other Impacts

(1) Impacts on the Natural Environment

A water treatment plant, a sewage treatment plant, and a pump station had been constructed at the sites owned by ASA, and transmission pipes, distribution pipes, and sewer pipes have been buried under the ground. As civil works have been implemented at the sites where existing facilities were installed and the instalation of new pipes is replacememt of exisiting pipes in most of the sections, it is concluded that civil works' impacts on natural environment are insignificant. When civil works start, explanatory meetings had been held and the residents were informed of the contact address to file complaints in meetings and through radio broadcasts and residents meeting. On the other hand, dried sludge has been stored in the sewage treatment plant, and thus, an odor issue still remains and needs to be tackled.

As shown in "3.3.1 (2) Sewage Service", the BOD5 of outlet waste water is below the concentration level permitted for the plant in accordance with Kazakhstan regulations.

(2) Land Acquisition and Resettlement

As mentioned above, since civil works have been implemented at the sites where existing facilities were installed, both land acquisition and resettlement of residents did not occur at the time of the project implementation.

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

3.5 Sustainability (Rating: ②)

3.5.1 Institutional Aspects of Operation and Maintenance

On the operation and maintenance of this project, Astana City was in charge of project implementation, and the ASA has been in charge of the operation and maintenance since project completion. ASA is a public enterprise fully funded by the City of Astana, and important managerial decisions (such as, the investment plan, the number of staff members, and setting salaries) are under the supervision of Astana City. The Agency for the Regulation of Natural Monopolies approves the water tariff. Both at the appraisal and the ex-post evaluation, A Deputy General Manager directly responsible for the management of water supply and sewage facilities has been assigned and has supervised the operation and maintenance of the facilities constructed by the project.

In 2014, the number of ASA staff was 1,536 persons (81 managrial and adminstrarive staff, 280 engineers, and others are operational staff) and the number has increased since the time of appraisal (902 persons in 2001). The increase of staff members is due to the capacity expansion of water supply and sewage system to cope with the population growth.

The responsibility for operation and maintenance of the facilities constructed by the project was apparent, and the personnel required for the operation of the facilities was ensured. Thus, no problem which could impair the sustainability of the project was found.

3.5.2 Technical Aspects of Operation and Maintenance

On the employment of ASA engineers, it is a prerequisite that they have a degree in the relevant field or operating experience of a similar plant. For instance, an engineer in charge of SCADA has a degree in telecommunications and also has an experience of SCADA operation at a plant using steam. Engineers participate in seminars in relevant fields, and employees posted to the plant have EHS training, i.e. environment, health, and safety. Training for the machine operation is mainly implemented through OJT at a work place.

Manuals for machineries procured by the project and training materials were prepared in Russian and a three-month-training by the contractor was set at the water treatment plant and at the sewage treatment plant. In an interview with the contractor, it was pointed out that a three-month training period was not a sufficient period to change the attitudes of the operational staff. Whereas ASA staff has the sufficient operational experience and the technical knowledge required for the daily operation of water supply and sewage facilities, they are reluctant to change their old operating procedures even after the installation of new machnary.

Since the training period was not long enough to affect ASA staff’s attitude in regards to appropriate operation, ASA staff tend not to change existing procedures. Nevertheless, ASA staff members possessed the basic operational ability for water supply and sewage facilities, and when employing engineers, technical knowledge and operating ability is taken into consideration. Therefore, no issue which could impair the project sustainability was found in the technical aspects of operation and maintenance.

3.5.3 Financial Aspects of Operation and Maintenance

At the time of ex-post evaluation, ASA is financially self-sustainable without a subsidy from Astana City for operation and maintenance. For both water supply and sewage systems, the tariff revenue can be directly allocated to operation and maintenance. In the tariff adjustment process, ASA has to file an application of water tariff to the Agency for Regulation of Natural Monopolies and to obtain an approval on a new tariff. When filing an application, a 5-year investment plan is submitted together with the application.

Regarding ASA’s sales of water supply and sewerage services for the last five years, an increase in revenue has exceeded the consumer price index (see Table 10). According to the ASA, despite an increase in the number of the employees, there has been no delay of salary payments. Also, malfunctioning facilities have been fixed or replaced at the plants. Although data on expenditure items for operation and maintenance was not available, it is assumed that expenses required for routine operation and maintenance are ensured taking into consideration the timely salary payment and proper repairs to facilities.

Table 10: Sales of ASA in Water Supply and Sewage Services

	2009	2010	2011	2012	2013
Sales (Tenge)	1,504,482,981	2,019,317,020	3,148,965,050	4,665,042,349	5,483,380,760
Rate of increase compared to the previous year	-	34.2%	55.9%	48.1%	17.5%
CPI(2010=100)	79.9	100.0	127.2	131.7	131.3
Rate of increase compared to the previous year	-	25.2%	27.2%	3.5%	-0.3%

Source: ASA

Since 2010, a water tariff reform has progressed in Astana City. On the water supply service, the same rate was applied to all users before 2010, but differant rates have been applied to individual users, government organizations/state-owned enterprises, and private corporations since 2010 (see Table 11). Moreover, a progressive rate system has been introduced for individual users since 2011, in which the rates are classified into three categories water usage volume, i.e. “Below 3 m^3/month”, “Above 3 m^3/month”, and “No meter”.

Table 11: Trend of the Water Rates

Unit: Tenge/m^3

<table>
<tr><th>Service</th><th>Classification</th><th>5/2004-6/2006</th><th>10/2009-8/2010</th><th>9/2010-8/2011</th><th>9/2011-8/2012</th><th>9/2012-8/2013</th><th>9/2013-4/2015</th></tr>
<tr><td rowspan="5">Water Supply</td><td>Individual Users (below 3m^3 /month)</td><td rowspan="5">20.14</td><td rowspan="5">22.59</td><td rowspan="3">22.59</td><td>27.11</td><td>31.17</td><td>35.85</td></tr>
<tr><td>Individual Users (above 3m^3 /month)</td><td>32.53</td><td>37.41</td><td>43.02</td></tr>
<tr><td>Individual Users (no meter)</td><td>39.04</td><td>46.84</td><td>53.78</td></tr>
<tr><td>Government organizations/ State-owned enterprises</td><td>35.71</td><td>62.49</td><td>93.74</td><td>97.49</td></tr>
<tr><td>Private corporation</td><td>56.48</td><td>90.00</td><td>111.95</td><td>112.59</td></tr>
<tr><td rowspan="3">Sewage Treatment</td><td>Individual Users</td><td rowspan="3">14.48</td><td rowspan="3">16.35</td><td>16.35</td><td>18.80</td><td>21.62</td><td>24.87</td></tr>
<tr><td>Government organizations/ State-owned enterprises</td><td>35.2</td><td>84.48</td><td>92.93</td><td>102.22</td></tr>
<tr><td>Private corporation</td><td>40.9</td><td>89.14</td><td>101.24</td><td>107.80</td></tr>
</table>

Source: ASA

The rate in May 2004 was 20.14 Tenge/m^3 for water supply service and 14.48 Tenge/m^3 for sewage treatment service. In September 2013, the rate for water supply service was 35.85 Tenge/m^3 (178% compared to 2004) for individual users of “Below 3 m^3/month”, 43.02 Tenge/m^3 (214% compared to 2004) for individual users of “Above 3 m^3/month”, 112.59 Tenge/m^3 (559% compared to 2004) for private corporations, and the rate of sewage treatment service was 24.87 Tenge/m^3 (172% compared to 2004) for individual users and 107.8 Tenge/m^3 (774% compared to 2004) for corporate users. The inflation rate during that period was approximately 200% and the rate of water supply and sewage treatment services for individual users remained at a similar level in real terms. Although water tariff reform has been underway, it can be assumed that the current tariff has not recovered the investment cost.

While the current water tariff covers daily operational costs, it does not seem to be enough to handle a major repair and reinvestment. It is concluded, therefore, that there is a minor problem in the financial aspects of operation and maintenance.

3.5.4 Current Status of Operation and Maintenance

With regard to spare parts, the timing of inspections is scheduled and the inspections are implemented based on a record of operation time. Repair and replacement are also carried out based on its necessity. During the project implementation, the lists of spare parts and inter-changeable equipment produced by other companies were made. From hearings with ASA staff members, there seems to be no spare part that is difficult to be obtained. Poor functioning was observed for some installed facilities at the time of the ex-post evaluation. The major malfunctions reported by ASA are as follows:

- Distribution Pipes Valves: It was reported that there were problems in the valves made in Thailand due to a breakdown of gears. ASA has already replaced these valves with Russian-made valves.
- Grit Separator: The facility has been clogged often due to unremoved garbage. The grit separator currently has not been used but ASA has coped with this problem by using the grit channel which has been used before the rehabilitation. ASA staff find garbage in the grit channel by visual inspection and dispose of it.
- Walls of the Building: Some walls were encroached as ice clogged the gutter and rainwater could not be drained. ASA has repaired the walls and the roofs.
- Digester: The digester needs to obtain heat from a boiler when it decreases the quantity of sludge and makes it safe. The digester malfunctioned at the time of the ex-post evaluation, and it has not been used. The sludge was being stored in the sewage treatment plant at the time of the ex-post evaluation. The storage capacity will

reach its limit in the medium- and long-term since there was no plan for the final disposal of the sludge.

- SCADA: In the water treatment plant, the monitoring function of a sand filter has ceased. In the sewage treatment plant, since a meter for polymers at the sludge treatment plant has not been monitored by SCADA, ASA has directly checked the meter and a manual operation has been on-going.

It is concluded that there are minor problems in operation and maintenance. The digester was not used, and the storage capacity will reach its limit in the medium- and long-term. However, there is no definite plan to cope with this issue.

Some minor problems have been observed in terms of the financial aspects and the current status of operation and maintenance. Therefore, sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of this project was to ensure a wider coverage of water supply and sewage services and to improve the quality of the water supply through the development of water supply and sewerage infrastructures in Astana City which has seen a remarkable increase in its population. As the project objective is consistent with the priorities of the development policy (both at the time of the project appraisal and the ex-post evaluation) and given the increase in demand for water supply and sewerage service, the relevancy of this project is high. The efficiency of the project is low. The project cost was substantially exceeded mainly because a construction boom caused an increase in construction and labour costs in Astana. In addition, the project period was prolonged due to a delay in both procurement and civil works. In terms of water supply service, the volume of water supply and the water leakage rate achieved their target. Water supply volume per capita has decreased due to the diffusion of water flow meters as well as better awareness of water saving, both of which were brought about by this project. In terms of sewage service, although the quality has not been improved as much as projected, due to the population growth, the quality of discharged water satisfies both the discharge standard based on domestic regulations in Kazakhstan and the standard activated-sludge method in Japan. Approximately 70% of beneficiaries did not experience a suspension of water supply and sewerage services, and approximately 20-30% replied that the suspension of these services was not frequent. From this point of view, the effectiveness and impact of this project is considered high. As for the sustainability of the project, given the tariff level at the time of the ex-post valuation, it will be difficult to recover the investment costs and secure capital costs for any major repairs that become necessary. In terms of the current status of operation and maintenance, no definite plan on the final disposal of sludge from the sewerage treatment plant has yet to be worked out. Therefore, sustainability of the project effects is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

ASA stored dried sludge in the sewerage treatment plant. This shows that a countermeasure for odor needs to be enhanced and that the final disposal of the sludge will face a storage capacity limitation in the sewage treatment plant in the medium- and long-term. It is desirable for ASA to formulate an environmentally-sustainable program to cope with dried sludge at the earliest opportunity.

4.2.2 Recommendations to JICA

It is desirable for JICA to monitor two or three times a year, the disposal of dried sludge, encourage ASA to take appropriate actions, and continuously provide technological advice to the government of Astana City, if needed.

4.3 Lessons Learned

<u>Public Awareness Campaign in Grey Water</u>

The population growth was much greater than initially forecasted. The unexpected population growth resulted in an increase of grey water and, eventually, an excessive load on the sewage treatment plant. For this reason, the target for the improvement of water quality was not achieved. It was infeasible to flexibly change the capacity of the sewage treatment along with the increase in population. Nevertheless, a reduction of pollutants with the cooperation of the residents was an option worth considering. For examples, these options are to stop discharging waste oil into a sewage system and to use biodegradable detergents. It is worth assessing a campaign to reduce grey water as a contingency plan for an unexpected population growth in a project that rehabilitated and constructed a sewage treatment plant.

<u>Longer Training Period</u>

This project set a three-month training period for using the new equipment. Although the operators obtained sufficient knowledge of the machineries in the water treatment plant and the sewage treatment plant, they continued with their existing operating procedures. It takes time to understand the benefits of new technologies fully and to practice new procedures whenever that new technology involves a radical change in operational procedures. In such cases, it is desirable to carefully plan a project period to accommodate at least one year training period.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	Civil Works: • Construction of water intake facility (5 pumps) • Renewal of transmission pipes (approx.15km) • Construction of a water treatment plant (capacity of water purification 100,000m^2/day) • Renewal (approx.99km)and new installation in the new city (15km) of distribution pipes • Installation of water flow meters (153,900) • Rehabilitation of sewage treatment plant • Renewal of sewer pipes (approx.21km, 44 pumps) • Introducing of sewage treatment machinery(Sludge belt- thickener, replacement of sludge pumps) Consulting Service: Overseas 207M/M Domestic 558M/M	Civil Works: • Construction of water intake facility (6 pumps) • Construction of a water treatment plant(capacity of water purification 105,000m^2/day) • Renewal (approx.98km) and new installation in the new city (approx.6km) of distribution pipes • Installation of water flow meters (85,333) • Rehabilitation of sewage treatment plant (repair works with concrete of aeration tank is out of the scope of the project) • Renewal of sewer pipes (approx.15km, 54 pumps) • Introducing of sewage treatment machinery (changed the construction of digester to rehabilitation) Consulting Service: Overseas 442M/M Domestic 1,623M/M
2. Project Period	July 2003 – February 2008 (56 months)	July 2003 – January 2012 (103 months)
3. Project Cost		
Amount paid in Foreign currency	19,109 million yen	23,432 million yen
Amount paid in Local currency	9,372 million yen (10,530 million KZT)	31,897 million yen (39,998 million KZT)
Total	28,481 million yen	55,329 million yen
Japanese ODA loan portion	21,361 million yen	21,253 million yen
Exchange rate	1KZT = 0.89 yen (As of January 2002)	1KZT = 0.80 yen (Average between January 2003 and December 2011)