Republic of Peru

FY 2017 Ex-Post Evaluation of Japanese ODA Loan Project

"North Lima Metropolitan Area Water Supply and Sewerage Optimization Project (I)"

External Evaluator: Hajime Sonoda, Global Group 21 Japan, Inc.

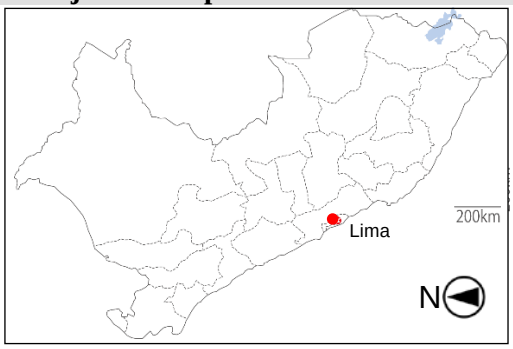
0. Summary

"North Lima Metropolitan Area Water Supply and Sewerage Optimization Project (I)" (hereinafter referred to as "the Project") was implemented with the objective of optimizing water supply and sewer systems to improve the quality of water supply and sewerage services and thereby contribute to improving the sanitation environment for residents of Comas-Chillon area within the service area of Huachipa Water Treatment Plant (WTP) in the Lima Metropolitan Area (hereinafter referred to as the "LMA"). The water supply and sewage sector has consistently been a priority issue for the Government of Peru since the time of appraisal to the time of ex-post evaluation. At the time of appraisal, there was a great need for the development of water supply and sewer systems in the LMA, and the facilities under the Project play an important role at the time of ex-post evaluation. In addition, the Project was relevant to Japan's ODA policy at the time of appraisal. Based on the above, the relevance of the Project is high. Although the scope of water supply network rehabilitation was reduced and other revisions including an increase in the number of sectors were made at the time of the detailed design[1], the Project cost was roughly as planned. Meanwhile, due to delay in completion of the North Branch Water Transmission Line (hereinafter referred to as the "North Branch") as the water source, the Project was completed two years behind schedule. Therefore, the efficiency of the Project is fair. The intended effects of the Project, including 24-hour water supply based on appropriate water pressure, major improvement in the non-revenue water rate, and reduction of sewerage blockages, have generally materialized as planned. In addition, the sanitation environment has been improved for residents, while the 24-hour water supply has resulted in greater convenience and flexibility in the lives of residents. Therefore, the effectiveness and impacts of the Project are high. As no problems are observed with the institutional, technical and financial aspects of the operation and maintenance of the Project, the sustainability of the Project is high.

To sum up, the Project is evaluated to be highly satisfactory.

[1] In the Project, "sectorization" was carried out whereby the water supply network was divided into independent sectors (water distribution zones). Sectorization makes it possible to ensure appropriate and uniform water distribution pressure, manage non-revenue water and water leakage, and conduct efficient water supply management and operation and maintenance through localizing works and damage arising from accidents. Through controlling and measuring the volume of water supply in each sector and introducing SCADA (Supervisory Control and Data Acquisition - a remote management system using telemetry), it is possible to regulate the water pressure according to the volume of water consumption, reduce water leakage, and rapidly close sectors in remote control when executing water supply works, thereby making it possible to limit the areas and duration of water outages. The sectorization in the LMA was started in 1997. It is planned for the entire metropolitan area to be divided into almost 400 sectors. At the time of the ex-post evaluation, more than 300 sectors have been compartmented.

1. Project Description



Project Location

Distribution tank rehabilitated by the Project

1.1 Background

The LMA, which has the largest population in Peru (some 9 million in 2008), has a desert climate with hardly any rainfall all year round. In the latter half of the 2000s, it experienced severe water shortages as a result of rapid increase in the demand for water brought about by population concentration. In particular, compared to the non-revenue water rate of central area (36%) and southern area (22%), where water supply pipeline and sewer networks have been rehabilitated and sectorization has been implemented, the northern area, where the increase in population has been especially marked, experienced a high non-revenue water rate of up to 50% and daily water supply time of only around 12 hours, shorter than the water supply time of around 22 hours and 24 hours in central and southern areas respectively. With a view to resolving the water shortage in the Northern LMA, Lima Sanitation Services Company (hereinafter referred to as "SEDAPAL"[2]), which is responsible for water supply and sewerage services in the LMA, advanced construction of Huachipa WTP and the North Branch with cooperation from JICA[3]. Even so, to realize the effective utilization of water made available by these facilities, it was also necessary to renew water distribution facilities and improve the non-revenue water rate.

Against this background, the Project aimed at optimizing water supply and sewer systems[4] to improve the quality of water supply and sewerage services and thereby contribute to improving the sanitation environment for residents in the Comas-Chillon area, which belongs to the service area of Huachipa WTP in the LMA.

1.2 Project Outline

To improve the quality of water supply and sewerage services through optimizing water supply

[2] *Empresa Prestador de Servicio SEDAPAL Sociedad Anónima*
[3] In 2000, the "Lima Marginal Areas Sanitary Improvement Project" (yen loan) was implemented.
[4] "Optimization of water supply and sewer systems" refers to reducing physical water leakage through rehabilitating the water supply and sewer networks, while at the same time sectorizing the water supply system, and thereby building infrastructure that enable efficient water supply management and operation and maintenance.

and sewer systems, thereby contributing to an improvement of sanitation environment for residents in the Comas-Chillon area which belongs to the service area of Huachipa WTP in the LMA.

Loan Approved Amount/ Disbursed Amount	5,500 million yen / 5,398 million yen	
Loan Agreement Signing Date	September 2009	
Terms and Conditions	Interest Rate Repayment Period (grace period) Conditions for Procurement	Main component: 1.4% Consulting service: 0.01% Main component: 25 years (7 years) Consulting service: 25 years (7 years) Main component: general untied Consulting service: general untied
Borrower / Executing Agencies	Republic of Peru / Lima Sanitation Services Company (SEDAPAL)	
Project Completion	September 2015	
Main Contractors	A&R Sociedad Anónima Cerrada Contratistas Generales (Peru) / Ortiz Construcciones y Proyectos S.A. Sucursal del Perú (Spain), Constructora MPM S.A. (Peru) / COMSA S.A. Sucursal en Perú (Peru)	
Consultants	Nippon Koei LAC, Inc. (Japan), Nippon Koei Co., Ltd. (Japan)	
Related Study	Feasibility Study (2008, SEDAPAL)	
Related Projects	Lima Marginal Areas Sanitation Improvement Project (2000-, yen loan), North Lima Metropolitan Area Water Supply and Sewerage Optimization Project (II) (2013-, yen loan), Project for Capacity Strengthening for Non-Revenue Water of SEDAPAL (2012-2015, technical cooperation)	

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Duration of the Evaluation Study

The ex-post evaluation study was conducted with the following schedule.

Duration of the Study: October 2017-March 2019

Duration of the Field Survey: 8-22 November, 2017, 21-28 March, 2018

3. Results of the Evaluation (Overall Rating: A[5])

3.1 Relevance (Rating: ③[6])

3.1.1 Consistency with the Development Plan of Peru

At the time of appraisal (2009), the Garcia Administration, which regarded the expansion and improvement of water supply and sewerage services as important, was implementing the "*Agua para Todos*" (Water for Everybody) program. In the "*National Sanitation Plan (2006-2015)*", the government identified the following goals: promotion of the modernization of management of water supply and sewerage sectors, improvement in the sustainability of water supply and sewerage services, improvement in the quality of services, improvement of the financial condition of water and sanitation companies, expansion of water supply and sewerage facilities.

Viewing the water and sanitation sector as a top priority, the Kuczynski Administration that came to power in 2016 has promoted measures such as consolidating local service providers of water and sanitation and strengthening technical support through OTASS[7]. Moreover, under the "*National Water Supply and Sewerage Plan (2017-2021)*", which primarily aims to realize "universal and sustainable access to high-quality water supply and sewerage services", efforts are being made to expand access to water supply and sewerage services, secure financial sustainability, and strengthen the capacity of water and sanitation companies and other service providers. Under this program, it is intended to achieve 100% water supply coverage, water supply time of 22 hours/day, 100% sewerage coverage, and 100% sewage treatment rate in urban areas by 2021.

As such, relevance of the Project to the development plans is high both at the time of planning and ex-post evaluation.

3.1.2 Consistency with the Development Needs of Peru

As already described in 1.1 Background of the Project, at the time of appraisal, the non-revenue water rate in the northern LMA was at a critically high level and the daily water supply time, as well, was lower than other areas. To maximize the impact of Huachipa WTP and North Branch, which were intended to supply water to the northern LMA, the most important issue was to optimize the local water supply and sewer systems of the same area.

At the time of ex-post evaluation, as described later in 3.3.1 Effectiveness, the facilities improved or newly constructed under the Project are playing an important role in providing water supply and sanitation services in the northern LMA where population growth is acute. Meanwhile, SEDAPAL envisages increases in population, water demand and sewerage volume of 22%, 18%

[5] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory
[6] ③: High; ②: Fair; ①: Low
[7] OTASS: Organismo Técnico de la Administración de los Servicios de Saneamiento

and 19% respectively in the 15-year period from 2014 to 2030, and it plans continuous development of water sources, water treatment, transmission and distribution facilities and sewerage facilities. This means that the importance of the Project has been maintained at the time of ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policies

Japan's Country Assistance Implementation Report for Peru (2009) identified "reduction of poverty and inequity" as one of the priority fields. As the means for achieving this, regarding "water (water supply and sewerage)", the policy of "implementing development of water supply and sewerage facilities primarily through loan aid to cater to diverse needs in large cities, medium-size cities and provincial areas" was specified. Therefore, the relevance of the Project to Japan's ODA policies can be confirmed.

Based on the above, the Project has been highly relevant to the country's development plans and development needs as well as Japan's ODA policies and, therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The Project constructed a water transmission line linking the newly constructed North Branch to the existing water supply network. It also carried out sectorization of the existing water supply network in the target area (sectorization of the water distribution network, repair of distribution reservoirs, connections to SCADA, installation of pressure reducing valves, air valves, etc.), and rehabilitation of the water supply and sewerage networks and connections (see Figure 1). In addition, consulting services related to detailed design, tender assistance and construction supervision were also implemented. Incidentally, since SEDAPAL was working on a major program to introduce water meters over the entire LMA in tandem with the Project, installation of water meters was not included in the Project[8].

The Project was financed by the yen loan of JICA, as well as loans provided by the World Bank and KfW (Kreditanstalt für Wiederaufbau) of Germany. Under the contracts for civil works subject to the yen loan, the yen loan portion (water supply) and KfW portion (sewerage) were implemented under the same contract based on the JICA procurement guidelines. Meanwhile, the

[8] In the target area of the Project, water shortage was serious, water supply time was limited to about 12 hours, since there were lot of water leakage due to aging of distribution network and wasteful use of water by fixed rate users without water meter. The Project aimed to improve water supply service by eliminating water shortage by reducing water leakage through rehabilitation and sectorization of the water distribution network and by increasing water supply through the north branch. Also, at the time of appraisal, SEDAPAL agreed with JICA to set the water meter coverage rate of the target area to 100% by 2012. In the Project, the water supply system was planned and designed with supply capacity corresponding to the suppressed water consumption after the installation of water meters.

contract subject to the loan from the World Bank was implemented based on the World Bank's procurement guidelines, and is scheduled to undergo separate ex-post evaluation by the World Bank. Accordingly, in this ex-post evaluation, out of the whole scope of the Project at the time of appraisal, analysis is only conducted on the scope covered by the JICA and KfW loans.

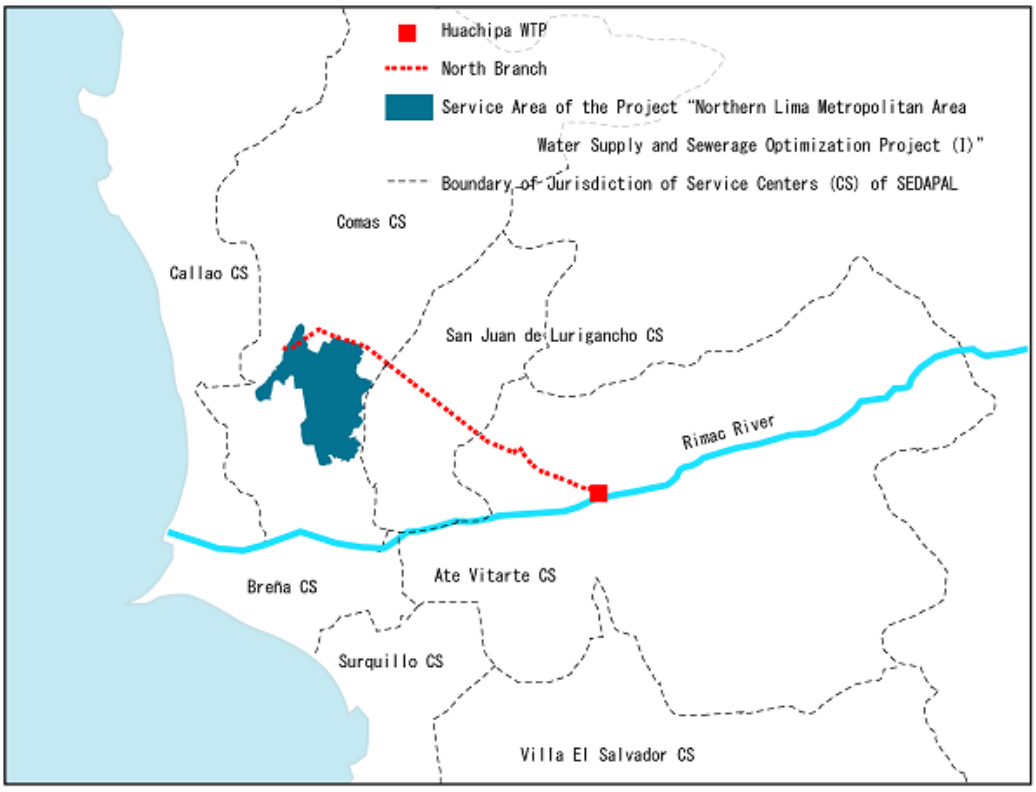


Figure 1 Water Supply Area of the Project

Table 1 shows the planned and actual outputs of the Project. According to SEDAPAL, there were no major issues in the quality of design and construction. As well, no specific problems were identified through the field visit. The two major revisions of the outputs are as described in the following paragraphs[9]. Both revisions are deemed to have been implemented based on adequate technical review and are considered to be appropriate.

[9] These revisions were made during the detailed design. The SEDAPAL side reviewed and decided the consultant's proposals and reported them to JICA.

Table 1　Outputs (excluding the World Bank portion)

Plan at time of appraisal		Actual
Construction of new water transmission pipelines from the North Branch	22.5km	21.0km
Rehabilitation of distribution reservoirs	19 sites	23 sites
Rehabilitation of water supply network	325.5km	211.3km
Rehabilitation of sewer network	Unknown*	163.5km
Rehabilitation of water supply connections	Approx. 37,000 sites	36,650 sites
Rehabilitation of sewer connections	Unknown*	22,938 sites
Sectorization	9 sectors	14sectors
Consulting services		
Detailed design, preparation of tender documents and tender assistance, environmental impact assessment, advice on activities for raising awareness of local residents, construction supervision, establishment of a water supply and sewerage inventory, preparation of an asbestos cement pipe handling manual		Generally, as planned** 3 high-pressure cleaning vehicles (Outside of the scope of the yen loan)
Others (no plans)		

Source: Materials provided by JICA; figures on actual performance provided by SEDAPAL.

Notes: * It wasn't possible to obtain planned values for the sewerage component excluding the World Bank portion. On conducting trial calculation in reference to the planned figures for water supply, it is estimated that the planned extent of sewer network rehabilitation was approximately 190km and 24,000 household connections.

**As the water supply and sewerage inventory, drawings of facilities were digitally prepared in the Project. It is subsequently planned for inputting to SEDAPAL's geographic information system (GIS) to be completed in 2018. No asbestos cement handling manual could be confirmed. It should be noted that the consulting services under a single contract was provided for the entire project including the World Bank portion.

(1) Downsizing of water supply network rehabilitation

In the feasibility study implemented by SEDAPAL, it was planned for the existing water distribution network to undergo total rehabilitation based on technical and economic analysis taking such aspects as occurrence of water leakage / breakages in the existing water supply network, and age of pipes into consideration[10]. In the subsequent detailed design stage, the maximum water pressure in the pipeline design was lowered by increasing the number of sectors (due to reduction in elevation disparities within the same sector), eliminating the necessity to replace some of the pipelines that had sufficient strength to withstand the maximum water pressure. As a result, the overall length of rehabilitated pipelines was reduced to 65% of the total distribution network. While, the water supply connections that had been experiencing numerous leaks were 100% repaired as planned. Concerning the sewer network, no major changes were

[10] 90% of the existing water purification network comprised asbestos pipes. In the feasibility study, consideration was given to the cancer risk of asbestos in water, however, according to SEDAPAL, between then and the time of the detailed design, it became widely accepted in implementing agencies that use of asbestos pipes in the water supply network posed no major health risk.

made to the plan, however, repairs were partial (roughly 70% of the total).

(2) Increase in the number of sectors and rehabilitation of distribution reservoirs

The target area has hilly districts with relatively large elevation disparities. Therefore, at the time of the detailed design, in order to secure appropriate water pressure and water supply time even in districts at high elevation, sectors including hills were finely compartmented according to elevation. As a result, the number of sectors increased by approximately 1.5 times. In line with the increased number of sectors, the number of distribution reservoirs requiring rehabilitation also increased[11].

3.2.2 Project Inputs

3.2.2.1 Project Cost

Table 2 shows the planned and actual project costs. Compared to the planned total project cost of 15,309 million yen (yen loan 5,550 million yen), the actual total project cost was 14,779 million yen (97% of the planned amount). The loan amount used was 5,398 million yen (97% of the planned amount) and it fell within the plan. Even considering the changes in outputs, the Project cost was roughly as planned[12].

Table 2 Planned and Actual Project Cost (Excluding the World Bank Portion)

(Unit: million yen)

	Planned		Actual	
	Overall	Yen loan	Overall	Yen loan
Civil works	12,591	4,313	10,245	3,562
Consulting services	1,021	1,021	2,248	1,836
Physical contingency	630	216	-	-
Taxes	866	0	1,844	0
Interest during construction / charges	202	0	442	0
Total	15,309	5,550	14,779	5,398

Sources: Materials provided by JICA and SEDAPAL
Exchange rate: (Planned) 1 US$ = 111 yen = 3.16 nuevo sol
(Actual) 1 US$ = 100 yen = 2.77 nuevo sol (the rate actually applied)

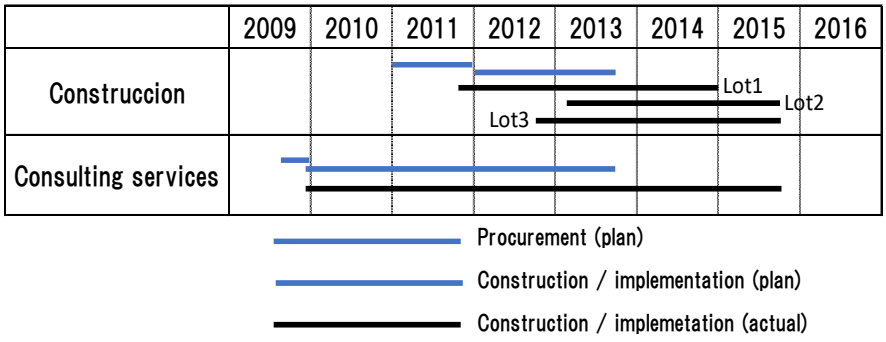
The main reasons for the increase or decrease in the Project cost were; reduction in the length of rehabilitation in the water supply network, increase in the quantity of works due to increase in the number of sectors and rehabilitated distribution reservoirs; miscellaneous changes in the

[11] Most of the sectors established in the Project receive water supply from separate reservoirs for each.
[12] The adjusted planned amount considering the fact that repairs were limited to 65% of the water supply network is calculated at approximately 14.3 billion yen, which means that the actual cost is 103% of this. While, similar trial calculation cannot be made concerning the repair of distribution reservoirs and increase in the number of sectors, since the final adjusted planned amount would be greater than 14.3 billion yen, the planned vs. actual cost ratio taking changes in outputs into account is deemed to be lower than 103%.

quantity of works due to design modifications based on the materials and positions of pipelines in the water supply and sewer network, existence of new connections and other buried objects which were discovered following the start of works; increase in the volume and period of consulting services in line with extension of the project period.[13]

3.2.2.2 Project Period

Following the signing of the loan agreement in September 2009, the Project was scheduled for completion in September 2013. In reality, however, the Project was completed two years behind schedule in September 2015 (see Figure 2 and Table 3). The actual project period was 73 months, equivalent to149% of the originally intended 49 months.



Source: Materials provided by JICA and SEDAPAL

Figure 2 Planned and Actual Project Periods (Excluding the World Bank portion)

Table 3 Works Contract for the Project for Optimization of Water Supply and Sewerage in North Lima Metropolitan Area (I) (Excluding the World Bank portion)

Contract Lot	Scope of Works	Date of Contract	Date of Completion
Lot 1	Water transmission line from the North Branch, repair of distribution reservoirs	November 2011	December 2014
Lot 2	Repair of the water supply and sewer networks	February 2013	September 2015
Lot 3	Repair of the water supply and sewer networks	September 2012	September 2015

Source: Materials provided by SEDAPAL

[13] At the time of the ex-post evaluation, SEDAPAL and the contractor are in dispute over settlement of the cost of main works, so it is possible that the amount paid could increase by up to 3%. Moreover, according to responses to the questionnaire that was sent out to officials of SEDAPAL, the reason why so many changes arose following the start of works was partly due to the insufficient quality of the detailed design implemented by the consultant. Moreover, because the same consultant implemented the detailed design and construction supervision under a single contract, the consultant was unwilling to recognize the deficiencies in the detailed design that were pointed out by the contractor, and this led to an increase in the number of issues under dispute.

The main reasons for the increase in the Project period were as follows.

- According to responses of SEDAPAL officials to the questionnaire, more time than planned was required for procurement of some of the civil works (Lots 2, 3) which were implemented under three contracts since the SEDAPAL personnel assigned were not well accustomed to the procurement process and other reasons. As a result, the start of some of the works was delayed by around one year.

- It was scheduled for the North Branch, which was to supply water to the Project, to be completed in May 2011. However, in reality, there was a large delay and it was completed in July 2014[14]. Accordingly, in Lot 1, which included the water transmission main connecting to the North Branch, even though the actual works were not greatly delayed, the work completed in December 2014 because the hydraulic testing couldn't be implemented (delays arising from the North Branch amounted to approximately 19 months). Similarly, the delayed completion of the North Branch caused delays in other works (Lot 3; delay of three and a half months).

- Various design changes arising following the start of works resulted in the works period of each contract extended by 3 to 7 months.

3.2.3 Results of Calculations for Internal Rate of Return

At the time of appraisal, the economic internal rate of return (EIRR) of the water supply component of the Project was calculated as 8.9% assuming the Project cost to be the cost, and the reduction in water leakage, reduction in operation and maintenance cost, and the residents' willingness to pay for longer water supply time to be the benefits. On the other hand, the financial internal rate of return (FIRR) has not been calculated considering that the Project has high public nature and water supply and sewerage tariffs are collected at relatively low level.

Since specific information concerning the preconditions and procedures used for calculating the EIRR at the time of appraisal couldn't be obtained, and no necessary information was available concerning operation and maintenance cost for the Project facilities and the amount that residents are willing to pay for longer water supply time, recalculation of the EIRR was not conducted in the ex-post evaluation.

Summing up, although the project cost was kept within the planned amount, the project

[14] Following the signing of the contract, works on some sections were delayed due to revision of the number of distribution reservoirs attached to the North Branch (distribution tanks) from 5 to 4, discovery of more rocky soil than expected along the tunnel route of the North Branch. In addition, it took longer than 1 year to repair damage caused by an accident in the North Branch over a section that was handed over in February 2012, resulting in the entire completion and handover being postponed until July 2014.

period exceeded the plan. Therefore, the efficiency of the Project is deemed to be fair.

3.3 Effectiveness and Impacts[15] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The purpose of the Project was "to improve the quality of water supply and sewerage services through optimizing water supply and sewer systems". "Optimization of water supply and sewer systems" refers to reducing leakages of water and sewage through rehabilitating the water supply and sewer networks, while at the same time sectorizing the water supply system and thereby making it possible to implement efficient water supply management and operation and maintenance. In view of this, the degree to which targets have been achieved in the Project is analyzed based on the following indicators: sectorization, water meter coverage (reference indicator), non-revenue water rate, water supply time and water pressure, number of breakages and leakages in water supply pipelines, and number of sewerage accidents (see Table 4).

Table 4 Operation and Effectiveness Indicators – Standard, Planned and Actual Values

Indicator	Standard Value (before Project implementation)	Planned Value	Actual Value
Number of sectors	0 sectors	9 sectors	14 sectors
Non-revenue water rate	50%	25%	21% (2017 trial calculation value)
Water supply time	Approx. 12 hours	No planned value	24-hour (September 2016-)
Water pressure	Unknown	10-50mca (Government standard value)	Dry season (June) Min. 11-14mca, Max.14-35mca Rainy season (January) Min.14-20mca, Max. 25-40mca
Number of breakages and leakages in water supply pipelines	(2008) Breakages: 209 Leakages: 993 Total: 1,202	Approx. 86% reduction	(2016) Breakages: 120 (43% reduction) Leakages: 212 (79% reduction) Total: 332 (72% reduction)
Number of sewerage accidents	661 (2008)	No planned value	439 (2016)
Water meter coverage (reference indicator)	25% (2008)	100% (2012)	96% (2016)

Source: Prepared from materials provided by JICA and SEDAPAL
Note: The unit of water pressure (mca) is "meter of water column", which is the unit of pressure that can support a 1-meter column of water. The standard value in Peru is 15-50 meters of water column.

(1) Sectorization

The planned number of sectors was nine, but 14 were established in reality. Each sector has

[15] Sub-rating for Effectiveness is to be put with consideration of Impacts.

a distribution reservoir that makes it possible to conduct 24-hour water supply. Water transmission to the distribution tanks has been automated (with standard values for automatic operation able to be changed by SCADA) and the volume of inflow to and water level in distribution tanks are constantly monitored by SCADA. The valves for transmitting water from the distribution tanks to the water supply network are left open at all times, and water pressure is not controlled according to time of day[16]. According to SEDAPAL, the 14 sectors of the Project are being operated appropriately without any problems.


(Left) Valves at a distribution tank connected to SCADA
(Right) SCADA control room (SEDAPAL headquarters)


(Left) Street where water supply and sewerage rehabilitation were made
(Right) Newly installed water meter (outside of the Project scope)

[16] In sectors in the central part of Lima, valves for controlling the inflow volume are installed and are automatically tightened for lower pressure at night to reduce water leakage. In sectors in the Project target area, only valves installed at inlets to distribution reservoirs are connected to SCADA. Manually operated valves are installed at sections for transmitting water from the distribution reservoirs to the water supply network, however, no flow meters are installed, and no continuous records of the amounts of water flow and distribution are kept.

(2) Water meter coverage (reference indicator)

While the water meter coverage at the time of appraisal was 25% (June 2008), it was agreed that SEDAPAL would advance the installation of water meters in tandem with the Project and that the water meter coverage in the target area would be 100% by 2012. Due to delays in the procurement of meters and implementation of works in the Project, as the timing deviated, the installation of water meters by SEDAPAL was not completed in time for the completion of the civil works in 2015. In 2016, a large batch of water meters for installation in the target area were procured, and the coverage ratio had risen to 96% by December that year.

Introduction of metered billing with installation of water meters is considered to suppress water consumption by helping users save water. Therefore, in those areas where there is much waste of water, increased coverage of water mater can lead to an improvement of supply hours and water pressure even though supply volume of water is same. According to hearings with SEDAPAL and residents[17], in the sectors where water meter coverage before the Project was low, it was only after the installation of water meters that noticeable improvements in water supply services such as increase in supply hours were observed. The Project constructed water distribution facilities with supply capacity corresponding to the water demand with 100% coverage of water meter, that is to the suppressed water demand[18]. It was originally planned for the rehabilitation of facilities and installation of water meters to be advanced simultaneously. However, in reality, there was a time lag of one to two years from the rehabilitation of facilities to the installation of meter, and actual water demand was temporarily larger than the supply capacity during this period[19].

In the hilly areas, there are still some blocs where residents will not consent to installing water meters because they are afraid of higher water tariffs[20]. According to SEDAPAL, when newly installing meters, residents tend to demand that services be improved first. However, in the Project, because the water meter installation was made some years after the rehabilitation of facilities (without any noticeable improvement in services), some residents were doubtful over

[17] In the ex-post evaluation, qualitative survey was implemented through conducting group interviews with ordinary residents in the target area and individual interviews with owners of local shops, restaurants, etc. Interviews with general residents were conducted with a total of 78 householders or their spouses (36 males, 42 females) comprising one group in each of the 14 target sectors, while 14 shops or restaurant owners (one in each sector) were individually interviewed. In both cases, persons who have lived in the target area for six or more years were targeted. In the interviews at the area where water meter was newly installed, specific examples of the water saving effect was seen by such reports as; "I stopped watering the garden after installing the meter", "Now I always close the faucet securely so that there should be no water leak", "I closed all the faucets and checked if the water meter turns in order to verify any leakage in the house."

[18] At the time of planning, it was assumed that installation of water mater would reduce water consumption by some 20%.

[19] According to the consultant's completion report, there were sectors where the peak water consumption volume was more than three times the planned volume by the time the Project was completed.

[20] According to SEDAPAL, among the fixed rate users, there are households that use water paid for by other households (use of single household contracts for multiple households), and households that sell water, and such households are averse to installing water meters.

the service improvement and were averse to installing water meters[21].

According to the interviews with residents, many residents understand that water meter installation will promote saving water and lead to improvements in water supply time and water pressure. They are making efforts to save on water with a view to holding tariffs down, however, they also have their doubts about the accuracy of meters.

(3) Non-revenue water rate

Before the Project, the non-revenue water rate in the Project target area reached as high as 50%. The Project was intended to bring this down to 25% or lower.

In the 14 sectors in the Project target area, except for one sector, official monitoring of the non-revenue water rate has not yet been started. In the ex-post evaluation, as a result of conducting trial calculation of the non-revenue water rate over the entire target area (14 sectors) based on the volume of water supplied to distribution reservoirs and volume of water consumption targeted for charges in each sector, the non-revenue water rate was approximately 22% in 2016 and 21% in 2017. Accordingly, it is highly likely that the Project goal of reducing the non-revenue water rate to no higher than 25% has been achieved[22]. According to the non-revenue water control team of SEDAPAL, experience to date in the LMA shows that the most effective measures for reducing non-revenue water have been to reduce commercial losses through installing water meters, followed by reducing water leakages through appropriately maintaining the water supply network and rationalizing water pressure. The reduction in non-revenue water rate described above has been achieved through synergy of the Project combined with water meter installations which was implemented separately from the Project. Hence, the Project is deemed to have contributed to the reduction of non-revenue water.

The non-revenue water control team of SEDAPAL nominates sectors that meet certain conditions as "Controlled Sectors" and monitors their non-revenue water rate every month, and in sequence, it implements sector-wise projects to control non-revenue water utilizing the results of JICA's technical cooperation[23]. As of November 2017, only one out of 14 sectors in the Project

[21] On the other hand, in other projects where rehabilitation of facilities was implemented at the same time as installation of water meters, there have been relatively few problems. In consideration of such experiences, SEDAPAL is simultaneously conducting the rehabilitation of facilities and installation of water meters under the same contract in the subsequent "Project for Optimization of Water Supply and Sewerage in North Lima Metropolitan Area (II)" (2013-).

[22] The non-revenue water rate over the entire service area of Comas Service Center in 2016 was 32%, representing a major improvement compared to 50% in 2009. The figure over LMA overall was 28% in 2016.

[23] Under the JICA technical cooperation "Project for Capacity Strengthening for Non-revenue Water of SEDAPAL" (2012-2015), interventions to control non-revenue water were implemented in two sectors in the central part of Lima. SEDAPAL has continued these activities and implemented similar interventions in 36 out of LMA's 300-350 sectors as of 2017. In each sector, over the course of one year, the following activities are implemented: assessment of non-revenue water and water leakages, detection and repair of water leakages, setting of appropriate water pressure, establishing of sub-sectors, installation and replacement of water meters, removal of unlawful connections. For sectors to qualify for the interventions, they must be i) properly hydraulically isolated, ii) connected to SCADA to enable accurate measurement of flow rates, iii) have a water meter coverage rate of at least 80%, and iv) have uniform meter reading days for all the contract holders. In the sectors targeted in the Project, failure to comply with condition iv) has

has satisfied the condition, however, a further two to nine sectors are expected to meet the required conditions during 2018[24]. Targeting the entire metropolitan area, SEDAPAL intervenes to control non-revenue water in roughly 15 sectors every year, while, no such projects have yet been implemented in the Project target area. If such projects are implemented in the Project target area in future, further improvement to the non-revenue water rate is anticipated.

(4) Water supply time and water pressure

Before the Project (2008), water supply was conducted for roughly 12 hours per day in the Project target area. Following completion of the Project, 24-hour water supply has been conducted in the whole target area of the Project since September 2016 when progress was made in the installation of water meters. This is the synergistic result of the Project, water meter installations, and construction of Huachipa WTP and the North Branch. However, due to delays in the installation of water meters, there was a gap of one year between completion of the Project in August - September 2015 and the realization of 24-hour water supply in the whole area. As for the water supply time, no target value was set at the time of appraisal. On the other hand, water supply time over the entire LMA in 2016 was 21.7 hours/day.

The minimum / maximum water pressure in each sector in 2016 was 11-14 mca / 14-35 mca during the dry season (June) when water consumption goes up, and 14-20 mca / 25-40 mca during the rainy season (January), indicating that it was within the standard range of 10-50 mca[25].

According to interviews with residents, almost all residents are satisfied about the improvements that have been made to water supply time and water pressure. However, there were also some complaints that the water pressure falls and water supply is sometimes interrupted during the dry season (summer) when the demand for water increases.

(5) Number of breakages and leakages in water supply pipelines

At the time of appraisal, it was planned for the number of incidents involving pipeline breakages and leakages in the water supply network to decrease by approximately 86% compared to 2008[26]. In the water supply network in the Project target area, the number of incidents involving

been the main drawback, however, SEDAPAL is working to remedy the situation. Moreover, since flow meters are only installed at inlets to distribution tanks, it has been pointed out that water used for washing the distribution tanks and so on is included in the water consumption flow. Moreover, there is said to be a higher risk of errors due to the poor positioning of flow meters at some distribution reservoirs. SEDAPAL intends to take necessary measures for them upon investigating the situation.

[24] According to a staff member in charge of non-revenue water countermeasures at Comas Service Center, which is responsible for operation and maintenance in the Project, although the necessary knowledge and know-how have been acquired thanks to JICA's technical cooperation, the shortage of personnel to implement actual work is a constraint.

[25] The unit of water pressure (mca) is "meter of water column". A "meter of water column" is the unit of pressure that can support a 1-meter column of water.

[26] At the time of appraisal, it was intended to reduce frequency from 36 per month in 2008 to 5 per month in 2015. However, since the scope of measuring indicators was unclear, making it difficult to compare with actual figures, it was decided to make comparison based on the rate of decrease in the number of breakage and leakages in the project area.

pipeline breakages and leakages declined from 1,202 in 2008 (209 pipeline breakages and 993 leakages) to 332 in 2016 (120 pipeline breakages and 212 leakages). The rate of reduction over the period between 2008-2016 was 72% overall, breaking down as 43% for pipeline breakages and 79% for leakages, more than 80% of the planned level of 86%.

According to SEDAPAL, almost all pipeline breakages occur in asbestos concrete pipes that have not been rehabilitated. Therefore, one of the reasons why the rate of decrease in pipeline breakages was lower than planned was because rehabilitation in the water supply network were limited to 65% of the planned figure. On the other hand, almost all leakages occur in connections, while, repairs were implemented as planned on all connections. Accordingly, reduction rate of leakages is higher than that of pipeline breakages.

(6) Number of sewerage accidents

It was envisaged that the Project would result in development of the sewer network and reduction of sewage blockages[27]. According to SEDAPAL, the number of sewage blockages occurring in the Project target area fell from 661 in 2008 to 439 in 2016 (34% rate of decrease) [28]. Sewage blockages are mainly caused by disposal of wastes by residents into sewers and manholes and occurs more in hilly areas, where the frequency of waste collections is lower and the residents treat sewers and manholes as alternative waste receptacles.

According to interviews with residents, many of them are satisfied that the frequency of sewage blockages, sewage spills and bad odor has declined to some extent. On the other hand, some owners of stores, restaurants, etc. said that there has been no noticeable decline in sewage blockages along main roads. Reasons for this, according to SEDAPAL, are as follows: i) sewer pipelines along trunk roads in flat areas have small inclination; ii) sloppy sediment caused by roadworks and gasworks often infiltrates into sewers as its management by construction companies is insufficient; and iii) restrictions on water supply during the dry season of 2016 caused the sewage flow to decline. Over the scope of the interviews, residents are increasingly aware that disposal of wastes into the sewer system is a cause of sewage blockages, while some homemakers make efforts not to dispose of kitchen wastes in the sewage. However, among the residents interviewed, there was no one who received education or information in relation to the Project concerning how to use the sewer system form the consultant, construction companies nor SEDAPAL[29].

Incidentally, pipeline breakages refer to incidents where water leakage is confirmed aboveground, while water leakages refer to cases that cannot be confirmed aboveground.

[27] At the time of appraisal, standard values and indicators were not set. In addition, data on sewerage accidents in the target area of the Project could not be obtained except for the number of sewage blockages.

[28] The number of sewage blockages in the entire Comas area including the target area of the Project has not changed significantly in the past 10 years (7,723 cases in 2005, 7,542 cases in 2015).

[29] According to the report of the consultant, an explanatory meeting for the residents on the scope and effects of the Project was carried out when implementing the project's civil works. However, it was not possible to confirm whether

Summing up, the degree of achievement regarding the Project objective of "improving water supply and sewerage services" has been high when measured using the indicators of non-revenue water rate, water supply time and water pressure, number of water supply pipeline breakages and leakages, number of sewerage accidents, etc.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The Project was expected to contribute to improvement of the environmental and sanitation conditions in the target districts based on the development of water supply and sewerage facilities.

Many residents reported in the interviews that thanks to the realization of 24-hour water supply with appropriate water pressure, they had become able to conduct cleaning, bathing and washing whenever necessary, making it possible for them to increase frequency of cleaning / bathing / laundry and keep their homes clean and maintain personal hygiene at all times. In the past, when the water supply time was limited, residents needed to store water in buckets and tanks and could only conduct cleaning, bathing and washing at limited times. In addition, since some residents didn't conduct regular cleaning of tanks, the sanitary management of stored water left much to be desired. Accordingly, it is thought that the Project has contributed to improving the sanitary condition of residents. Moreover, some residents believe that removing the need to store water has helped prevent the spread of Dengue fever and other infections transmitted by mosquitoes, while there is no clear basis for this. When the decrease in sewerage issues is also taken into account, many residents believe that the improvements to water supply and sewerage services resulting from the Project have contributed to the improvement of household sanitation. In restaurants, hotels, barbershops that require even greater care regarding hygiene, the sanitation improvement arising from 24-hour water supply is recognized as a particularly important benefit.

3.3.2.2 Other Positive and Negative Impacts

(1) Environmental Impacts

An environmental impact assessment (EIA) for the Project was implemented under the consulting services, and the findings were approved by the Ministry of Housing, Construction and Sanitation in May 2010 (before the tender for the civil works). According to SEDAPAL, during the civil works, measures to address air pollution, soil pollution, waste treatment, etc. were implemented according to the environmental management plan included in the environmental impact assessment. During the rehabilitation works of asbestos cement pipes, which may cause health risk from asbestos dust during construction, water sprinkling and other measures to protect workers from dust were adopted. Removed asbestos pipes were stored, transported and disposed

the enlightenment or education on proper use of sewerage has been carried out.

(safe landfill) according to the waste management law and relevant guidelines in Peru[30]. No other negative impacts were recognized in the natural environment as a result of the civil works in the Project.

On the other hand, in the interviews with residents, some people said that the installation of water meters has led to less greenery and more dust in hilly neighborhoods because residents are sprinkling less water in their gardens and on streets in an effort to conserve water.

(2) Land acquisition and resettlement of residents

In the Project, land was acquired to enable distribution reservoirs to be repaired (construction of fences, etc.) and valve chambers, etc. to be installed, while, in each case public land or land owned by SEDAPAL was used at no cost. There was no resettlement of residents and no major problems were observed regarding land acquisition.

(3) Other Impacts

In the hearings with residents, the realization of 24-hour water supply had a major impact in raising the quality of life. Residents are happy about having greater convenience and freedom because they no longer need to store or carry water and they can conduct cooking, cleaning, bathing and so on whenever they need. In restaurants, hotels, etc. too, owners have reported that work efficiency has been improved due to reduction in water-related labor and greater freedom of business operating hours and so on.

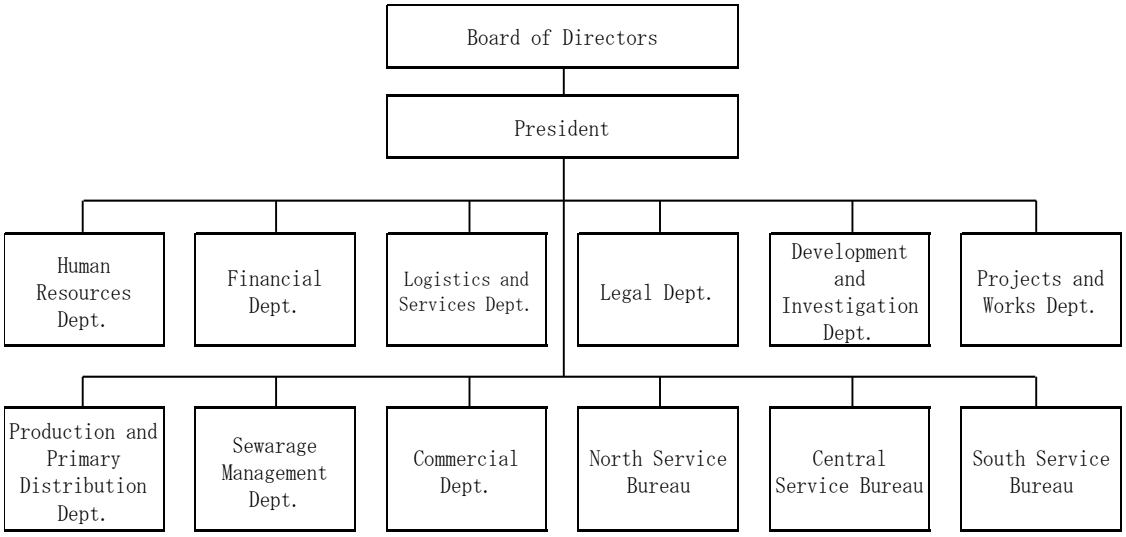
Summing up, the Project has realized the planned effects and its effectiveness and impact are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

SEDAPAL has a staff strength of roughly 2,500 employees and enjoys the highest organizational capability among the sanitation service companies in Peru. Figure 3 shows the organizational structure of SEDAPAL. In respect to the Project, the Production and Primary Distribution Department is responsible for the SCADA and water supply transmission trunk line, while the Comas Service Center belonging to the North Service Bureau handles operation and maintenance of the distribution tanks and water supply and sewer networks.

[30] Procedures concerning the handling of asbestos cement pipes are given in the construction waste management guidelines established by the Ministry of Housing, Construction and Sanitation in 2013 and the water distribution network rehabilitation manual prescribed by SEDAPAL in 2014.



Source: Prepared based on materials provided by SEDAPAL

Figure 3 Organizational Structure of SEDAPAL

The Production and Primary Distribution Department of SEDAPAL operates the SCADA system for the general water supply networks. It also has two operation and maintenance teams for valve-replacement, two operation and maintenance teams for SCADA, and two operation and maintenance teams for pipeline-repairs, with each team comprising 5-6 members ready to respond to emergencies. These teams possess heavy equipment. Once damage to a pipeline or leakage is discovered, the distribution sector in question is shut down through SCADA and the relevant service center is contacted to work together for repair. If this work is urgent, an external contractor allocated to each service center may assist the repair works. According to a staff member of this department, the number of teams is not sufficient to fully cover the entire LMA.

In the LMA, seven service centers are in charge of the operation and maintenance of water supply and sewer networks. Comas Service Center, which is in charge of the Project area, has emergency response teams for repairing leakages, sewage blockages, etc. In fact, emergency response is provided 24 hours a day with three shifts for the water supply service (2-4 teams depending on the time of day) and during daytime with two shifts (4-7 teams depending on the time of day) for the sewerage service. The emergency response teams for water supply not only respond to leakages but also conduct preventive maintenance on valves, fire hydrants and so on. The emergency response teams for sewerage service use high-pressure cleaning vehicles procured in the Project (outside of the scope of the yen loan). In addition, workers of external contractors are deployed at this service center and conduct such work as (i) preventive maintenance of the pipelines (replacement of old pipes and cleaning, sterilization and washing of pipelines) and (ii) emergency repairs. When a leakage or blockage of sewage is reported, an emergency response team is dispatched. If repair work is found to be necessary, such works are conducted by the

external contractor. While the Comas Service Center believe that the current staff strength is generally adequate, reinforcement of the emergency response teams and additional staff members to supervise the work of external contractors are required to improve speed and quality of repair works. Also, it is desirable to increase the number of teams to ensure that sufficient time is spent on preventive maintenance of valves and fire hydrants. According to the interviews with residents, one of the dissatisfactions with SEDAPAL are the lack of speed in responding to leakages, sewage blockages, etc. coupled with a lack of trust concerning meter readings[31].

Summing up, although there appears to be some shortage in staffing and the number of emergency response teams[32], the operation and maintenance system for the Project is clearly established, posing no major problems.

3.4.2 Technical Aspect of Operation and Maintenance

SEDAPAL employs many engineers, possesses a human resource strengthening program and implements various training for its employees[33]. It has been a pioneer in introducing advanced technologies in Peru's water supply and sewerage sector such as sectorization, SCADA, and sewage treatment using the activated sludge process. SEDAPAL has been certified for international standards relating to quality control, environmental management, occupational health and safety, information security and the competence of testing and calibration laboratories. In short, it is fair to say that SEDAPAL has a high level of technical capability in general. SEDAPAL has built up its SCADA operating experience over nearly 20 years and it is fair to say that it has the technical capability to operate and maintain the SCADA systems with some support from outsourced contractors. No new technologies are required for the operation and maintenance of the water supply and sewer network and water transmission lines, and there do not appear to be any technical issues. The manuals are provided for the distribution tanks and the daily operation and maintenance management results are recorded. A communication setup is established for emergencies and other events. The geographical information system on which additional work is being advanced in the Project target area makes it easier to search facilities and users, and it is utilized in reducing non-revenue water, managing assets, conducting operation and maintenance.

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[31] Some residents reported receiving tariff invoices that were exorbitant in relation to the household composition. Although many such cases occur in the first invoices after installation of water meters, they also occur at other times, and some residents believe that they arise from inaccurate meter readings. According to SEDAPAL, all the water meters installed in the Project target area are appropriately calibrated and the said situations arise out of air infiltrating connections or water leakages that are unnoticed by the residents. Residents can inquire to SEDAPAL about exorbitant invoices and request amendment at any time. Also, SEDAPAL dispatches technicians to check for water leakages as the need arises.

[32] According to SEDAPAL, staffing level is gradually strengthened, but concrete improvement plan could not be confirmed.

[33] Every year, at least 1 staff member from SEDAPAL takes part in JICA's task-based training on operation of the water supply and sewerage.

Summing up, there are no particular technical problems concerning operation and maintenance of the Project.

Table 5 Financial Status of SEDAPAL

(Unit: 1,000,000 soles)

	2012	2013	2014	2015	2016
Operating revenue (i)	1,385	1,472	1,513	1,624	1,737
Water supply and sewerage service charge	1,331	1,419	1,409	1,508	1,608
Other revenue	54	52	104	115	129
Operating cost (ii)	1,318	1,224	1,385	1,301	1,523
Cost of operation (a)	1028	904	941	949	1,058
Retail expenses	155	180	194	181	199
Administration cost, etc.	135	140	250	171	267
Operating profit (iii) = (i) – (ii)	67	248	128	3232	214
Non-operating revenue (iv)	301	154	288	177	153
Non-operating cost (v)	118	85	115	346	293
Taxes (vi)	67	90	42	90	50
Ordinary profit (vii) = (iii) + (iv) – (v) – (vi)	182	227	259	63	24
Operating profit ratio	5%	17%	8%	20%	12%
Current ratio (b)	212%	272%	355%	418%	367%
Debt ratio (c)	77%	80%	82%	135%	131%

Source: Materials provided by SEDAPAL

Notes: (a) Includes the operating and maintenance cost and the depreciation cost
(b) Current assets / current liabilities
(c) Liabilities / capital

3.4.3 Financial Aspect of Operation and Maintenance

The operating profit of SEDAPAL for 2012 through 2016 was in the black with a high operating profit ratio of 12% in 2016 (see Table 5). During this period, the current ratio was constantly high above 200%. The debt ratio for 2012 through 2014 was less than 100% in each year but has increased to more than 100% since 2015. This is not indicative of a decline in corporate financial stability, rather it was caused by a decrease in equity capital on book following changes in accounting standards to match international accounting standards. On the other hand, non-revenue water rate and coverage rate of water meter installation of SEDAPL were 28.0% and 92.2% respectively in 2016. Both of these have been improved[34]. Accordingly, the financial situation of SEDAPAL is judged to be sound and stable. Because of the scattered nature of the facilities, separate information for the operation and maintenance expenses of the facilities related to the Project couldn't be obtained. Nevertheless, no serious problems caused by financial constraints were found regarding their operation and maintenance.

[34] In 2005, the non-revenue water rate was 41.1%, while water meter coverage was 65.8%.

3.4.4 Status of Operation and Maintenance

Judging from the findings of site visits and interviews with SEDAPAL, no major problems have been observed regarding the operation and maintenance of facilities constructed in the Project. The distribution tanks, pressure reducing valves and others undergo regular cleaning and have required no major repairs so far. Concerning the water supply and sewer networks and connections, emergency response teams perform repairs in response to calls from users.

Based on the above, no major problems have been observed in regard to the institutional, technical and financial aspects and current status of the operation and maintenance of the Project. Therefore, sustainability of the Project effects is high.

4. Conclusions, Recommendations and Lessons Learned

4.1 Conclusions

The Project was implemented with the objective of optimizing water supply and sewer systems to improve the quality of water supply and sewerage services and thereby contribute to improving the sanitation environment for residents of Comas-Chillon area within the service area of Huachipa WTP in the LMA. The water supply and sewage sector has consistently been a priority issue for the Government of Peru since the time of appraisal to the time of ex-post evaluation. At the time of appraisal, there was a great need for the development of water supply and sewer systems in the LMA, and the facilities under the Project play an important role at the time of ex-post evaluation. In addition, the Project was relevant to Japan's ODA policy at the time of appraisal. Based on the above, the relevance of the Project is high. Although the scope of water supply network rehabilitation was reduced and other revisions including an increase in the number of sectors were made at the time of the detailed design, the Project cost was roughly as planned. Meanwhile, due to delay in completion of the North Branch as the water source, the Project was completed two years behind schedule. Therefore, the efficiency of the Project is fair. The intended effects of the Project, including 24-hour water supply based on appropriate water pressure, major improvement in the non-revenue water rate, and reduction of sewerage blockages, have generally materialized as planned. In addition, the sanitation environment has been improved for residents, while the 24-hour water supply has resulted in greater convenience and flexibility in the lives of residents. Therefore, the effectiveness and impacts of the Project are high. As no problems are observed with the institutional, technical and financial aspects of the operation and maintenance of the Project, the sustainability of the Project is high.

To sum up, the Project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency (SEDAPAL)

- In addition to promptly preparing the conditions for treating the Project sectors as "managed sectors" and commencing the monitoring of non-revenue water, it is necessary to utilize the results of JICA's technical cooperation to successively implement interventions for controlling non-revenue water with a view to further improving the non-revenue water rate.

- It is necessary to work on raising awareness and educating residents concerning appropriate use of sewerage. This should entail preparing educational materials that demonstrate the problems caused by disposing waste into sewers and their impacts on the lifestyle and health of residents, and proper methods for handling waste. Such materials should be used in the social component (explanations to residents, raising of awareness, and education) of public investment projects for rehabilitation / construction of water supply and sewerage. In addition, it is necessary for service centers to investigate the conditions and causes of sewage blockages, identify the areas where sewage blockages caused by discharge of wastes occur frequently, and prioritize such areas in implementing programs aimed at raising awareness. Possibilities should also be examined regarding cooperation with public health and waste management campaigns conducted by the Ministry of Health.

- Concerning dissatisfaction among residents regarding the lack of trust in the accuracy of meter and slow speed of responses to leakages and sewage blockages, it is necessary to examine countermeasures through disseminating appropriate information and improving the emergency response setup.

4.2.2 Recommendations to JICA

It is necessary to monitor the implementation of interventions to address non-revenue water of the sectors created by the Project and take steps to expedite their smooth implementation.

4.3 Lessons Learned

<u>Water meter installation when conducting water supply network repairs</u>

In projects that are intended to improve water supply services by rehabilitating water supply networks and increasing the water meter installation rate, rather than installing water meters after some time has passed following rehabilitation works, it is easier to obtain public understanding by installing water meters at the same time as the rehabilitation works. There is a possibility that an increase in the coverage of water meter leads to an improvement of water supply hours and

pressure by suppressing water consumption through saving water, even though supply volume of water is unchanged. Moreover, residents tend to be more receptive to water meter installation on condition that they receive satisfactory water supply services in return. In the Project, water supply network rehabilitation was implemented on the assumption of a 100% water meter installation rate. However, due to delays in the water meter installations which were outside the scope of the Project, improvement in water supply services did not immediately materialize following the completion of rehabilitation works. As a result, some residents started to doubt whether water supply services would be improved and resisted the installation of water meters, leading to the further delay of water meter installation in some blocks.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
① Outputs*	Construction of new water transmission pipe from the North Branch 22.5km Rehabilitation of distribution tanks 19 sites Rehabilitation of water supply network 325.5km Rehabilitation of sewer network Unknown* Rehabilitation of water supply** connections unknown Rehabilitation of sewerage connections Unknown* Sectorization 9 sectors Consulting services: Preparation of detailed design, preparation of tender documents and tender assistance, environmental impact assessment, advice on activities for raising awareness of local residents, construction supervision, establishment of a water supply and sewerage inventory, preparation of an asbestos cement pipe handling manual Others (no plans) Approx. 37,000 sites	22.5km 19 sites 325.5km unknown approx. 37,000 9 sectors Generally, as planned 3 high-pressure cleaning vehicles
② Project Period*	September 2009-September 2013 (49 months)	September 2009 - September 2015 (73 months)
③ Project Cost* ODA loan portion Fund from Peru side** Total Exchange rate	 15,309 million yen 9,759 million yen 5,550 million yen 1 US$ = 111 yen = 3.16 nuevo sol	 14,779 million yen 9,381 million yen 5,398 million yen 1 US$=100 yen=2.77 nuevo sol

Notes: * Excluding the World Bank portion
** Funding on the Peru side (actual) includes loan from KfW.