

Republic of Peru

FY2024 Ex-Post Evaluation Report of
Japanese ODA Loan “North Lima Metropolitan Area Water Supply & Sewerage
Optimization (II)”
Technical Assistance Project Related to ODA Loan “The Project for Capacity
Strengthening for Non-Revenue Water Management of SEDAPAL”

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

0. Summary

”North Lima Metropolitan Area Water Supply & Sewerage Optimization (II)” (hereinafter referred to as “the Project”) was implemented from January 2013 to November 2022 to optimize the water and wastewater systems in the northern part of the Lima Metropolitan Area, which is located in the area served by the Huachipa Water Treatment Plant, in order to improve water and wastewater services, thereby contributing to improved sanitation in the area. “The Project for Capacity Strengthening for Non-Revenue Water Management of SEDAPAL¹” (Technical Assistance Project Related to ODA Loan; hereinafter referred to as “the Technical Assistance”) was implemented from June 2012 to June 2015 with “Non-Revenue Water of SEDAPAL is reduced” as overall goal and “the capacity to reduce NRW of SEDAPAL is improved” as project purpose.

The Project is consistent with Peru’s development plans and development needs at the time of planning and post-evaluation. The Project and the Technical Assistance are consistent with Japan’s ODA policy. Planned synergistic effects with other donors have developed, leading to project effectiveness. Therefore, its relevance and coherence are high. The output of the Project was generally achieved as planned. Project cost slightly exceeded the plan, and the project period significantly exceeded the plan. Thus, efficiency is moderately low. Targets for non-revenue water (hereinafter referred to as “NRW”) ratio and sewer line clogging were met, and water supply times and water pressure were partially improved. In the areas where 24-hour water supply was realized, significant benefits were observed in terms of sanitation and housework, and the improved sewage system improved the environment, thus largely achieving the Project's objectives. Although the synergistic effects between the Project and the Technical Assistance are small at the time of ex-post evaluation, the results of the Technical Assistance were utilized in other JICA projects. Based on the above, the effectiveness and impacts of the Project are high. Regarding sustainability, minor issues are found in the current status of operation and maintenance, but no major issues are found in the policy / system, institutional / organizational, technical,

¹ SEDAPAL refers to Lima Drinking Water and Sewerage Service.

financial, environmental and social aspects, or preventive measures to risks. The Technical Assistance has some organizational and institutional challenges, but they do not significantly affect the continuation of NRW reduction. Therefore, the sustainability of the Project is high.

In light of the above, the Project is evaluated to be highly satisfactory.

1. Project Description



Project Location

(Prepared by the evaluator using Google Maps)



Rehabilitated Distribution Reservoir²

1.1 Background

SEDAPAL, which is responsible for water and wastewater services in the Lima metropolitan area, consists of headquarters and northern, central, and southern regional offices, with a total of seven local service centers divided under three regional offices. Although SEDAPAL had set annual NRW reduction targets and aimed to achieve a NRW rate of 25% or less in the future, in the late 2000s, the NRW rate in the Lima metropolitan area reached nearly 50% due to frequent leakages, water theft, low meter installation rates, and meter deterioration. In addition, due to the high NRW ratio and insufficient water supply capacity caused by problems with water sources and other factors, the average daily water supply time in northern region was less than 15 hours/day, which was lower than in the central and southern regions. To alleviate water shortages in the northern region, SEDAPAL was constructing the Huachipa Water Treatment Plant and the northern water pipeline with the cooperation of JICA.³ As for the sewage system, aging pipes, material problems, and insufficient sewage flow caused pipe blockages and breaks, resulting in frequent sewage spills/spouts and land subsidence. These problems have caused the deterioration of the sanitary environment of the local residents, and improving this situation has become an urgent issue in the northern region. Against this backdrop, a loan agreement for the “North

² All photographs in this report were taken by the external evaluator during the site visit, unless otherwise noted.

³ In 2000, the “Lima Marginal Areas Sanitary Improvement Project” (ODA loan) was granted.

Lima Metropolitan Area Water Supply & Sewerage Optimization (I)” (hereinafter referred to as the “Prior Project”) was signed in September 2009, and a loan agreement for the Project, its successor, was signed in January 2013.

On the other hand, JICA has been working with other donors to develop a water supply network throughout the Lima Metropolitan Area through several ODA loan projects since 1996, but in many areas, particularly in areas where the pipeline network has not yet been improved and has become increasingly deteriorated, corrective and preventive NRW control measures were needed. To address this issue, the Technical Assistance associated with a series of ODA Loan projects, including the Project, was implemented from June 2012 to June 2015.

1.2 Project Outline

[ODA Loan Project] North Lima Metropolitan Area Water Supply & Sewerage Optimization (II)

The Project was implemented to optimize the water and wastewater systems in the six districts in the northern part of the Lima Metropolitan Area, which is located in the area served by the Huachipa Water Treatment Plant, in order to improve water and wastewater services, thereby contributing to improved sanitation in the area.

Loan Approved Amount / Disbursed Amount	5,078 million yen / 4,834 million yen
Exchange of Note Date / Loan Agreement Signing Date	August 2012 / January 2013
Terms and Conditions	Interest Rates (main works): 1.7% (consulting service: 0.01%) Repayment Period: 25 years (Grace Period: 7 years) Conditions for Procurement: General untied
Borrower / Executing Agency	Lima Drinking Water and Sewerage Service (SEDAPAL)
Project Completion	November 2022
Target Area	Six Districts in the northern part of the Lima Metropolitan Area (Comas, Carabayllo, Puente Piedras, Los Olivos, San Martín de Porres, and Callao)
Main Contractor (Over 1 billion yen)	ENGECORPS ENGENHARIA SA (Brazil) / GITEC CONSULT GMBH (Germany) / TECNICA Y PROYECTOS S.A. SUCURSAL DEL PERU (Spain)
Main Consultants (Over 100 million yen)	CONSTRUCTORA MPM S.A. (Peru) / IVC CONTRATISTAS GENERALES S.A. (Peru)
Related Studies (Feasibility Studies, etc.)	Preparatory Study for North Lima Metropolitan Area Water Supply & Sewerage Optimization (II) (JICA, September 2011)

Related Projects	<Japanese ODA loan projects> - Lima-Callao Metropolitan Area Water Supply and Sewerage Improvement Project (1996 -) - Lima Marginal Areas Sanitary Improvement Project (I) (2000 -) - North Lima Metropolitan Area Water Supply & Sewerage Optimization (I) (2009 -) - Lima Marginal Areas Sanitary Improvement Project (II) (2010 -)
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[Technical Assistance Project Related to ODA Loan] The Project for Capacity Strengthening for Non-Revenue Water Management of SEDAPAL

Overall Goal	NRW of SEDAPAL is reduced.	
Project Purpose	The capacity to reduce NRW of SEDAPAL is improved.	
Outputs	1	The management capacity to reduce NRW is improved.
	2	The capacity to implement activities related to the reduction of NRW is improved.
	3	The quality control capability related to the installation of service connections is improved.
Total cost (Japanese Side)	319 million yen	
Period of Cooperation	June 2012 – June 2015	
Target Area	Metropolitan Area of Lima	
Implementing Agencies	SEDAPAL	
Other Relevant Agencies / Organizations	None	
Organizations in Japan	Kyowa Engineering Consultants Co., Ltd., Tokyo Waterworks Service Co., Ltd.	

The Technical Assistance addressed both “corrective measures” for NRW (measures to reduce NRW that has already occurred) and “preventive measures” (measures to minimize NRW that may occur in the future). Output 2 of the Project corresponds to the corrective measures, while Output 3 corresponds to the preventive measures. These technologies were expected to be utilized in areas developed through ODA loan projects in the past and in the future, thereby enhancing the outcomes of those projects. The related ODA loan projects (the main projects to which the Technical Assistance was attached) included several initiatives listed below.

- Lima-Callao Metropolitan Area Water Supply and Sewerage Improvement Project (1996 -)
- Lima Marginal Areas Sanitary Improvement Project (I) (2000 -)
- North Lima Metropolitan Area Water Supply & Sewerage Optimization (I) (2009 -)
- Lima Marginal Areas Sanitary Improvement Project (II) (2010 -)
- North Lima Metropolitan Area Water Supply & Sewerage Optimization (II) (The Project: the project subject to this ex-post evaluation)

【Integrated Evaluation】

In this ex-post evaluation, the Project, among the above-mentioned related ODA loan projects, and the Technical Assistance were evaluated in an integrated manner. Each evaluation item was evaluated as follows.

Relevance	Only the relevance of the Project will be considered.
Coherence	Consistency of the Project and the Technical Assistance with other projects will be considered.
Efficiency	Only the efficiency of the Project will be considered.
Effectiveness	The effects of the Technical Assistance are taken as a part of the effects of the Project.
Impact	Contribution of the Technical Assistance to realization of the Project's Impact will be analyzed.
Sustainability	The sustainability of the activities of the Technical Assistance will be taken into account in the evaluation.

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda, Global Group 21 Japan, Inc.

2.2 Duration of Evaluation Study

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

Duration of the Study: October 2024 – January 2026

Duration of the Field Study: 3 – 18 February, 2025 and 3 – 7 June, 2025

3. Results of the Evaluation (Overall Rating: A⁴)

3.1 Relevance/Coherence (Rating: ③⁵)

3.1.1 Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Peru

At the time of the planning of the Project, the Peruvian government had formulated *the National Sanitation Plan 2006-2015*, which emphasized efforts to promote modernization of management in the water and wastewater sector, improve the sustainability of water and wastewater services, service quality, the financial condition of water and wastewater entities, and expand water and wastewater facilities. In addition, the Ministry of Housing, Construction, and Sanitation (hereinafter referred to as “MVCS”) had set goals for

⁴ A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

⁵ ④: Very High, ③: High, ②: Moderately Low, ①: Low

improving the quality of water service, financial soundness, and promotion of NRW reduction through *the National Sanitation Plan 2006-2015*. In the metropolitan area, the top priority was to promote the construction of the Huachipa Water Treatment Plant and the northern water pipeline through a Japanese ODA loan project, and to improve the water and sewage systems in the areas covered by the water supply.

At the time of the ex-post evaluation, *the National Development Strategic Plan for 2050* aims to “provide safe drinking water and adequate sanitation to all citizens” as part of Strategic Goal 2: Expand access to opportunities and services. *The General Government Policy 2021-2026* indicates a “reduction of disparities in water and sanitation services, with emphasis on the urban periphery, marginalized communities, and rural areas,” with emphasis on the periphery of the Lima metropolitan area. Peru’s *National Sanitation Plan 2022-2026* aims to “promote safely managed water and sanitation services,” and its main strategies include ensuring financial sustainability, improving the capacity of water utilities, and technological innovation and optimization, based on the recognition that water quality and supply security in urban areas are a challenge.

Based on the above, the Project is consistent with Peru’s development plan at the time of planning and ex-post evaluation.

3.1.1.2 Consistency with the Development Needs of Peru

As described in “1.1 Background,” at the time of the planning, the high NRW ratio was serious in the northern part of the Lima Metropolitan Area, and the average daily water supply time was also low compared to other areas. SEDAPAL did not have a department to centrally oversee NRW control measures, and planning, implementation, and evaluation of annual NRW control, etc. were not carried out. SEDAPAL didn’t have sufficient technology to repair leaks and respond to illegal connections, and lacked quality control capacity for the various tasks (leak detection, repair of leaks, installation of water supply equipment, etc.) that were outsourced to private companies. In addition, the improvement of the sewerage network was also an important issue.

At the time of the ex-post evaluation, the facilities improved and constructed by the Project play an important role in providing water supply and sanitation services in the northern part of the metropolitan area, where the population is growing rapidly. In 2024, the NRW ratio (38.5%) in the northern region (entire region including the target area of the Project) is higher than that in the central and southern regions (30.8% and 27.8%, respectively), indicating that there is still much room for improvement.

Based on the above, the Project is consistent with the development needs at the time of planning and post-evaluation.

3.1.2 Coherence (Rating: ③)

3.1.2.1 Consistency with Japan's ODA Policy

At the time of the planning of the Project, Japan's Business Development Plan for Peru identified the development of economic and social infrastructure and the correction of disparities, environmental measures, and disaster prevention measures as three priority areas for assistance. Water supply and sanitation improvement is one of the most important development issues in the "environmental measures" priority area of assistance, and a large number of ODA loans for the "Water Program" were being implemented, mainly in the form of grant aid and technical assistance. Therefore, the Project and the Technical Assistance are consistent with Japan's development cooperation policy at the time of planning.

3.1.2.2 Internal Coherence

There is no prior plan for collaboration between the Project, the Technical Assistance and other JICA projects (excluding the main projects of the Technical Assistance), and no specific synergistic effects can be seen.

3.1.2.3 External Coherence

The Project was a co-financing arrangement with the World Bank and KfW German Development Bank. SEDAPAL's Third-Party Advisory Committee⁶, consulting services for detailed design and construction supervision, procurement of maintenance equipment, and primary network for water transmission were funded by Japanese ODA loan, while the water distribution and sewerage facilities were divided into three zones within the target area, with each donor providing funding for one zone. The primary network for water transmission developed with the Japanese ODA loan is supplying water to all target areas, including other donor-supported areas. The third-party advisory committee and consultants for detailed design and bidding assistance hired under the Japanese ODA loan were for the entire project, including other donor portions. Thus, synergistic effects with other planned donors have developed in the Project, leading to project effectiveness.

As described above, the Project was consistent with Peru's development plans and needs at both the time of planning and ex-post evaluation, and with Japan's development cooperation policy at the time of planning. There were synergistic effects through coordination and collaboration with other JICA projects and other donor projects that led to the results of the Project. Therefore, its relevance and coherence are high.

⁶ For more information on the third-party advisory committee, see the explanation in "3.2.1 Project Outputs" (p. 10).

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

In the water supply sector of the Project, the construction of water transmission pipes to deliver water from the Huachipa water treatment plant, improvement of distribution reservoirs and pump facilities (mainly repair), expansion and renewal of existing water distribution network, installation of new distribution pipes, renewal of individual house connections (water service connections) and water meters, improvement (repair) of wells, and installation of SCADA (remote control system using telemetry) were conducted in six districts in the northern part of the Lima Metropolitan Area. In the sewerage component, the Project targeted severely deteriorated pipelines, including diameter expansion and renewal of existing pipelines, repair and installation of new manholes, and renewal of household sewer connections. In the targeted areas, “sectorization” was implemented to divide the water supply network into hydrologically independent sectors (water distribution zones). 15 sectors were established as planned, with most sectors further divided into several subsectors.⁷ The quantities of outputs were generally implemented as planned, although there were some changes from the plan (Table 1). The main changes in outputs and the reasons for these changes are as follows.

- Some distribution reservoirs were excluded because SEDAPAL had rehabilitated them separately from the Project.
- Renewal of the pipeline network increased due to aging. On the other hand, new construction decreased as SEDAPAL had undertaken similar works in some of the target areas.
- The number of connections decreased based on the results of the field verification conducted during the detailed design phase.
- The number of meters was reduced because residents in some neighborhoods opposed their installation.⁸
- Some wells were excluded because they were found to have low production.
- The number of SCADA installations decreased due to a decrease in the number of facilities covered (pump facilities, wells, pressure reducing valves, etc.).

⁷ Sectorization enables efficient water supply management and operation and maintenance through optimization and equalization of water pressure for distribution, management of NRW and leakage, and localization of construction and accidental damage. Sectorization of the Lima Metropolitan Area began in 1997. The entire metropolitan area is planned to be divided into nearly 400 sectors, and more than 300 sectors have been realized by the time of the ex-post evaluation.

⁸ Because of a widespread misconception among residents that the installation of meters would immediately result in a significant increase in water rates (see footnote 18).

Table 1. Planned and Real Outputs

	Planned Outputs	Actual Outputs
Optimization of water supply system		
• Improvement of water transmission pipes	40 km	32.3 km
• Improvement of distribution reservoir	27 units	25 units
• Improvement of pumping facilities	4 units	4 units
• Upsizing and renewal of existing water distribution pipes	Around 180 km	235.9 km
• Construction of water distribution pipes	Around 50 km	41.7 km
• Renewal of household connections	Around 70,000 units	67,616 units
• Installation of water meters	Around 10,500 units	8,683 units
• Improvement of wells	23 units	22 units
• Installation of SCADA units	64 units	55 units
Optimization of sewer system		
• Upsizing and renewal of existing pipelines	Around 237 km	229.9 km
• Repair and installation of manholes	Around 4,700 units	4,478 units
• Renewal of household connections	Around 33,700 units	28,879 units
Procurement of maintenance equipment	Leak detection equipment, sewer cleaning equipment, etc.	2 vehicles for leak detection team, 8 hydro-jet trucks, 6 water tank trucks, 3 vehicles for project management, equipment for leak detection, equipment for project management
Third-party advisory committee	To be established.	As planned
Consulting services	Detailed design, procurement support, environmental monitoring, social intervention, construction supervision	Generally as planned (construction supervision was partially performed by the third-party advisory committee)

Source: Materials provided by JICA and SEDAPAL



Photo 1. Valves in a water distribution reservoir



Photo 2. A well installed in a park



Photo 3. A hydro-jet truck



Photo 4. A vehicle for leak detection team



Photo 5. Leak detection equipment



Photo 6. Leak detection training yard⁹

In the sewerage sector, focusing on the deteriorated portions of the sewer network excluding the main trunk pipelines, works were carried out for the upsizing and renewal of existing pipelines, the repair and replacement of manholes, and the replacement of household connections. As some pipelines had already been rehabilitated and certain household connections had already been replaced, the quantities achieved were slightly below the original plan.

Furthermore, maintenance equipment procured included vehicles for the leak detection team, a hydro-jet truck for high-pressure sewer cleaning, water tank trucks for emergency water supply, leak detection devices (flow meters, metal detectors, etc.), and project management tools (PCs, etc.).

In the Prior Project, considerable time was required for coordination between SEDAPAL and the consultant concerning the detailed design. Drawing on this experience, a Third-Party Advisory Committee consisting of several experts, hired separately from the consulting service, was established to review the detailed design independently. According to

⁹ Established in follow-up cooperation with the Technical Assistance.

SEDAPAL, the Committee fulfilled its expected role effectively. It was subsequently retained to continue its involvement as the construction supervision consultant (see below).

With regard to construction supervision under the consulting services, due to procurement difficulties, the Third-Party Advisory Committee undertook construction supervision for approximately the first year and a half after the commencement of works. Thereafter, separate consultants were engaged for Lot 1 under the Japanese ODA loan and Lot 2 under the World Bank.¹⁰ For Lot 3 under the KfW German Development Bank, the Third-Party Advisory Committee continued to carry out construction supervision until completion.

The social intervention was implemented in line with the “Social Management Strategic Plan” developed by SEDAPAL for the Project, through close coordination among the civil works contractors, the construction supervision team, and SEDAPAL’s social specialists. Drawing on the experience of the preceding project, a “Rapid Response Plan” was prepared to address various issues, requests, and complaints from water users, and a “Water User Service Center” was established. Through this mechanism, approximately 550 complaints were addressed. In addition, about 900 agreements were signed between residents and contractors concerning works such as secondary pipeline installation and household connection renovations. Furthermore, information on the Project’s objectives and benefits, construction details and their impacts (such as water supply interruptions), and hygiene practices involving the use of water was disseminated to residents in the target area through community meetings, workshops, and mass media. According to SEDAPAL, the northern area has a relatively high proportion of recent settlers and low-income residents, where conflicts between residents and public works projects are not uncommon; however, as a result of these measures, the works under the Project were implemented without generating significant friction with the community.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost was 15,553 million yen, of which 5,078 million yen was planned for Japanese ODA loans, but the actual result was 19,316 million yen (124% of the plan), slightly exceeding the plan (Table 2). The actual amount of the yen loan was 4,834 million yen (95% of the plan). Excluding the increase in expenses due to the COVID-19 pandemic (283 million yen), actual project cost were 19,033 million yen (122% of the plan).

According to SEDAPAL, the project cost increased due to the increased quantity of upsizing and renewal of existing water distribution pipes, the extension of the construction

¹⁰ The Project comprised three civil works contracts, each financed respectively by JICA, the World Bank, and the KfW German Development Bank.

period, and the addition of costs related to COVID-19 pandemic.¹¹ COVID-19-related expenses accounted for approximately 2% of total project costs. Excluding these costs, the actual project cost for the Project was approximately 122% of the plan.

The actual project cost for the Technical Assistance was 320 million yen (84% of the plan) compared to the planned 380 million yen, which was within the plan.

Table 2. Planned and Actual Project Cost

(Unit: million Yen)

Items	Planned Cost			Actual Cost		
	ODA Loan	Others	Total	ODA Loan	Others	Total
Civil works	3,043	6,464	9,507	3,809	11,307	15,116
Maintenance equipment	512	0	512			
Price escalation	256	670	926	-	-	-
Contingency	0	611	611	-	-	-
Consulting services	1,267	0	1,267	1,025	0	1,025
Interest during construction	0	223	223	0	223*	223*
Commitment charge	0	36	36	0	36*	36*
Land acquisition	0	0	0	0	0	0
Administration	0	163	163	0	163*	163*
Tax (VAT)	0	2,308	2,308	0	2,753	2,753
Total	5,078	10,475	15,553	4,834	14,482	19,316

Source: Materials provided by JICA and SEDAPAL

Notes: Values shown are rounded and may not equal totals.

“Others” include funds from World Bank, KfW German Development Bank and SEDAPAL. Some estimated values are included. (* Estimated to be the same as the plan)

3.2.2.2 Project Period

The Project was originally scheduled to be completed within 60 months from the signing of the loan agreement in January 2013 to the commencement of facility operations in December 2017. In reality, the facilities began operation in November 2022, and the actual project period significantly exceeded the plan: 119 months (198% of the plan). Excluding the approximately 12-month extension caused by the COVID-19 pandemic, the project period was about 107 months, or 178% of the planned period.

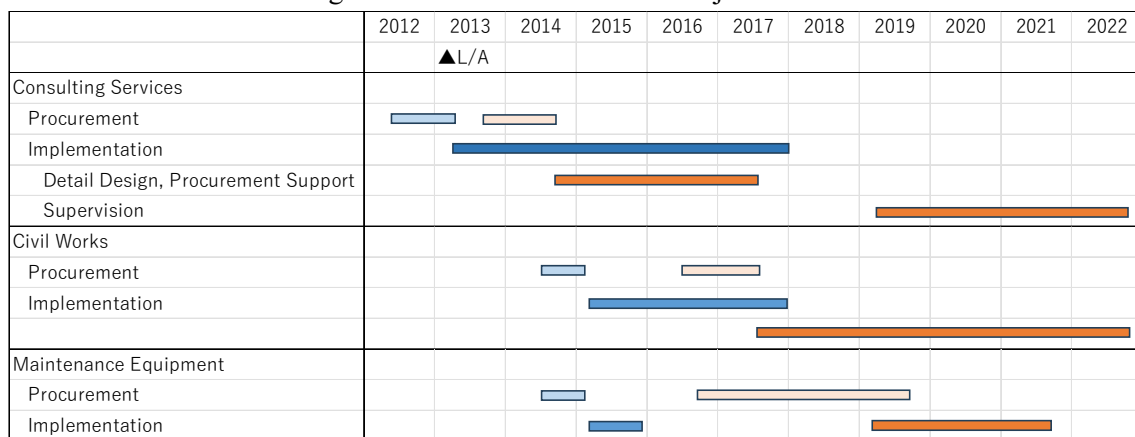
Detailed design and construction management of the Project were expected to be performed under the same contract. However, based on the experience of the Prior Project, at the time of procurement preparation, it was decided to hire separate consultants for each

¹¹ The additional costs incurred during the nationwide activity restrictions due to the COVID-19 pandemic included personnel costs for security staff during the suspension of construction work, additional costs resulting from the extension of the construction period due to reduced work efficiency, and expenses for the purchase of sanitary supplies, etc.

task.¹² As a result, additional time was required to prepare for the procurement of the detailed design consultant. Furthermore, during the detailed design stage, it was found that the maps used in the preparatory survey were of low accuracy, necessitating the rework of certain tasks, which further delayed the completion of the design and the start of procurement for civil works.

The construction work took more than twice the planned duration. The main reasons for the delay included the time required to obtain necessary permits, such as archaeological and municipal approvals; delays in approving design changes after the start of construction; and delays in the installation of power supply facility.¹³ In addition, a construction period extension of approximately 12 months was granted due to the COVID-19 pandemic.

Figure 1. Planned and Actual Project Period



Source: Prepared by the evaluator based on the materials provided by JICA and SEDAPAL

Note: The blue line represents the plan and the red line represents the actual.

It should be noted that the actual implementation period of the Technical Assistance was 37 months (103% of the planned duration: June 2012 to June 2015), compared with the planned 36 months (March 2012 to February 2015), thus slightly exceeded the plan.

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

At the time of planning, a financial internal rate of return (FIRR) of 5.0% and an economic internal rate of return (EIRR) of 7.9% were calculated based on the following assumptions.

¹² For certain design changes identified as necessary during construction, the consultant was reluctant to acknowledge deficiencies in the original detailed design, which in some cases resulted in delays in obtaining approval.

¹³ Following the commencement of construction, modifications were made to the design and construction methods of the distribution reservoir foundation, as well as changes to the SCADA communication system. Additionally, adjustments to the project plan were necessitated by discrepancies between the water distribution network assumed during the detailed design phase and the actual network. Although the installation of power supply facility fell within the scope of the Project, the work was conducted by a certified contractor under the supervision of the electric utility company, resulting in delays in execution.

Table 3. Assumptions for Internal Rate of Return (at time of planning)

	Cost	Benefit
FIRR (5.0%)	Initial investment Operation and maintenance	Reduction in operation and maintenance costs Increase in tariff revenue due to leakage reduction
EIRR (7.9%)	Initial investment Operation and maintenance	Reduced operation and maintenance costs, increased tariff revenues and decreased water production costs due to reduced leakage, willingness to pay for improved water supply services

Source: Materials provided by JICA and SEDAPAL

Note: Project life is 20 years.

In this ex-post evaluation, the project cost (excluding the costs related to the COVID-19 pandemic), project period, and project effects - specifically, the NRW ratio and the population served with a 24-hour water supply - were updated to the extent possible extent, based on actual results and recalculated using the same methodology as at the planning stage. Consequently, the Financial Internal Rate of Return (FIRR) was recalculated at 3.2% and the Economic Internal Rate of Return (EIRR) at 7.0%. These figures are considered to have declined from the planning stage estimates, primarily due to the increase in project cost.

In summary, the outputs of the Project were generally achieved as planned. However, the project cost slightly exceeded the plan, and the project period significantly exceeded the plan. Therefore, efficiency of the Project is moderately low.

3.3 Effectiveness and Impacts¹⁴ (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Table 4. Actual Results of Operational and Effect Indicators

	Baseline value 2009	Target value 2019 (2 years after completion)	Actual value (achievement status) 2024 (2 years after completion)
NRW ratio (%)	49.6	25.0	24.2 (achieved)
Water supply hours per day (hours/day)	19.8	24.0	20.2 (partially achieved)
Number of sewage pipe clogging incidents (cases/year)	-	Reduction by 80%	Reduction by 83% (achieved)

Source: Prepared by the evaluator based on the materials provided by JICA and SEDAPAL

Note: The indicators refer to the area covered by the Project.

¹⁴ When providing the sub-rating, Effectiveness and Impacts are to be considered together.

(1) Reduction of NRW Ratio

The Project aimed to reduce the NRW ratio in the target area to 25% through improvements to the distribution network and household connections, installation of water meters, pressure management utilizing distribution reservoirs, and monitoring and prompt response to NRW through sectorization.

A total of 15 sectors were established in the Project's target area. Among them, six sectors - covering 57% of the target area's population - had comparable NRW data for both the pre-project period and the ex-post evaluation.¹⁵ In these six sectors, the NRW ratio improved from 49.6% in 2009 to 24.2% in December 2024, thereby achieving the target value of 25%. Therefore, it is considered that the Project's objective concerning NRW reduction was achieved. While most NRW is due to physical water losses such as leakage, SEDAPAL considers that a portion is attributable to commercial losses, including meter inaccuracies, illegal connections, and meter tampering.¹⁶ According to SEDAPAL, illegal water use is particularly prevalent in the northern part of the metropolitan area, where recent in-migrants from rural areas and low-income households are concentrated.

(2) Increase in Water Supply Hours

At the time of planning, 12 of the 15 target sectors were already receiving 24-hour water supply. The Project aimed to meet the increased water demand through water transmission from the Huachipa Water Treatment Plant, with a plan to realize 24-hour supply in all 15 sectors. After the implementation of the Project, one sector which had been relying primarily on wells as the main water source at the time of planning began receiving 24-hour supply as a result of the Project.

On the other hand, in three sectors that had already been supplied for 24 hours at the time of planning, supply hours became restricted by 2018 due to a reduction in groundwater production at the Chillón Water Treatment Plant (the main water source), and population and water demand significantly exceeding the planning assumptions. Even after project completion, 24-hour supply has not been realized in these sectors. One of these sectors is included in a new water supply project currently under preparation by SEDAPAL, which, once implemented, is expected to enable 24-hour supply. In the other

¹⁵ In the other nine sectors, sector-specific NRW rates were not measured either before or after the start of operations. Under the Project, similar distribution network improvement works were implemented across all 15 sectors. The only difference between the sectors where measurements are possible and those where they are not lies in the requirements for approval as management sectors such as calibration of flow meters and standardization of meter reading dates. Therefore, the measurement results obtained from the six measurable sectors are considered sufficiently representative of the Project as a whole.

¹⁶ NRW consists primarily of physical losses, such as leakage, and commercial losses, such as meter inaccuracies and illegal water use. It also includes water supplied without charge for specific purposes, such as for firefighting.

two sectors, constraints in sewage collection capacity exist, requiring installation of new main sewer pipelines to achieve 24-hour supply.¹⁷

Additionally, two other sectors with low meter coverage rates had not achieved 24-hour supply as of the end of 2024.¹⁸ Subsequently, as SEDAPAL advanced meter installation, one of these two sectors began 24-hour supply by May 2025. The remaining sector is also expected to start 24-hour supply within 2025.

As a result, 24-hour water supply is expected to be achieved in 12 out of the 15 sectors ($12 + 1 - 3 + 2 = 12$ sectors) by 2025.

The average water supply hours across all 15 sectors in 2024 was 20.2 hours, slightly exceeding the baseline of 19.8 hours in 2009.¹⁹ However, without the water transmission from the Huachipa Water Treatment Plant enabled by the Project, the target area would have faced severe water shortages, making continued 24-hour supply difficult in many sectors. Based on the above, it is considered that the Project's objective regarding water supply hours was partially achieved.

In the Project, multiple distribution reservoirs were installed in many sectors, and sectors were subdivided into multiple subsectors, enabling a more limited impact area during emergencies or waterworks. Furthermore, new distribution reservoirs were installed in areas previously supplied directly from transmission pipes, allowing water supply to continue for a certain period even if transmission is temporarily suspended. These improvements, in addition to the water transmission from the Huachipa Water Treatment Plant, have contributed to enhanced continuity of water supply in the target area.

(3) Reduction of sewage pipe clogging incidents

The Project aimed to reduce sewer pipe clogging incidents by 80% through the rehabilitation of aging sewer pipelines. According to the Comas and Callao Service

¹⁷ Since precipitation is extremely low in the Lima Metropolitan Area, the sewer system is basically designed to handle wastewater only, without consideration for stormwater drainage. As a result, an increase in wastewater inflow due to population growth and other factors may immediately exceed the system's treatment capacity. It should be noted that improvements to main sewer pipelines were not included in the Project.

¹⁸ In these two sectors, approximately 6,000 water meters planned for installation under the Project could not be installed due to opposition from residents. Among the residents, there was a widespread misconception that the installation of meters would immediately lead to a significant increase in water charges. At that time, local community leaders exploited this situation for political activities, which further delayed the meter rollout. As a result, meter installation was temporarily stalled; however, through continued efforts by SEDAPAL, residents' understanding improved, leading to increased acceptance of meters and a more promising outlook for achieving 24-hour water supply.

¹⁹ If 24-hour water supply is realized in the two sectors that have not had 24-hour water supply due to low meter coverage, the average water supply time in the target area is expected to increase to approximately 22 hours/day.

Centers, which oversee the Project's target area²⁰, sewer blockages have significantly decreased in areas where the sewer network was improved. However, frequent blockages still occur in areas where the old sewer network remains. In addition, residents disposing of solid waste and grease that do not decompose in water into the sewer system are a major cause of blockages.

According to SEDAPAL's data, 2,058 sewer clogging incidents occurred annually in the target area in 2018, when the Project's civil works began, but this number decreased to 1,272 incidents in 2023. The Project improved approximately 300 km, equivalent to 46% of the 652 km of branch sewer pipelines in the target area. Assuming that the number of incidents in unimproved sections remained unchanged before and after the Project, it is estimated that 1,111 incidents (54% of the 2018 figure) occurred in the unimproved sections in 2023. Therefore, the number of incidents in the improved sections is estimated at 161 (1,272 - 1,111), representing an 83% reduction compared to the incidents in the same sections in 2018 (947 which correspond to 46% of 2,058). Based on these results, it is inferred that the Project significantly contributed to reducing sewer pipe clogging incidents in the improved sections. This finding is consistent with reports from the two service centers mentioned above.

Accordingly, it is considered that the Project's objective regarding the reduction of sewer pipe clogging incidents was achieved.

3.3.1.2 Qualitative Effects (Other Effects)

(1) Water pressure

Through the rehabilitation of distribution reservoirs under the Project, it became possible to operate them while controlling water pressure, thereby expanding the areas where proper water pressure management is conducted. As reported in beneficiary interviews (see below), improvements in water pressure were observed. SEDAPAL operates the distribution network with the aim of maintaining water pressure within the range of a minimum of 10 m to a maximum of 50 m.²¹ Distribution reservoirs enable appropriate water pressure management in accordance with variations in demand due to elevation and time of day, as well as measurement of distribution volumes for each subsector through macro-meters. According to the Comas Service Center, the average water pressure in the Project's target area ranges from 15 to 33 m, which is within the appropriate range, and the minimum standard of 10 m has been achieved. Furthermore, as

²⁰ Fourteen of the 15 sectors covered by the Project (approximately 97% in terms of population) are under the jurisdiction of the Comas Service Center, and only one sector is under the jurisdiction of the Callao Service Center.

²¹ A water pressure of 1 m refers to the pressure generated by a 1-meter-high column of water. A water pressure of 10 m is sufficient for using tap water without problems on the second floor.

high water pressure tends to increase leakage, efforts have been made in the target area to manage water pressure at the subsector level and reduce leakage through nighttime pressure reduction.

(2) NRW management through the establishment of Controlled Sectors

SEDAPAL divides the water supply network into hydraulically independent sectors and designates those meeting certain criteria as “Controlled Sectors”. In addition to hydraulic independence, the criteria include accurate flow monitoring using SCADA or similar systems, a water meter coverage rate of 80% or higher, and uniform meter reading dates. In hydraulically independent sectors, by accurately measuring distribution volumes and unifying the meter reading date, it is possible to match the billed consumption volume to the distribution volume and calculate the NRW ratio on a monthly basis. SEDAPAL’s Leakage Management Team calculates the NRW ratio for all Controlled Sectors every month, and if an increase is observed, issues a warning to the relevant service center to prompt timely countermeasures. This system enables continuous monitoring of NRW and efficient leakage control.

Of the 15 sectors targeted by the Project, hydraulic independence test was conducted in 13 sectors as part of the civil works contracts, confirming their independence. In the remaining two sectors, some subsectors had not completed the test by the completion of the Project due to operational considerations of the distribution reservoirs. Subsequently, the Comas Service Center carried out the tests and confirmed hydraulic independence.

Among the 15 sectors, six had already been designated as Controlled Sector prior to the Project’s implementation. However, three of these lost their designation temporarily due to changes in sector boundaries as a result of the Project. As of the ex-post evaluation, no new sectors had been designated as Controlled Sector, leaving only three sectors maintaining the designation. SEDAPAL plans to gradually prepare the remaining sectors to meet the criteria for Controlled Sector designation and proceed with the certification process.

3.3.1.3 Effects of the Technical Assistance and Synergy with the Project

The Technical Assistance was implemented to strengthen SEDAPAL’s organizational capacity for planning, implementation, and evaluation of NRW management (Output 1); transfer technical know-how on the NRW management which involves efficiently detecting leakages and other issues through interdepartmental collaboration within Controlled Sectors (Output 2); and improve quality control capacity for household connection installation and repair (Output 3). It was completed in June 2015.

According to SEDAPAL's Leakage Management Team, the Technical Assistance enabled the establishment of a new framework whereby the Operation Section, responsible for leakage repair, and the Commercial Section, in charge of meter installation and illegal connection countermeasures – previously operating independently – worked together in an integrated manner toward NRW reduction. Through training, staff from both teams acquired a shared methodology, which strengthened interdepartmental collaboration and made it possible to implement NRW countermeasures in a planned and consistent manner. As a result, initiatives became more efficient and their achievements more visible. In addition, technical procedures were established for conducting hydraulic tests within target sectors without fully draining the distribution pipelines, eliminating the need to interrupt water supply for such testing.

Since 2015, the NRW management utilizing the technologies developed under the Technical Assistance has been implemented in 11 sectors under the Comas and Callao Service Centers; however, the Project's target area was not included, and no direct synergies with the Technical Assistance have been confirmed at the time of ex-post evaluation. The guidelines for quality control of household connections developed under the Technical Assistance were not incorporated into the Project's design phase. However, in the Project's target sectors, some repair activities have been confirmed by the leakage management teams of the two service centers, indicating that certain technologies from the Technical Assistance related to household-connection quality control may have been applied.

Although the technical staff who participated in the Technical Assistance are no longer present at the two service centers, some knowledge and skills have been retained on site. Since SEDAPAL continues to apply the technologies of the Technical Assistance for the NRW management, there is a possibility that synergies with the Project may emerge in the future.

In conclusion, while there is evidence of a certain degree of technical succession and influence between the Project and the Technical Assistance, the synergies are considered limited at the time of ex-post evaluation. It should be noted that the Technical Assistance evaluated here was a somewhat exceptional case, implemented in conjunction with multiple ODA loan projects (the Project and related projects) as its main body.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The Project aimed to improve residents' sanitary environment through enhancements in water supply and sewerage services in the target area, which was expected to be an impact of the Project. In this ex-post evaluation, to verify this from the perspective of service users, group interviews and individual interviews were conducted with 41 general water users, as

well as individual interviews with 8 commercial water users (restaurants, hotels, laundries).²² The results are summarized below.

(1) Improvement of water supply services

In the Project's target area, SEDAPAL's water supply services are generally favorably evaluated by water users in terms of water quality, water pressure, and continuity of supply.

Regarding supply hours, user satisfaction is particularly high in sectors where 24-hour water supply has been achieved, especially in those sectors where 24-hour supply was introduced recently, with users recognizing a notable improvement in convenience. On the other hand, sectors where supply hours remain limited received lower evaluations; users in these areas are forced to rely on water storage tanks, and securing sufficient water, particularly during the dry season, can be challenging.

Regarding water pressure, improvements have been reported in many sectors, significantly alleviating the previous problem of insufficient pressure that made water use difficult on upper floors of buildings. However, sectors with significant elevation differences still experience regional disparities in water pressure.

As for water quality, many users reported that the water has become clearer and cleaner; however, the Project itself did not directly aim to improve water quality. According to SEDAPAL, the improvement in supply continuity may have contributed to the reduction of turbidity.

(2) Improvement of sewerage services

Almost all water users reported perceivable improvements in sewerage services. Problems such as sewer pipe clogging, overflow, and foul odors have been significantly reduced. These improvements are considered attributable to the replacement of deteriorated cement pipes with PVC pipes, which has facilitated smoother sewage flow and reduced the occurrence of damage and blockages. In areas where old pipelines remain, problems persist; however, SEDAPAL is responding promptly to reports from residents.

²² From the 15 target sectors, eight were selected taking into account the diversity of project outcomes such as changes in water supply hours and meter penetration rates. Within each sector, five to six general water users and one commercial water user were chosen. Starting from the central areas of each sector, collaborators were sought through door-to-door visits. The first collaborator encountered in each block was selected, and multiple blocks were visited until the target number of collaborator was reached. Commercial users were selected from the first collaborator encountered during this process.

(3) Impact on daily life, sanitation, and economic activities

Improvements in water supply and sewerage services have had a positive impact on household and workplace sanitary conditions, quality of life, and even local economic activities.

In areas where 24-hour water supply has been achieved, the ability to use water at any time has greatly improved the convenience of daily activities such as cleaning, laundry, and bathing. Activities previously restricted to the water supply hours can now be distributed throughout the day, reducing both mental and time burdens. Interviewees commented, for example, “In the past, I could bathe only once a day, but now I can bathe without restriction,” and “Previously, due to limited water, I could not do laundry frequently, and clothes piled up. I could not take showers frequently. People living on the second or third floor could not shower at all. These problems have now been resolved.” Even in areas where 24-hour supply had already been in place, improved water pressure has been reported to increase the efficiency of household chores and further enhance convenience.

The reduction in sewer pipe clogging and leakage has mitigated the risk of diseases related to foul odors and stagnant water, leading many residents to perceive an improvement in sanitary living conditions. The elimination of the need for water storage tanks has also reduced the perceived risk of mosquito-borne diseases such as dengue fever.

Furthermore, improvements in water supply and sewerage services have influenced local economic activities. For example, in the laundry business, better water pressure has improved the efficiency of washing operations, while in the restaurant and food service sector, improved drainage conditions have facilitated sanitary management and contributed to increased reliability in business operations.

(4) Perceptions and issues related to water tariffs

In all sectors, residents perceived an increase in their water tariff payments, and concerns regarding the associated financial burden were commonly shared.²³ In areas where 24-hour water supply has been achieved, however, a certain degree of acceptance of the increase was observed, with some residents viewing it as a reasonable cost for improved service quality and convenience. Conversely, in areas where supply hours have not improved, strong opposition to the increase was reported.

Perceptions of water meter installation varied across sectors. In some sectors, meters were introduced in parallel with the achievement of 24-hour water supply, and a shared understanding emerged among users that this represented a “fair payment according to

²³ Since the interviews were conducted shortly after the water tariff increase in January 2024 (in February 2024), water users may have been particularly sensitive to the issue of tariffs.

consumption.” Nevertheless, concerns were raised by some users about the increase in monthly bills and the lack of clear guidance on how to respond to water leaks, leading them to question whether meter installation was truly the right choice. In other sectors, the procedures for meter installation and the tariff structure were perceived as inadequately communicated. As a result, contradictory information circulated among residents, including the erroneous belief that meter installation would automatically lead to high charges, alongside the view that responsible water use would keep charges manageable.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the environment

The Project did not fall under the sectors, characteristics, or regions considered sensitive to environmental and social impacts as defined in the *JICA Guidelines for Environmental and Social Considerations* (April 2010) and was therefore classified as Category B, as no significant adverse environmental impacts were anticipated.

The Project’s Environmental Impact Assessment (EIA) was approved by the MVCS in January 2016. Measures specified in the EIA for the pre-construction, construction, and operation/maintenance stages – including environmental and social measures, waste management plans, environmental monitoring plans, and disaster preparedness plans – were implemented. For environmental management, the contractors and construction supervisors prepared monthly environmental monitoring reports, which were reviewed and approved by SEDAPAL and the General Directorate of Environment of MVCS. SEDAPAL also verified compliance with the environmental management commitments stipulated in the EIA on a semi-annual basis and reported the results to the General Directorate of Environment.

According to SEDAPAL, monthly environmental monitoring reported no particular problems with air quality or noise, and no significant issues occurred. Similarly, no notable concerns were reported in interviews with water users. Asbestos-cement pipes included in the rehabilitation scope were generally reburied underground; however, when connections were repaired using the open-cut method, removed sections were treated as hazardous waste and disposed of safely. Asphalt removed during construction was donated to local municipalities for reuse in road surfacing.

(2) Resettlement and land acquisition

The Project involved the improvement and rehabilitation of existing facilities and did not require any new land acquisition or the resettlement of residents. As described earlier, social interventions were implemented in accordance with the “Social Management

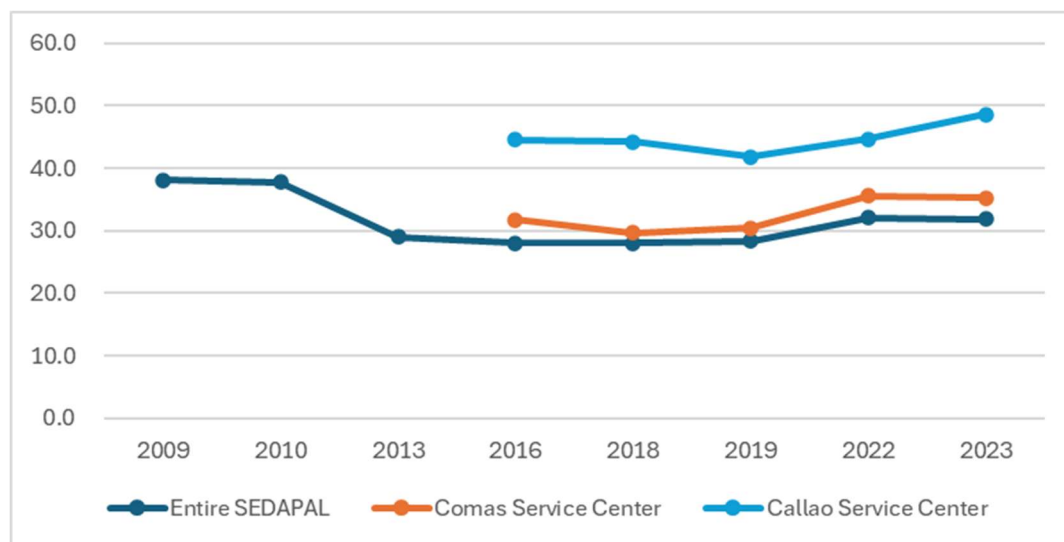
Strategy Plan,” and construction works were carried out without causing significant conflicts with the local community.

(3) Other positive / negative impacts

a. NRW ratio of SEDAPAL

The NRW ratio of SEDAPAL as a whole including northern / central / southern regions, as well as for the Comas Service Center and the Callao Service Center, are shown in Figure 2.²⁴ SEDAPAL’s NRW ratio improved from 38.1% in 2009 to 28.0% in 2016; however, it subsequently worsened slightly to 31.9% in 2023. This deterioration is considered attributable to the slowdown in meter reading and bill collection, as well as in leak repairs and distribution network rehabilitation/replacement, during the COVID-19 pandemic. In addition, according to SEDAPAL, the increase in water pressure in southern part of the Lima Metropolitan Area, resulting from the commissioning of a new transmission pipeline in 2023, may have contributed to an increase in leakage.

Most components of the Project were implemented in the area under the jurisdiction of the Comas Service Center. Compared with the Callao Service Center, the recent deterioration in leakage rates in the Comas Service Center has been more limited, which may be attributable, at least in part, to the Project.



Source: Materials provided by JICA and SEDAPAL

Figure 2. Trend in NRW Rate (Unit: %)

²⁴ The project site is part of the jurisdiction of both the Comas and Callao Service Centers, but mostly falls within the jurisdiction of the Comas Service Center (see footnote 16).

b. Financial impact on SEDAPAL

As described above, in six sectors within the Project target area for which NRW ratios before the commencement of the Project and at the time of the ex-post evaluation could be compared (accounting for 57% of the total population of the target area), the NRW ratio improved by approximately 25 percentage points from 49.6% in 2009 to 24.2% in December 2024. The reduction in NRW in these six sectors is estimated at approximately 5.4 million m³ per year.²⁵ Assuming a similar reduction in the other sectors, the total reduction in NRW across the entire target area would be approximately 9.47 million m³ per year. This volume corresponds to approximately 1.7% of SEDAPAL's total water sales volume in 2023 (54.64 million m³) and is considered to have had a modest positive effect on SEDAPAL's tariff revenues.

c. Utilization of results from the Technical Assistance in other JICA projects

As a follow-up cooperation to the Technical Assistance (2018-2019), a training yard for leak detection was set up at the SEDAPAL site and leak detection training was conducted for 23 employees of 11 water supply companies in the country. Counterparts of the Technical Assistance served as instructors. In addition, with the cooperation of SEDAPAL, JICA third-country training on the NRW management was conducted for three fiscal years (FY2022-FY2024) for waterworks authorities in Latin American countries. The training period was 7 days, and the training yard mentioned above was utilized, with a total of 85 participants (16 of whom were SEDAPAL staff) from 11 Latin American countries.

SEDAPAL has continued the NRW management by utilizing the technologies introduced through the Technical Assistance. As a preventive measure, the quality control guidelines for household connections developed under the Technical Assistance have been applied throughout SEDAPAL, and these technologies are considered to have been utilized in areas covered by ODA loan projects other than the Project. In addition, corrective measures for the controlled sectors have been progressively expanded, and the number of sectors covered is expected to reach 50 by 2025 (see "3.4.8 Status of Ongoing Activities under the Technical Assistance"). These sectors may include those targeted by ODA loan projects other than the Project. Furthermore, the technologies introduced through the Technical Assistance are expected to continue to be utilized and to contribute to enhancing the overall outcomes of the ODA loan projects.

²⁵ Estimated based on a 25% reduction in the total water supply of 1.8 million m³ to these six sectors in December 2024.

3.3.2.3 Summary of Effectiveness and Impacts

The targets related to the reduction of NRW ratio and the reduction of sewage pipe clogging incidents were achieved, while the target for water supply hours was partially achieved. Improvements in water pressure were also confirmed. In the areas where 24-hour water supply was newly realized, positive effects were observed, including improved sanitary conditions in households and workplaces, enhanced efficiency in household chores, and greater flexibility in daily activities. Furthermore, the reduction of sewer clogging and overflow incidents is considered to have contributed to lowering the risk of diseases associated with unpleasant odors and stagnant water. Based on these achievements, the Project is considered to have largely attained its objectives. While the technologies transferred through the Technical Assistance appear to have been partially utilized in the Project, the synergy effects between the two projects are limited at the time of ex-post evaluation. Meanwhile, the results of the Technical Assistance are utilized in other JICA projects.

In light of the above, the Project has mostly achieved its objectives. Therefore, effectiveness and impacts of the project are high.

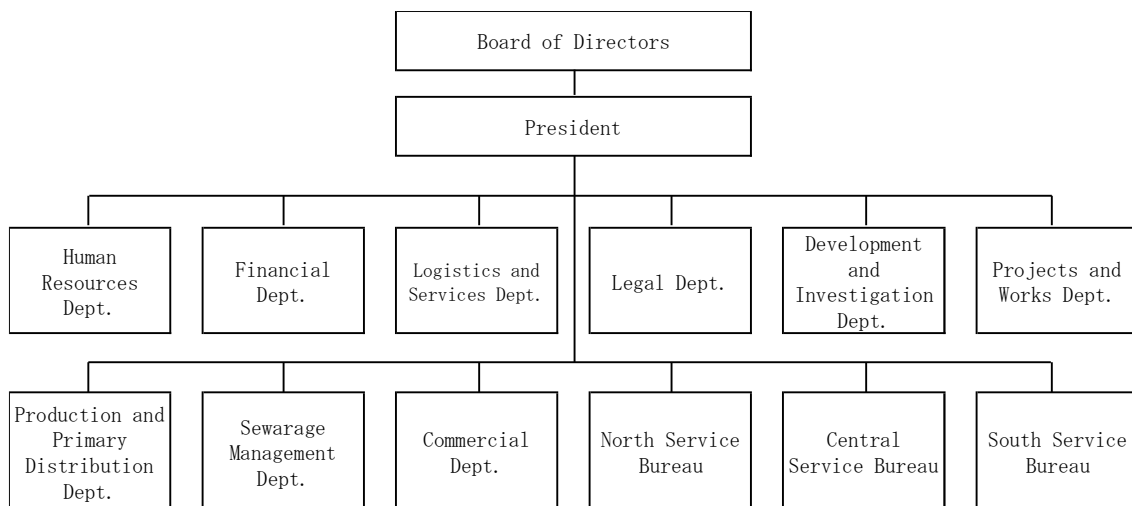
3.4 Sustainability (Rating: ③)

3.4.1 Policy and System

As described in section “3.1.1 Relevance,” the improvement of water supply and sewerage services and the reduction of NRW are priorities for both the Government of Peru and SEDAPAL. There are no policy- or institutional-level issues that threaten the sustainability of the Project.

3.4.2 Institutional/Organizational Aspect

SEDAPAL, with approximately 2,400 employees as of 2023, possesses the highest organizational capacity among water supply and sewerage utilities in Peru. Regarding the Project, the Water Production and Primary Distribution Department is responsible for SCADA, water transmission mains, wells, and pumping facilities, while the Comas and Callao Service Centers under the Northern Service Bureau are in charge of the operation and maintenance of the distribution reservoirs and water and sewerage networks. Concerning leakage reduction related to the Technical Assistance, the Leakage Management Team under the Water Production and Primary Distribution Department detects invisible leaks and monitors leakage rates in Controlled Sectors, while the seven service centers carry out leak repairs. In addition, the NRW Committee (not shown in the organizational chart) coordinates and facilitates cooperation among relevant departments for NRW countermeasures.



Source: Materials provided by SEDAPAL

Figure 3. Organizational Chart of SEDAPAL

The Water Production and Primary Distribution Department of SEDAPAL operates SCADA for the water transmission mains and manages teams responsible for valve replacement, SCADA operation, and transmission pipeline repair and maintenance for emergency response. When transmission pipeline damage or leakage occurs, the affected distribution sector is first isolated using SCADA, and repairs are conducted in coordination with the responsible Service Center.

Operation and maintenance of wells and pumping facilities are carried out by the Pump Facility Operation and Maintenance Team under the Water Production and Primary Distribution Department. This team outsources inspections and preventive maintenance of each well and pumping facility every four months to external contractors. Engineers are dispatched as needed for on-site inspections and repairs. Facilities include cranes necessary for pump installation and removal, as well as workshops for pump facility repairs.

Operation and maintenance of the water supply and sewerage networks are managed by the seven service centers. The Comas and Callao Service Centers, which are responsible for the Project, each have multiple emergency response teams covering household connections, distribution networks, sewer networks, and water distribution operations. Separately, each Service Center conducts planned sewer cleaning using hydro-jet trucks operated directly by their staff. Additionally, external contractors are commissioned to operate, clean, disinfect, and wash distribution reservoirs, repair leaks, manually clean sewers, and repair sewer pipe blockages. Upon receiving reports of leaks or sewer blockages, the emergency response teams are dispatched first, and if repairs are required, contracted external workers perform the necessary work. Each service center operates a call center that receives reports, complaints, and inquiries from water users via telephone and social media, aiming for

prompt responses. Furthermore, a communication system with the fire department is established, and in the event of a fire, measures such as increasing the water pressure at fire hydrants are implemented. According to interviews with residents, responses to leaks and sewer blockages are timely and appropriate.

Thus, the operation and maintenance system of this Project is clear, and no organizational or institutional issues have been identified.

3.4.3 Technical Aspect

SEDAPAL employs a large number of engineers and has established a human resource capacity development plan through which various training programs are conducted for its staff. Moreover, it has been a pioneer in Peru in introducing advanced technologies for NRW reduction, including sectorization, SCADA systems, and leak detection using satellite data.²⁶ SEDAPAL also has experience in conducting JICA third-country training programs related to leak reduction. Additionally, the organization holds certifications for international standards covering quality management, environmental management, occupational health and safety, information security, and the capabilities of its testing and calibration laboratories. Taken together, SEDAPAL is considered to possess a generally high level of technical capability.

SEDAPAL has accumulated nearly 20 years of experience in SCADA operation and has sufficient technical capacity to manage and maintain SCADA systems through external contractors. No new technologies were required for the operation and maintenance of the water transmission mains or the water supply and sewerage networks under the Project, and no technical challenges have been identified. Distribution reservoirs are equipped with manuals, daily operation and maintenance records are kept, and communication systems for emergencies are established. In summary, there are no particular technical issues threatening the sustainability of the Project.

3.4.4 Financial Aspect

SEDAPAL recorded positive operating profits from 2021 to 2024, with operating profit margins ranging from 18% to 38% (Table 5). During this period, the debt ratio remained below 66%. The current ratio ranged from 62% to 134%, with somewhat lower values observed since 2022; however, operating profit margin significantly increased to 38% in

²⁶ In 2021, SEDAPAL conducted a pilot introduction of a private sector service utilizing satellite data to identify leak locations, and began full-scale operation in 2024. Additionally, software that monitors the flow rates of macro-meters installed in the distribution network in real time has been implemented at each service center. This software detects and alerts abnormalities such as leaks, pipe breaks, and excessive water pressure by identifying unusual fluctuations. These advancements are expected to enable more efficient leak detection and repair.

2024. This increase was influenced by an 8.4% tariff hike implemented in January 2024. Therefore, SEDAPAL's financial condition is judged to be sound and stable.²⁷ It should be noted that the reduction of leakage achieved through the Project has had a positive impact on SEDAPAL's tariff revenues (see Section 3.3.2 Impact).

According to interviews with the North Service Bureau, the Water Production and Primary Distribution Department, the Comas Service Center, and the Callao Service Center, there are no significant financial constraints affecting the operation and maintenance of the Project. Regarding the Technical Assistance, the activities of detecting invisible leaks by SEDAPAL's Leakage Management Team and repairing leaks by each service center have continued as part of SEDAPAL's routine operations, with no major financial constraints observed.

Table 5. Financial Status of SEDAPAL

	(Unit: million Nuevos Soles)			
	2021	2022	2023	2024
Operating revenue	2,168	2,448	2,651	2,837
Water supply and sewerage service charge	1,991	2,253	2,440	2,632
Other revenue	177	196	210	205
Operating cost	1,440	2,018	1,828	1,773
Cost of operation*	1,359	1,686	1,524	1,567
Retail expenses	251	306	328	365
Administration cost, etc.	140	26	-24	-159
Operating profit	728	430	822	1,064
Non-operating revenue	35	162	113	154
Non-operating cost	309	268	290	282
Taxes (cost)	135	94	175	158
Ordinary profit	319	231	470	778
Operating profit ratio	34%	18%	31%	38%
Current ratio	134%	80%	80%	62%
Debt ratio	64%	66%	64%	60%

Source: Materials provided by SEDAPAL

Notes: * Includes the operating and maintenance cost and the depreciation cost

Operating profit margin = Operating profit ÷ Operating revenue

Current ratio = Current assets ÷ Current liabilities

Debt ratio = Total liabilities ÷ Total assets

3.4.5 Environmental and Social Aspect

SEDAPAL has an environmental management plan in place, promoting environmentally friendly efficiency measures, adaptation to climate change, and proper waste management.

²⁷ According to the Peruvian credit rating agency Apoyo & Asociados, as of November 2023, SEDAPAL's credit ratings are as follows: long-term debt rating: AA(pe) (very high payment capacity); revenue management trust (a trust established to manage and safeguard water tariffs and other revenues) rating: AAA(pe) (highest rating, excellent payment capacity); and rating outlook: stable.

It also conducts awareness-raising activities through sanitation and environmental education programs to encourage the proper use of the water supply system and sewer system.

Each service center strives to provide prompt responses to water users through its call center. The Comas Service Center has been making ongoing efforts to persuade residents in the Project target areas who initially refused the installation of water meters, promoting meter installation and working toward the achievement of a 24-hour water supply.

In conclusion, there are no particular issues with respect to environmental and social considerations.

3.4.6 Preventative Measures to Risks

SEDAPAL's Integrated Risk Management Manual establishes procedures for risk identification, assessment, monitoring, and response. It includes preparedness measures for emergencies and unforeseen events to ensure the continuity of services in the event of natural disasters or other contingencies. For example, in March 2023, heavy rainfall and landslides increased the flow and turbidity of the Rimac and Chillón rivers, which serve as water sources. By activating its contingency plan and business continuity plan for large-scale landslides, SEDAPAL was able to manage the emergency without causing any major disruption to drinking water and sewerage services.

Water trucks procured under the Project are kept on standby to supply water to critical facilities such as hospitals and schools during service interruptions.

In conclusion, there are no particular issues regarding risk management.

3.4.7 Status of Operation and Maintenance

Based on the results of the site inspection and interviews with SEDAPAL, no particular problems were observed in the operation and maintenance of the facilities constructed and equipment procured under the Project. The reservoirs and valves, including pressure-reducing valves, are cleaned regularly, and no major repairs have yet been required. For the water supply and sewerage networks and connections, emergency response teams carry out repairs upon receiving reports from users. The hydro-jet trucks, water trucks, and various leak detection devices provided under the Project are functioning properly and are in active use. However, at the rehabilitated reservoirs, some valves used to control the inflow have begun to show signs of malfunction, requiring operators to manually adjust the flow.²⁸

From the above, it can be concluded that there are minor issues in the operation and maintenance of the Project.

²⁸ Based on this experience, SEDAPAL intends to use a different manufacturer when procuring similar valves in the future.

3.4.8 Status of Ongoing Activities of the Technical Assistance

Regarding the Technical Assistance, a system is maintained whereby the Leakage Management Team detects non-visible leaks, each Service Center carries out leak repairs, and the NRW Committee facilitates cross-sectional coordination and collaboration through monthly meetings.²⁹ SEDAPAL sets NRW reduction targets for each service center, and budgetary incentives are provided to encourage achievement of these goals. The NRW Committee regularly reviews progress toward these targets, conducts cause analyses when targets are not met, and offers advice and support to promote achievement.

Many staff members who participated in the Technical Assistance at each service center have since retired or been transferred, weakening the organizational capacity for leak management based on the NRW management. However, key counterparts who were central to the effort have retained the acquired skills and knowledge within the organization – for example, by serving as instructors in JICA’s third-country training programs. The organization remains eager to acquire and apply new technologies, such as the use of satellite data, and no technical capacity issues are observed. Additionally, the leak detection equipment provided by the Technical Assistance continues to be used by the Leakage Reduction Team.

Between 2016 and 2018, NRW reduction activities using the NRW management were implemented in a total of 36 management sectors. However, these efforts were interrupted from 2019 onward, partly due to the impact of the COVID-19 pandemic, and continued to be suspended until 2024. In 2025, NRW reduction activities are scheduled to resume, targeting two sectors per service center, totaling 14 sectors.

In summary, while some organizational and structural challenges exist in the continuity of activities under the Technical Assistance, the technologies from the Technical Assistance are utilized continuously, and are contributing to the sustainability of SEDAPAL’s ongoing NRW reduction efforts.

Based on the above, regarding the sustainability of the Project, while there are minor issues in operation and maintenance, no significant challenges are recognized in terms of policy/system, institutional/organizational, technical, financial and environmental and social aspects, including preventive measures to risks. On the other hand, although minor issues are observed in the Technical Assistance, they do not pose major obstacles overall. Therefore, the sustainability of effects of the Project and the Technical Assistance is high.

²⁹ The Technical Assistance proposed the establishment of a new organizational framework dedicated to the continuous reduction of NRW. However, due to concerns over functional overlap with the existing Leakage Management Team, this proposal was not implemented.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project was implemented from January 2013 to November 2022 to optimize the water and wastewater systems in the northern part of the Lima Metropolitan Area, which is located in the area served by the Huachipa Water Treatment Plant, in order to improve water and wastewater services, thereby contributing to improved sanitation in the area. The Technical Assistance was implemented from June 2012 to June 2015 with “NRW of SEDAPAL is reduced” as overall goal and “the capacity to reduce NRW of SEDAPAL is improved” as project purpose.

The Project is consistent with Peru’s development plans and development needs at the time of planning and post-evaluation. The Project and the Technical Assistance are consistent with Japan’s ODA policy. Planned synergistic effects with other donors have developed, leading to project effectiveness. Therefore, its relevance and coherence are high. The output of the Project was generally achieved as planned. Project cost slightly exceeded the plan, and the project period significantly exceeded the plan. Thus, efficiency is moderately low. Targets for NRW ratio and sewer line clogging were met, and water supply times and water pressure were partially improved. In the areas where 24-hour water supply was realized, significant benefits were observed in terms of sanitation and housework, and the improved sewage system improved the environment, thus largely achieving the Project's objectives. Although the synergistic effects between the Project and the Technical Assistance are small at the time of ex-post evaluation, the results of the Technical Assistance were utilized in other JICA projects. Based on the above, the effectiveness and impact of the Project is high. Regarding sustainability, minor issues are found in the current status of operation and maintenance, but no major issues are found in the policy / system, institutional / organizational, technical, financial, environmental and social aspects, or preventive measures to risks. The Technical Assistance has some organizational and institutional challenges, but they do not significantly affect the continuation of NRW reduction. Therefore, the sustainability of the Project is high.

In light of the above, the Project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to SEDAPAL

- Accelerate the establishment of “controlled sectors” with the necessary conditions throughout all target areas of the Project and commence monthly monitoring of NRW. Furthermore, as needed, implement NRW countermeasures utilizing the technologies of the Technical Assistance to maximize the effects of the Project.
- In the target sectors of the Project where 24-hour water supply has not yet been

realized, promote the installation of water meters and advance additional construction of transmission, distribution, and sewerage facilities to enable 24-hour water supply.

- In the northern region, which has a relatively high number of new residents and low-income populations requiring significant social intervention, strengthen information dissemination to water users regarding how water meter installation and water-saving efforts by users affect water charges, as well as the proper use of sewerage services.
- For subsequent projects, based on the experience of the Project, it is necessary to further strengthen early coordination with the commercial sections regarding social interventions for meter installation and the establishment of controlled sectors. To this end, it is important to organize or appoint a dedicated team within the commercial section to conduct regular awareness-raising and social intervention activities in the target areas. Additionally, continuous information dissemination by SEDAPAL through various communication channels such as bills, social media, and hygiene education programs is indispensable.
- Utilize the functions of the NRW Committee to compile experiences from the Technical Assistance and each service center concerning leak management and commercial NRW reduction, and develop and implement efficient and effective strategies.

4.2.2 Recommendations to JICA

JICA will monitor the implementation status of the above recommendations by SEDAPAL and provide advice as necessary to promote their execution.

4.3 Lessons Learned

Importance of social considerations in water supply projects

In the Project, social interventions were carried out through collaboration between construction stakeholders and SEDAPAL experts, based on the “Social Management Strategic Plan.” A “Water User Response Center” was established as a point of contact for addressing various issues, requests, and complaints from water users related to the construction. In addition, extensive information was provided to residents through explanatory meetings and the media. As a result, the construction was implemented without major conflicts with residents. However, in some areas, misunderstandings spread among residents unfamiliar with the volumetric billing system, leading to a misconception that installing water meters would automatically increase water charges. This caused delays in meter installation for about 6,000 households. Nevertheless, after project completion, continued dialogue by SEDAPAL with residents eventually led many households to accept meter installation.

From the above, it is clear that social considerations for beneficiary residents are crucial for the smooth implementation of water supply projects, including distribution network improvements, and for achieving project effects. To build smooth relationships with residents, planned social interventions and information provision are effective. On the other hand, lack of understanding of new systems such as volumetric billing can cause misunderstandings and resistance, making careful explanations from an early stage and continuous dialogue are indispensable.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective Perspective

None

5.2 Additionality

None

(End)

Comparison of the Original and Actual Scope of the Project

Items	Plan	Actual
1. Project Outputs*		
Optimization of water supply system		
• Improvement of water transmission pipes	40 km	32.3 km
• Improvement of distribution reservoir	27 units	25 units
• Improvement of pumping facilities	4 units	4 units
• Upsizing and renewal of existing water distribution pipes	Around 180 km	235.9 km
• Construction of water distribution pipes	Around 50 km	41.7 km
• Renewal of household connections	Around 70,000 units	67,616 units
• Installation of water meters	Around 10,500 units	8,683 units
• Improvement of wells	23 units	22 units
• Installation of SCADA units	64 units	55 units
Optimization of sewer system		
• Upsizing and renewal of existing pipelines	Around 237 km	229.9 km
• Repair and installation of manholes	Around 4,700 units	4,478 units
• Renewal of household connections	Around 33,700 units	28,879 units
Procurement of maintenance equipment	Leak detection equipment, sewer cleaning equipment, etc.	2 vehicles for leak detection team, 8 hydro-jet trucks, 6 water tank trucks, 3 vehicles for project management, equipment for leak detection, equipment for project management
2. Project Period	January 2013 – December 2017 (60 months)	January 2013 – November 2022 (119 months)
3. Project Cost		
Total	15,553 million Yen	19,316 million Yen
Japanese ODA Loan	5,078 million Yen	4,835 million Yen
Exchange rates	1 PEN = JPY 29.1 (August 2008)	1 PEN = JPY 32.4 (the average exchange rate for each year since 2014)
4. Final Disbursement	April 2022	