Independent State of Samoa

FY2019 Ex-Post Evaluation of Japanese Grant Aid Project

"The Project for Improvement of Urban Untreated Water Supply Schemes"

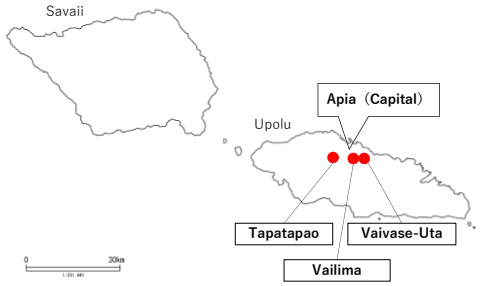
External Evaluator: Keisuke Nishikawa / Juri Ishimoto, Japan Economic Research Institute Inc.

0. Summary

The objective of this project was to contribute to the improvement of sanitary conditions in three water supply districts in Apia, the capital city of Samoa, by ensuring a stable supply of purified and treated safe water; and in the project, water intake facilities were improved and water treatment plants, water transmission and distribution facilities, etc. were constructed. The project was consistent with Samoa's development policy and development needs from the time of the project planning to the time of the ex-post evaluation, as well as with Japan's assistance policy at the time of the project planning, and the relevance was high. As for the implementation of the project, the facilities were constructed as planned and the project cost was within the plan, but as the project period exceeded the plan, the efficiency of the project was fair. The effect indicators set at the time of planning were achieved, and interviews with residents in the project area confirmed that water quality and water supply conditions have improved and confidence in the implementing agency's water supply services has increased. As for the impact of the project, safe and stable water supply to the surrounding residents, including the poor, has been realized, which is considered to have led to the improvement of sanitary environment in the households and the reduction of women's domestic work. Furthermore, the project also confirmed the effect of collaboration with projects under other schemes implemented by JICA. No negative impacts on the natural environment or resettlement were reported. From the above, the effectiveness and impact of the project were high. There were no problems in the operation and maintenance of the facilities developed in this project in terms of the institution and organizations, technology, finance, or condition of the facilities. Therefore, the sustainability of the effects of this project was high.

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

1. Project Description



Project Locations

Vailima Water Treatment Plant

1.1 Background

The Independent State of Samoa (hereinafter, referred to as "Samoa") consists of two main islands, Upolu Island, where the capital Apia is located, and Savaii Island. As an island nation, the country had been experiencing significant changes in rainfall patterns in recent years, including droughts and torrential rains that were thought to be caused by La Niña and other factors, which, together with the undeveloped water supply facilities and lack of operation and maintenance skills, caused frequent water cut-offs. In Samoa, the Samoa Water Authority (SWA) operated the water supply business, and about 80% of the population was served by SWA. Some of the systems distributed water without purification treatment, which posed a high risk of waterborne diseases. Self-sustaining water supply business operation that enabled stable supply of safely treated water was essential for the health of the people, and it was an urgent issue to develop water supply facilities and improve operation and maintenance capacities.

1.2 Project Outline

The objective of this project was to stably supply treated safe water by improving water intake facilities and constructing water treatment plants and water transmission and distribution facilities, etc. in three water supply schemes (WSSs) in the capital city of Apia, thereby contributing to the improvement of sanitary conditions in the three water supply districts of Apia.

Grant Limit /Actual Grant Amount	1,831 million yen / 1,825 million yen
Exchange of Notes Date /Grant Agreement Date	February 2014 / February 2014
Executing Agency	Samoa Water Authority (SWA)
Project Completion	November 2016
Target Area	Tapatapao, Vailima, and Vaivase Uta WSSs in Apia
Main Contractor	Konoike Construction Co., Ltd.
Main Consultant	Yachiyo Engineering Co., Ltd.
Preparatory Survey	May 2013–January 2014
Related Projects	[Technical Cooperation] ・Support Cooperation for Samoa Waterworks Operation (Miyakojima Model) (Grassroots Technical Cooperation Projects) (2010–2013) ・Operating a water resource management and water supply business in the Pacific Island (Acceptance of trainees) (2010–2015)

	・ Capacity Enhancement Project for Samoa Water Authority in Cooperation with Okinawa (CEPSO) (2014–2019) ・ Capacity Enhancement Project for Samoa Water Authority in Cooperation with Okinawa Phase 2 (CEPSO2) (2021–2024) ・ EU: Financial support for SWA's investment projects and human resource development[1] ・ Australia: Budget support for disaster recovery, technical support by Australian Civil Corp. ・ New Zealand: Training through the Samoa In-Country Program ・ ADB: Integrated Apia Master Plan for Water Supply, Sanitation and Drainage (2009–2010), financial support for sanitation and drainage projects to improve sewerage services, implementation of sanitation programs by installing septic tanks, etc.

2. Outline of the Evaluation Study

2.1 External Evaluator

Keisuke Nishikawa, Japan Economic Research Institute Inc.[2]

Juri Ishimoto, same as above[3]

2.2 Duration of Evaluation Study

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

Duration of the Study: September 2019–January 2022

Duration of the Field Study: May 2021–August 2021 (conducted remotely)

2.3 Constraints during the Evaluation Study

The evaluators were unable to travel to the project site due to the strict entry restrictions imposed by the Government of Samoa in response to the global spread of the new coronavirus infection, so the necessary information for the evaluation was collected by a remote survey from Japan. The field survey of the facilities and equipment installed in the project and the qualitative survey of the residents in the project area were all conducted by local assistants under the direction and supervision of the evaluator.

[1] This was a financial support for climate change adaptation in Samoa's water sector from 2016 to 2020, and was implemented in the form of funding based on the achievement of indicators for service improvement. One of the indicators was to increase the collection efficiency, and the implementation of this JICA project contributed greatly to the improvement of this indicator (which also led to the acquisition of financial support from the EU).

[2] Joined the evaluation team of Japan Economic Research Institute Inc. as a team member from QUNIE CORPORATION.

[3] Joined the evaluation team of Japan Economic Research Institute Inc. as a team member from Metrics Work Consultants Inc.

3. Results of the Evaluation (Overall Rating: A[4])

3.1 Relevance (Rating: ③[5])

3.1.1 Consistency with the Development Plan of Samoa

At the time of planning, the Government of Samoa identified access to safe and affordable water supply that met national water quality standards as one of the key priorities in the country's development policy, the *Strategy for the Development of Samoa* (2012–2016). In addition, the *Water and Sanitation Sector Plan* (2012–2016), which was a specific guideline for the above strategy, emphasized the improvement of urban water supply through SWA.

The *Strategy for the Development of Samoa* (2016/17–2019/20), which was an effective development plan at the time of ex-post evaluation, similarly identified sustainable access to safe drinking water and sanitation as one of the priority areas, and continued to prioritize improving water supply, sanitation, and wastewater treatment systems to meet water quality standards. The *Water and Sanitation Sector Plan* (2016–2019) also pointed out the need to expand water supply areas through SWA, reduce non-revenue water, improve drinking water quality, and strengthen financial sustainability for reliable, safe, and affordable water supply.

As stated above, both at the time of planning and during the ex-post evaluation, the emphasis was on improving access to safe drinking water in Samoa. Since this project aimed to provide safe water supply by improving water treatment facilities, the implementation of this project was in line with the development plan of Samoa.

3.1.2 Consistency with the Development Needs of Samoa

At the time of planning, two-thirds of the approximately 80% of the Samoan population receiving water supply services from SWA were receiving raw untreated raw water. In the three water supply schemes covered by the project (Tapatapao, Vailima, and Vaivase Uta WSSs), untreated water was supplied and the incidence of waterborne diseases was high, but there was no prospect of developing a water treatment facility. The operation of a water supply business that could provide a stable supply of safe water was essential for the health of the people, and the development of water supply facilities and the improvement of operation and maintenance management capabilities were urgent issues.

The ratio of untreated raw water supply at the time of ex-post evaluation has improved significantly since the time of planning (Table 1). On the other hand, the non-revenue water ratio is about 50% nationwide, and it is as high as about 40% in the three water supply districts covered by this project. In other words, about from 40% to 50% of the water distributed from water treatment plants and water sources does not lead to revenues. According to SWA, even during the ex-post evaluation, there were many areas where leakages

[4] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[5] ③: High, ②: Fair, ①: Low

occurred due to the aging of the existing pipelines, causing non-revenue water. Therefore, the renewal of pipelines is still an issue. This project aims to provide a stable supply of safe water through the construction of water treatment plants and the improvement of pipelines, and it meets the development needs of the target area both at the time of planning and ex-post evaluation.

Table 1 Water supply situation in the target area

	2014	2015	2016	2017	2018	2019
Untreated raw water supply ratio (%)						
Samoa as a whole	20.3	20.0	13.7	10.1	8.0	7.5
Tapatapao	100	100	43.7	21.8	3.7	1.6
Vailima	100	100	100	54.4	4.1	0.3
Vaivase Uta *1	100	100	96.1	24.9	0.0	0.0
Non-revenue water rate (%)						
Samoa as a whole	67.9	64.1	59.5	53.7	51.8	51.7
Tapatapao	N/A	N/A	N/A	N/A	N/A	40.0
Vailima	N/A	N/A	N/A	N/A	N/A	37.0
Vaivase Uta *2	68.0	N/A	N/A	N/A	53.0	39.0

Source: questionnaire response from SWA and documents provided by JICA

*1: The Vaivase Uta WSS does not have a water treatment plant in the district, and water is sent from the Alaoa Water Treatment Plant (outside the scope of this project). The water from the plant is also sent to the adjacent Alaoa WSS.

*2: The non-revenue water rate is not for the Vaivase Uta WSS alone, but for the area including the neighboring Alaoa WSS.

3.1.3 Consistency with Japan's ODA Policy

At the time of planning, the *Okinawa Kizuna Declaration* adopted at the Sixth Pacific Islands Leaders Meeting in May 2012 stated that the Japanese government would continue to support efforts related to environmental issues, including water management. In addition, in the *Project Development Plan* (April 2014) of the *Country Assistance Policy for the Independent State of Samoa*, "environment and climate change" was positioned as one of the priority areas, and "safe water supply and water source management" was identified as a development issue. In addition, the *JICA Country Analysis Paper for the Pacific Region* (December 2014) also identified "realization of recycling-oriented islands including water sector" as a priority area for cooperation. This project aims to supply safe water through the construction of water treatment plants and other facilities, which is in line with the above policy.

As described above, this project has been highly relevant to the country's development plan

and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The major outputs of the project were planned and achieved as shown in Table 2, and were generally implemented as planned, except for some changes from the original plan.

Table 2a Comparison of planned and actual main outputs (each WSS)

		Plan	Actual (Completion)
Tapatapao			
Rehabilitation of the existing water intake facility		1 unit	
Rehabilitation of the existing raw water pipeline		1,453m	
Construction of WTP	EPS	1 unit (75m^3/h)	As planned
	Clear water reservoir	1 unit (905m^3)	
Installation of pressure breaking tank		3 units	
Laying distribution pipelines		14,870m	
Installation of water supply equipment		293	90
Vailima			
Rehabilitation of the existing water intake facility		1 unit	
Rehabilitation of the existing raw water pipeline		1,057m	
Construction of WTP	EPS	1 unit (60m^3/h)	As planned
	Clear water reservoir	1 unit (715m^3)	
Laying distribution pipelines		11,936m	
Installation of water supply equipment		547	
Vaivase Uta			
Construction of transmission facility	Pumping station	1 unit	
	Water transmission pipeline	1,244m	As planned
Construction of distribution reservoir		1 unit (600m^3)	
Installation of pressure breaking tank		1 unit	
Laying distribution pipelines		10,593m	
Installation of water supply equipment		440	290

Note: WTP = water treatment plant, EPS = ecological purification system, referring to a slow sand filter

Table 2b Comparison of planned and actual main outputs (all WSSs)

	Plan	Actual
Equipment procurement	Sand washing machine (1 unit), engine pump for sand washing machine (1 unit), belt conveyor (1 unit)	As planned
Capacity building programme (soft component)	Guidance on maintenance management for the WTPs and water transmission pumping station	
	Support for public awareness activities for residents in the target water supply districts (promotion of the connecting to the water supply equipment, shift from flat rate to metered payment, water saving, understanding of disinfection by chlorination for the treated water, etc.)	

Source: Questionnaire response from SWA and interviews with the project consultants

The number of water supply equipment installed was changed during the project implementation. The connection of the water supply equipment (public service pipes, meter boxes, and water meters) procured under the project to each property was a Samoan responsibility, and the beneficiaries needed to register their water use with SWA for the connection. Although the connection to Vailima WSS was completed as initially planned, Tapatapao and Vaivase Uta WSSs were unable to register a total of 353 units because of absent and unregistered households due to overseas residence and the ongoing development of residential areas. For this reason, the number of equipment to be connected to the three WSSs until the completion of the project was changed from the originally planned 1,280 units to 927 units, and the target year for the completion of the remaining connections was changed to 2025. According to SWA, as of May 2021, Tapatapao WSS connected 734 houses against the planned 293 houses, and Vaivase Uta WSS connected 363 houses against the planned 440 houses.[6] In the case of Vaivase Uta WSS, although it is below the plan, the progress is good (about 83% of installations are completed) and it is considered that the installation will be able to be completed by the target year. Through interviews with SWA, it was confirmed that other Samoan obligations were implemented as planned.

The outputs that were not envisioned at the time of planning were as follows. In Vailima WSS, since there were many incidents of leakage from the existing distribution pipes, additional distribution pipes were laid on three important and urgent routes to ensure a stable water supply to the citizens. In addition, during the project period, a large fire (January 2016)

[6] According to SWA, the actual number of connections was confirmed from the financial customer report, which may have deviated from the actual number of connections because households residing in the Vaivase Uta area are sometimes counted as residents of the adjacent Alaoa WSS. However, as this is the most accurate figure available for this ex-post evaluation, this figure is used for the evaluation decision.

and a fire at an oil storage facility (April 2016) occurred in areas of Apia that were not covered by the project. The location of the fire hydrant could not be detected at the time, resulting in delays in firefighting operations. As a result, it was recognized that it would be necessary to determine the locations of fire hydrants from the perspective of saving lives, and valve posts were installed at a total of 288 additional locations to make it easier to check the location of fire hydrants and valves. In Samoa, water pipelines and fire hydrants were located together on the side of paved roads, and therefore it was difficult to locate fire hydrants before the installation of valve posts. Currently they can be easily found. The above additional work was the result of a flexible response to the local conditions after the detailed plan was formulated, and is considered appropriate because it was aimed at ensuring a stable water supply and the safety of the residents of the target area.


Water Supply Equipment (Water meter)

Valve Post

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost at the time of planning was 1,831 million yen for the Japanese side and 13 million yen for the Samoan side. Since the details of the actual amount on the Samoan side could not be obtained, an evaluation judgment was made based on a comparison of the Japanese side's planned and actual amounts. The actual amount for the Japanese side was 1,825 million yen, which was within the plan (99.7% of the plan).

3.2.2.2 Project Period

The project period was 33 months (March 2014 to November 2016), compared to the planned period of 30 months (April 2014 (start of detailed design) to September 2016 (completion of main construction and soft component)), exceeding the plan (110% of the plan). The main reasons for the delay were: 1) construction interruptions due to natural phenomena, 2) coordination with the World Bank-supported road expansion project, and 3) additional work

on valve posts and water distribution pipes (see 3.2.1 Project Outputs above). Regarding 1), the approach of a cyclone in November 2015 and abnormal rainfalls in April 2016 interrupted the water-resistant coating work on the concrete part of the facility. As for 2), it was necessary to discuss the road plan with the World Bank because in Samoa, water pipes need to be laid on the side of the road, not under the paved road. According to the project consultants, the overall project period was extended by about three months due to the combination of factors mentioned above. The reasons for the delay include natural phenomena and coordination with other donors, both of which are unlikely to be external factors, so the actual project duration was judged to be 33 months including the above delay period.

As described above, although the project cost was within the plan, the project period exceeded the plan. Therefore, the efficiency of the project is fair.

3.3 Effectiveness and Impacts[7] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Effect Indicators)

At the time of planning, the "water supply volume of purified water" and "treated water quality of the water treatment plant" were set as the effect indicators of this project. The baseline, target, and actual values for each indicator are shown in Table 3. Since the completion year of the water treatment plants was October 2016, the actual values were obtained from 2016 to the target year of 2019.

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

Table 3 Effect indicators of this project

	Baseline	Target	Actual			
	2014	2019	2016	2017	2018	2019
		3 Years after completion	Completion year	1 year after completion	2 years after completion	3 years after completion
Purification volume at WTP (m^3/day)						
Tapatapao	0	1,810	N/A	N/A	N/A	1,755
Vailima	0	1,430	N/A	N/A	N/A	2,247
Vaivase Uta[*1]	0	1,200	N/A	N/A	N/A	2,400[*2]
Treated water quality at WTP (Turbidity: NTU)						
Tapatapao	N/A	Below 5	1.06	0.85	0.67	0.65
Vailima	N/A	Below 5	N/A	0.68	0.46	0.48
Vaivase Uta	N/A	Below 5	N/A	0.72	0.66	0.44

Source: Documents provided by JICA, questionnaire response from SWA
*1: Water is distributed from the Alaoa WTP to the district through the water transmission pumps, etc., constructed in this project. Therefore, the above figures refer to the amount of water distributed from the Alaoa WTP.
*2: Actual result as of February 2019

As for the purification volume, Vailima and Vaivase Uta have achieved their targets. In the case of Vaivase Uta, a new water treatment plant was not built due to the inability to secure an adequate water source, and water is distributed from the Alaoa WTP. Therefore, the figures in Table 3 indicate the amount of water distributed from the Alaoa WTP to the district. According to SWA, the actual figure in Vaivase Uta was much higher than planned because the figure may include the water supply to other water supply districts. Although data on Vaivase Uta WSS alone were requested, according to SWA, it was difficult to capture the water supply volume for this area alone because the Alaoa WTP supplies water to multiple WSSs. Therefore, the degree of achievement was judged by comparing this actual value with the planned value. In Tapatapao, the target value was 1,810 m^3/day, while the actual value in 2019, the target year, was 1,755 m^3/day. Due to the delay in the connection of the water supply equipment to each household, the treated water supply was slightly below the target, but since it had already reached 97% of the target level, it can be considered that there was no problem.

As for the treated water quality at the WTPs, all WSSs are within the target value of 5 or less.

3.3.1.2 Qualitative Effects (Other Effects)

As the qualitative effects of this project, “improvement of sanitary environment by supplying treated water,” “securing stability of the water supply,” and “increase in reliability

of SWA service" were assumed. The "improvement of sanitary environment by supplying treated water" was considered to be the impact of the project (see "3.2.2 Impacts" below).

At the time of project planning, problems such as supply of untreated raw water, water cut-off during the dry season, and muddy water during rainfall were pointed out, but interviews with residents[8] in the target WSSs confirmed that the water supply situation has improved. Before the completion of the project, there were water supply interruptions due to cyclones and heavy rains, but after the completion of the project, there were almost no interruptions and 24-hour water supply has been realized. Although there are occasional planned water cuts for maintenance, they are over in a few hours and SWA informs the affected residents of the cut-off time in advance, so that it does not interfere with their daily life. In addition, before the completion of the project, muddy water was generated when it rained, but after the completion of the project, almost no muddy water is seen. Of the 30 households interviewed, three indicated that they sometimes tasted and smelled chlorine in tap water, but overall, they were satisfied with the quality of the water. All households indicated that they were also satisfied with the water quantity and water pressure.

Thus, there is a high level of satisfaction with the water supply services (quality and quantity of water supply) provided by SWA, and all the residents interviewed also indicated that they trusted SWA.

3.3.2 Impacts

3.3.2.1 Intended Impacts

From the interviews with the residents of the target water supply area, it was confirmed that the sanitation environment has improved after the completion of the project. Regarding the sanitation environment in their homes, they replied that the constant availability of water made it easier to wipe down the kitchen and floors, and they were able to keep their rooms and bodies clean. They also said that they were able to use tap water for cooking without boiling. As for the surrounding environment, respondents said that since water was always available, there was no longer a need to limit water usage in case of a water outage, and that the village was well kept and always clean.

3.3.2.2 Other Positive and Negative Impacts

(a) Impacts on the Natural Environment

At the time of planning, the project was classified as Category B as it was judged that the

[8] A qualitative survey was conducted with 10 households in each WSS, for a total of 30 households. The interviewees were as follows: Tapatapao WSS (5 males (1 in his 20s, 1 in his 30s, 1 in his 50s, 2 in their 60s), 5 females (1 in her 20s, 1 in her 40s, 2 in their 50s, 1 in her 60s)), Vailima WSS (5 males (1 in his 20s, 2 in their 50s, 2 in their 60s), 5 females (1 in her 30s, 1 in her 50s, and 3 in their 60s)), Vaivase Uta WSS (6 males (1 in his 20s, 2 in their 30s, 1 in his 50s, 2 in their 60s), 4 females (1 in her 50s, 3 in their 60s)).

undesirable impacts on the environment and society would not be significant based on the *JICA Guidelines for Environmental and Social Considerations* (2010). The project was required by Samoa's law regarding the Environmental Impact Assessment to submit a simplified Environmental Impact Assessment report to the Ministry of Natural Resources and Environment. According to SWA, the report was submitted to the Ministry as scheduled and approved in February 2014.

As for the implementation of the project, mitigation measures were planned through avoidance of soil runoff and civil works during rainy season and heavy rainfalls, and through vegetation protection. According to the project consultants, the mitigation measures were taken as planned, especially the excavation work for the pipeline construction, which was feared to have an impact on water quality, but was carried out in a short period of time;,and the residents were informed of the location and schedule of the pipeline construction in advance. As for environmental monitoring during the construction, SWA and the contractor visually checked for any problems in terms of air pollution, water pollution, waste, etc., based on the environmental monitoring plan, and the information was shared among the concerned parties in weekly meetings. The residents interviewed did not mention any negative impact on the natural environment.

(b) Resettlement and Land Acquisition

At the time of planning, it was necessary to secure land for the implementation of the project as some of the land was privately owned or customary land, and it was planned to make lease agreements. According to SWA, written agreements were obtained from landowners in February 2014 for the land that needed to be leased for the implementation of the project.

(c) Unintended Positive/Negative Impacts

Other impacts were assumed to be "benefit to the poor" and "reduction of women's domestic work." In addition, the effects of collaboration with projects under other schemes implemented by JICA were also confirmed. The status of each impact is described below.

1) Benefit to the poor

At the time of planning, it was expected that the project would improve the water supply in the target area and benefit the poor. According to SWA, water pipes were connected to all households in the target WSSs, and all residents, including the poor, had access to safe water. Interviews with residents including the poor showed that even after the completion of the project, most households were still paying less than 80 Samoan Tala/month (about 3,300 yen/month), which is an amount that the poor can afford, and many of them said that

the water tariff was reasonable.

2) Reduction of women's domestic work

According to the residents interviewed, the easier access to water has made it unnecessary to go to the nearest water point, and they are now able to complete household chores such as washing dishes and laundry inside the house. In addition, some respondents said that the project has shortened their housework time by eliminating the need to boil water and allowing them to use the washing machine. Others said that before the project, they had to wait for the water supply to be resumed when the water supply was cut off. However, after the completion of the project, water was always available, which made it possible to water the plants in the garden all at once and reduced the overall time required for watering.

3) Effect of collaboration with other schemes

Prior to this project, JICA had been providing continuous technical assistance to SWA through various schemes (grassroots technical cooperation, subject-specific training, and technical cooperation). Over the past 10 years of technical assistance, SWA has been able to provide safe water supply by improving its technology for maintaining WTPs using the Ecological Purification System (EPS), implementing water supply services based on water quality and quantity data, and detecting and repairing water leakage. This project introduces WTPs using the EPS method, which has been proven effective and established through past technical assistance, and also promotes the target area's long-term goal of a "stable supply of safe water in the capital city of Apia" through integrated support with related technical cooperation projects (see the BOX).

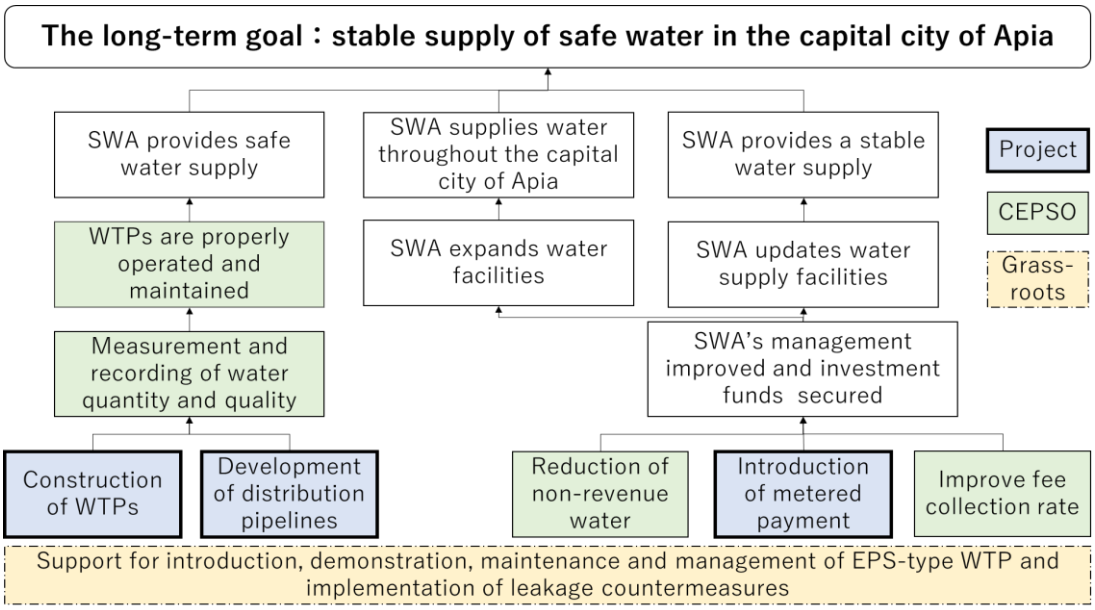
BOX Effect of collaboration with other JICA schemes

Prior to this project, JICA has been providing continuous technical assistance to SWA through various schemes (grassroots technical cooperation, subject-specific training, and technical cooperation). For example, in the grassroots technical cooperation proposed by Miyakojima City, Okinawa Prefecture, JICA provided technical support for the maintenance and management of the WTP applying EPS and leakage countermeasures at Alaoa and other WTPs. Furthermore, the subject-specific training provided through the cooperation of the water supply business organization in Okinawa Prefecture, mainly led by the Okinawa Prefectural Enterprise Bureau, enabled the SWA staff to operate the WTP applying EPS. Through the series of cooperations, guidance on the operation and maintenance of WTP applying EPS was provided mainly by an academic expert (Nobutada Nakamoto, Professor Emeritus of Shinshu University), who is an

authority in this field. The results and knowledge gained from such prior support were actively utilized in the implementation of this project. Specifically, through the grassroots technical cooperation, guidance was given on the operation and maintenance management methods of the Alaoa WTP, and the EPS-type WTP, which had been proven to be capable of appropriate water treatment, was introduced. Based on the existing manual for the maintenance and management of the Alaoa WTP, a manual for the project facilities was prepared.

In addition, from the planning stage, the mutual collaboration between the project and the technical cooperation "Capacity Enhancement Project for Samoa Water Authority in Cooperation with Okinawa" (CEPSO) was considered. At the time of planning, the business situation of SWA was deteriorating due to the inability to expect water tariff income from the flat rate system and non-revenue water, and thus it was aimed to ensure a stable supply of safe water in the capital city of Apia. In response to this long-term goal, the project provided safe water supply to untreated raw water supply areas and promoted the introduction of a metered payment system (see "3.4.3 Financial Aspects of Operation and Maintenance" below), while the CEPSO promoted the reduction of non-revenue water through water quality management and leakage prevention. In addition, the staff members supported by the CEPSO are in charge of the operation and maintenance of the facilities constructed under the project, and the skills and knowledge they acquired through the CEPSO are useful for the proper operation and maintenance of the facilities, thus creating a synergistic effect.

As described above, the integrated support between the schemes is contributing to the achievement of the target area's long-term goal of "stable supply of safe water in the capital city of Apia."



Source: Made by the evaluator based on the documents provided by JICA

Figure 1 Relationship between this project and other schemes

As described above, this project has mostly achieved its objectives. Therefore, the effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspects of Operation and Maintenance

SWA, in charge of operation and maintenance of the project, consists of eight departments with a total of 301 staff members as of March 2021. As assumed at the time of planning, the SWA Urban Operations (Maintenance Team, Non-Revenue Water Team, and Leak Detection Team) is in charge of the maintenance of the facilities developed under the project (Table 4). According to SWA, in order to ensure that the provision of water supply services would not be disturbed during the absence of the team in charge, other staff members would serve concurrently, and the staff was sufficient.

Table 4 The structure for maintenance at the time of ex-post evaluation (SWA Urban Operations)

Team	Responsibilities	Number of staff
Maintenance	Operation and maintenance of the entire water supply system and repair in case of malfunction	31
Non-Revenue Water	Grasping the amount of water demand, managing the amount of water supply, and grasping and taking measures for unknown water	3
Leak Detection	Leak detection, operation and maintenance of water supply networks, etc.	6

Source: Questionnaire response from SWA

The daily operation and monitoring of each facility are carried out by a dedicated operator. At the Tapatapao WTP and the Vailima WTP, operators (one for each facility) are stationed from 6:00 a.m. to 6:00 p.m. to conduct daily operations and inspections. During the night, remote monitoring is conducted (see "3.4.4 Status of Operation and Maintenance" below). At the Alaoa Pumping Station, two operators (who serve concurrently at the Alaoa WTS) conduct daily operation and monitoring in rotation. According to SWA, no failure or malfunction due to the shortage of staff members has been observed.

As described above, it is considered that there are no particular problems in the institutional and organizational aspect of operation and maintenance of the project.

3.4.2 Technical Aspects of Operation and Maintenance

The staff responsible for the operation and maintenance of the project have a bachelor's degree or diploma in civil engineering or science, or a qualification for plumbing and other fields, and they have at least three years of work experience. Since 2006, SWA has received

technical assistance for operation and maintenance of WTPs, water quality management, leak detection and countermeasures, etc., through grassroots technical cooperation, subject-specific training, and technical cooperation projects (hereinafter referred to as "Technical Cooperation"), and the staff in charge are equipped with the basic skills to maintain and operate the facilities developed under the project. In addition, although there are no facilities requiring special skills at the WTPs constructed under the project, the Technical Cooperation mainly targeted the improvement of the Alaoa WTP. Therefore, initial technical guidance specific to the new WTPs constructed under the project, as well as operation and maintenance guidance, was provided as a soft component under the project.

On-the-job training (OJT) has been provided to new hires at SWA. Although no training programs other than OJT were confirmed, the CEPSO was implemented at the same time as this project, and a successor CEPSO Phase 2 is being planned. Thus, it can be said that SWA continues to have opportunities to improve their capacity in operation and management of water supply facilities.

Based on the above, it is considered that the SWA staff in charge have the skills to operate and maintain the facilities constructed under the project and that there are no particular problems in the technical aspect.

3.4.3 Financial Aspects of Operation and Maintenance

At the time of project planning, SWA's billing efficiency and cost recovery rates for FY 2011/2012 were both 75%, and SWA was operating at a loss. Through this project, it was expected that the water supply service would be improved, and the conversion to tariff collection based on the metered payment system through the installation of water meters would increase the billing efficiency rate and improve SWA's financial situation. Table 5 shows the changes in SWA's billing efficiency rate, cost recovery rate, and the number of customers over time. Compared to before the implementation of the project, both the billing efficiency rate and the cost recovery rate are on an increasing trend, and after the implementation of the project, they have been maintained at 100%. The improvement in the billing efficiency rate can be attributed to the increase in the amount of water bills paid and the improvement in the customer database, etc., which have made it possible to collect bills more efficiently. In addition, the increase in the number of meter connections (number of customers) is thought to have contributed to the improvement in the cost recovery rate.

In addition, according to SWA, the quality of water supply services has been improved with the support of the EU, leading to the expansion of water supply coverage and increase in the number of meter connections (customers), while the improvement of billing efficiency rate is mainly due to SWA's self-help efforts.

Table 5 SWA's billing efficiency and cost recovery rates and number of customers

	2014	2015	2016	2017	2018	2019
Billing efficiency (%) *1	107	100	100	107	105	104
Cost recovery (%) *2	72	68	89	97	109	107
Number of customers *3	16,574	17,778	18,004	19,660	20,669	22,313

Source: Questionnaire response from SWA, SWA Annual Report 2015–2016 p. 10, 2019–2020 p. 6

*1: Ratio of collections against water sales

*2: Ratio of income against expenses (except for depreciation)

*3: Number of customers for residential and commercial use who were billed for water services

Water tariffs of SWA are shown in Table 6. The flat rate of 20 Samoan Tala per month was converted to the metered payment system after the completion of the project. Water tariffs are based on usage for residential and commercial use. Water tariffs were revised in July 2019 and were scheduled to increase, but this has not yet been applied due to a measles outbreak and the global spread of COVID-19.

Table 6 Water tariffs of SWA

	After the project completion		At the time of the ex-post evaluation	
	Amount of use (m^3/month)	Tariff (S$/$m^3$)	Amount of use (m^3/month)	Tariff (S$/$m^3$)
Household	0.50	0.50	~15	0.77
	66	1.40	16~40	1.67
	67~	1.90	41~	2.17
Business	~40	1.50	~40	1.77
	41~	2.00	40~	2.27

Source: Documents provided by SWA

SWA's financial data since 2013 are shown in Table 7. SWA's financial situation, which was in deficit when the project was planned because expenditures exceeded revenues, has improved. Since the completion of the project, water fee revenues have increased and SWA has maintained a surplus.

Table 7 Profit and loss statement of SWA

(Unit: thousands Samoan Tara)

	2013	2014	2015	2016	2017	2018	2019
Income	**19,937**	**20,650**	**23,400**	**22,915**	**25,882**	**26,909**	**27,600**
Customer water service revenue	11,103	12,449	14,947	15,870	17,079	18,096	18,807
Government grants	4,723	5,966	5,688	3,803	4,744	3,878	3,680
Other income	4,111	2,235	2,765	3,242	4,058	4,935	5,113
Expenses	**25,371**	**22,746**	**24,507**	**24,289**	**23,814**	**26,626**	**26,990**
Administration costs	3,081	2,632	2,470	2,479	2,817	3,063	3,373
Personnel costs	6,367	6,601	6,858	7,084	7,383	8,219	8,474
Operations and maintenance costs	8,931	8,017	9,148	9,410	9,017	9,881	9,551
Depreciation	4,328	4,600	4,613	4,630	4,922	5,199	5,333
Other cost	2,664	896	1,419	685	-325	265	258
Finance costs	84	109	-	12	4	64	29
Net profit	**−5,518**	**−2,204**	**−1,107**	**−1,362**	**2,064**	**218**	**639**

Source: SWA Annual Report 2013–2014 p. 4, 2016–2017 p. 5, 2017–2018 p. 5, 2018–2019 p. 5, questionnaire response from SWA

Although the operation and maintenance costs specific to the facilities and equipment developed in this project could not be confirmed, at the time of planning, the annual cost for the operation and maintenance of the facility was estimated to be approximately 510,000 Samoan Tala. This was less than 3% of SWA's total water services revenue and was considered sufficient to cover the cost. According to SWA, operation and maintenance is important for service provision and is always given priority in the budget allocation.

Based on above, it is considered that there are no particular problems in the financial aspect of operation and maintenance.

3.4.4 Status of Operation and Maintenance

From the site visit by the local assistants and the interview with SWA, it was confirmed that the facilities developed in this project were in good operating condition. No defects or failures were reported in the raw water pipelines and distribution pipes. However, it was found that the sand washing machine that was part of the equipment provided was not used during the ex-post evaluation. According to SWA, it was not used because the washing speed was slow and the amount of sand that could be washed by the machine during the day was insufficient compared to the amount needed for sand replacement. The sand washing machine is scheduled to be replaced by the end of FY2021. The sand washing is done about once a year, and since

the sand can be washed manually without the sand washing machine, the stoppage of the sand washing machine was not causing any major problems in the maintenance of the facility.

Regarding the maintenance of the facility, as recommended at the time of planning, regular maintenance of the WTP (cleaning work of the settling tank (once a year), removal of mud in the roughing filter tank (once a month), removal of dirt from the filter tank (once every three months), and re-sanding work) were being carried out.

At the time of planning, customers were supposed to install the water pipes from the meter to each house, and customers' faulty or illegal connections were a cause of leakage and water theft. According to SWA, at the time of ex-post evaluation, all these faulty and illegal connections in the WSSs in Apia had been removed. From the project site visit, it was also confirmed that the water meters were properly installed and in good condition. According to SWA, the main cause of non-revenue water is leakage from aging pipelines. Although the data on the amount of leakage in the target WSSs has not been confirmed, in light of the fact that the non-revenue water rate has been significantly reduced (see previously mentioned "3.1.2 Consistency with the Development Needs of Samoa"), the leakage situation is considered to have improved.

Regarding the operation of the WTPs, the water volume in the balance tank and distribution reservoir of the plant is constantly monitored and recorded at the call center by a remote monitoring and control system (Supervisory Control And Data Acquisition: SCADA[9]). The water volume data is output in the form of reports every three hours and shared with the staff and management. Based on the reports, the water quality standards are also checked by the operators of the WTPs. As for the water quantity, the operator and staff also visually check the condition of the water intake, water pipes, and filtration tanks, etc. to ensure that there is sufficient water flow from the water source to the treatment plant and that the filtration tanks are maintained in good condition. For leak monitoring, assistance, such as staffing, the securing of equipment, and trainings on leak detection, were implemented through CEPSO. SWA continues to use the standard operating procedures (SOPs) and data collection techniques developed in this project. In addition, SWA continues to receive online assistance from CEPSO experts to advance its work on non-revenue water and leak detection, as well as to share information among departments at monthly meetings.

According to SWA, there are no problems in procuring spare parts with respect to funding and procedures. At the time of planning, it was estimated that about 30,000 Samoan Tala per year would be required for the purchase of spare parts. As shown in the previous section, "3.4.3 Financial Aspects of Operation and Maintenance," there is no major problem in procurement because the customer water service revenue is sufficient to cover the cost. In

[9] One of the industrial control systems, which monitors and controls manufacturing processes and production equipment at plants and factories with computers

addition, there were no reports of problems such as equipment failure or aging due to lack of funds for the facilities and equipment developed in this project.

Based on the above, it is considered that there are no problems in the status of operation and maintenance.

As described above, no major problems have been observed in the institutional/ organizational, technical, or financial aspects or current status of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned, and Recommendations

4.1 Conclusion

The objective of this project was to contribute to the improvement of sanitary conditions in three water supply districts in Apia, the capital city of Samoa, by ensuring a stable supply of purified and treated safe water; and in the project, water intake facilities were improved and water treatment plants, water transmission and distribution facilities, etc. were constructed. The project was consistent with Samoa's development policy and development needs from the time of the project planning to the time of the ex-post evaluation, as well as with Japan's assistance policy at the time of the project planning, and the relevance was high. As for the implementation of the project, the facilities were constructed as planned and the project cost was within the plan, but as the project period exceeded the plan, the efficiency of the project was fair. The effect indicators set at the time of planning were achieved, and interviews with residents in the project area confirmed that water quality and water supply conditions have improved and confidence in the implementing agency's water supply services has increased. As for the impact of the project, safe and stable water supply to the surrounding residents, including the poor, has been realized, which is considered to have led to the improvement of sanitary environment in the households and the reduction of women's domestic work. Furthermore, the project also confirmed the effect of collaboration with other schemes implemented by JICA. No negative impacts on the natural environment or resettlement were reported. From the above, the effectiveness and impact of the project were high. There were no problems in the operation and maintenance of the facilities developed in this project in terms of the systems and structures, technology, finance, or condition of the facilities. Therefore, the sustainability of the effects of this project was high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Implementation of non-revenue water measures through leak detection and repair work and implementation of long-term preventive maintenance plans

Although there has been a significant improvement from before to after the start of the project, the non-revenue water rate is still high at about 50% in all of Samoa, including non-project areas, at the time of ex-post evaluation, and planning and implementing non-revenue water measures is still a priority issue in the country. The main causes of non-revenue water are inadequate construction of existing pipelines and leakage from aging water distribution pipes, which are outside the scope of this project. SWA has acquired knowledge and skills on leakage detection and repair through the support of the CEPSO, and is currently taking measures against leakage with continuous support from experts of the technical cooperation project. In addition, it is expected that the non-revenue water control activities in the "Capacity Enhancement Project for Samoa Water Authority in Cooperation with Okinawa Phase 2" (CEPSO2), which will be implemented from FY2021, will be expanded to other areas and that the training system for acquisition of non-revenue water control technology in SWA will be enhanced. SWA is expected to continue leak detection and repair work in accordance with the SOPs developed by the CEPSO, as well as identifying the amount of leakage, prioritizing old pipes based on leak monitoring, and formulating and implementing long-term preventive maintenance plans of renewing old pipes and doing other work

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

<u>Importance of integrated collaboration with other schemes in infrastructure projects</u>

Prior to this project, JICA had been providing continuous technical assistance to SWA through various schemes (grassroots technical cooperation, subject-specific training, and technical cooperation). Through more than a decade of long-term support, SWA has been able to maintain water treatment plants using an ecological purification system, provide water supply services based on water quality and quantity data, and improve technologies for detecting and repairing leaks, thereby ensuring a safe water supply. However, since there were still water supply areas with untreated raw water in Samoa, water treatment facilities were developed in this project by utilizing the results and knowledge gained through such prior support. In particular, the ecological purification system, which had proven to be capable of appropriate water treatment through the guidance of the operation and maintenance methods at the Alaoa WTP through grassroots technical cooperation, was introduced at the Tapatapao WTP and the Vailima WTP in this project; and based on the manual for the maintenance and management of the Alaoa WTP, a manual for the project facilities was prepared. It can be said that the results of the previous project were utilized in this project. In addition, the technical

cooperation project “CEPSO” (2014–2019) was implemented at the same time as this project, and the quality of SWA’s water supply services was improved through technical support for water quality control and for non-revenue water management by leakage prevention and other means. The staff members supported by the technical cooperation project are in charge of the operation and maintenance of the project facilities, and it was confirmed that the skills and knowledge acquired through the technical cooperation project are useful for the proper operation and maintenance of the project facilities, thus creating a synergetic effect.

In the case of introducing the facilities and equipment with which the executing agency is not familiar, there is a concern that the capacity building program (soft component) provided by the grant aid and the OJT alone will not be sufficient to acquire the necessary knowledge for operation and maintenance management. However, by strengthening the maintenance capacity through prior or parallel technical cooperation projects, the sustainability of the project effects can be enhanced. In this way, it is important to fully utilize the results of prior assistance and to integrate technical cooperation projects and grant aid in order to promote the effectiveness of each project and, in turn, to promote the achievement of the long-term goals of the target area.

Importance of planning the entire supply system in infrastructure development where end-users will be the beneficiaries

In water supply improvement projects such as this project, the effective functioning of the entire water supply system will ensure a stable supply of safe water from the intake point to the users. This project aimed to ensure a stable supply of safe water through the improvement and renovation of water purification, transmission, and distribution facilities. Based on the achievement of the effect indicators set at the time of planning and interviews with local residents, it was confirmed that both the volume and quality of water supply improved significantly from before the implementation of the project, and that safe and stable water supply was realized. The importance of developing the entire system can be applied not only to the water supply sector, but also to the electric power sector, for example, when developing the electric power supply system from generation to transmission to distribution.

In the future, when planning infrastructure development projects in which end users will be the beneficiaries, such as in the water supply and electric power sectors, it will be important to check the status of development of each system in the target area, as in this project, and to carefully examine the project scope and content to ensure that the entire supply system functions.

End