FY2024 Simplified Ex-Post Evaluation Report of Japanese Grant Aid Project

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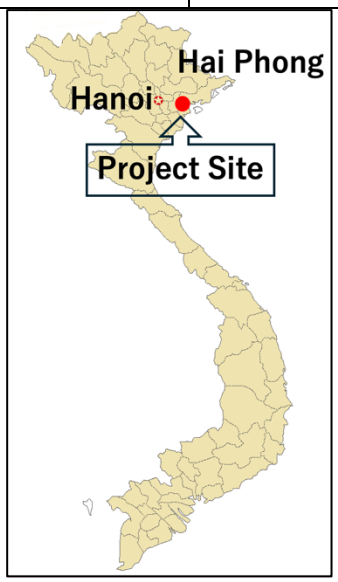
Duration of the Study: September 2024–December 2025

Duration of the Field Study: January 12, 2025–January 19, 2025

Country Name	The Project for Improving An Duong Water Treatment Plant in Hai Phong City
Socialist Republic of Viet Nam	



Location of the project site (source: made by the evaluator)

Photo 1: Intake river (Re River) and intake pipes constructed under the project (source: taken by the evaluator)

I. Project Outline

Background	In Viet Nam, as economic growth and urbanization continued, the volume of domestic and commercial wastewater increased. However, due to the low sewerage coverage rate, rivers and waterways in urban areas were receiving a significant pollution load from untreated wastewater, and water pollution was progressing in the major rivers and the sea into which they ultimately flowed. Of the seven water treatment plants (WTPs) in Hai Phong City, the largest, the An Duong WTP, was facing issues with raw water contamination. This was due to domestic wastewater flowing into its water source, the Re River. Specifically, the plant was experiencing problems with the water treatment process, such as the large amount of coagulant and chlorine being used to treat pollution from ammonium nitrogen and organic matters.	
Objectives of the Project	The objective of this project is to reduce the concentration of ammonium nitrogen in the raw water, stabilize the operation of An Duong WTP in Hai Phong City, and reduce the chlorine injection amount, by constructing an Upward Flow Biological Contact Filtration (U-BCF)[1] system and related facilities at the WTP, thereby contributing to the supply of safe drinking water.	
Contents of the Project	1. Project Site: Hai Phong City 2. Japanese Side: (1) Scope of Civil Works and Equipment Procurement: [Quan Vinh Intake Pumping Station] Electrical building, intake pump facilities, power receiving facilities, etc. [An Duong WTP] U-BCF (100,000 m^3/day), raw water reservoir reclamation, pipelines, electrical building, power receiving facilities, control panel, monitoring and control system, instrumentation facilities, etc. (2) Scope of Consulting Services: Detailed design, procurement and construction supervision, etc. (3) Scope of Soft Component: Technical instruction for operation and maintenance (O&M) of the U-BCF, and technical instruction for water quality management 3. Vietnamese Side: Installation of a new access gate for construction traffic, relocation of overhead electrical wires, acquisition of necessary permits and approvals, land rental (for a stockyard), installation of electrical equipment, and bearing of payment commissions, etc.	
Implementation	E/N Date	July 4, 2015 (Date of Amendment: March 31, 2020)

[1] U-BCF is a facility that artificially and more effectively reproduces the natural process in which microorganisms, attached to materials such as pebbles on a riverbed, take in and decompose pollutants. The Kitakyushu City Water and Sewer Bureau owns the national patent for the U-BCF technology.

Schedule	G/A Date	February 26, 2016 (Date of the First Amendment: August 1, 2018 / Date of the Second Amendment: March 31, 2020)	Completion Date	December 24, 2021 (Date of Handover)
Project Cost	E/N Grant Limit / G/A Grant Limit: 2,196 million yen, Actual Grant Amount: 2,191 million yen			
Executing Agency	Hai Phong Water Joint Stock Company			
Contracted Agencies	Main Contractors: Kobelco Eco-Solutions Co., Ltd. / SANKYU INC. (JV) (Japan) Main Consultants: NJS Co., Ltd. / Kitakyushu Water Service Co., Ltd. (JV) (Japan)			

II. Result of the Evaluation

Summary

This project aimed to reduce the concentration of ammonium nitrogen in the raw water, stabilize the operation of An Duong WTP, and reduce the chlorine injection amount, by constructing a U-BCF system and related facilities at the WTP. At the time of the ex-ante evaluation, the project plan was consistent with Viet Nam's development policies and needs, as well as Japan's assistance policy, and the project plan and approach were deemed appropriate. Moreover, the project was coordinated with other JICA projects and those of other donors, resulting in synergistic effects. Therefore, the relevance and coherence of the project are high. In terms of efficiency, based on an evaluation that took into account the increase in project outputs, although the project cost was within the plan, the project period significantly exceeded the plan; therefore, its efficiency is moderately low. Since the project's completion, the ammonium nitrogen concentration at the exit of the U-BCF constructed under this project has consistently achieved its target value. In addition, the U-BCF has also reduced other pollutants such as dissolved manganese, nitrite, and organic matters, along with hazardous trihalomethanes (THM), which are formed by the reaction of these substances with chlorine. This has led to the supply of safe drinking water and the stable operation of the WTP. Therefore, the effectiveness and impact of the project are high. Furthermore, the necessary policies/systems, institutions/organizations, technical capacity, and financial resources to sustain the project's effects have been established. There are no major concerns regarding environmental, social, or other risk factors, and the O&M status is favorable. Therefore, the sustainability of the project effects is very high.

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

Overall Rating[2]	**A**	**Relevance & Coherence**	③[3]	**Effectiveness & Impacts**	③	**Efficiency**	②	**Sustainability**	④

1 Relevance/Coherence

<Relevance>

• Consistency with the Development Policy of Viet Nam at the Time of Ex-Ante Evaluation

Viet Nam's urban water supply development guideline, *Orientation on Water Supply Development of Urban Areas and Industrial Zones in Vietnam up to 2020* (1998), set objectives such as "to secure safe water for all urban areas by the year 2020" and "to reinforce the human resource development system by introduction of modern technologies and facilities." In addition, in a speech by the Prime Minister regarding the *Socio-Economic Development Plan (SEDP) 2011-2015*, the goal was stated to effectively implement major environmental programs and projects related to clean water and environmental sanitation. Therefore, at the time of the ex-ante evaluation, this project was consistent with the development policies of the Government of Viet Nam.

• Consistency with the Development Needs of Viet Nam at the Time of Ex-Ante Evaluation

At the time of the ex-ante evaluation, raw water contamination at An Duong WTP was worsening due to the inflow of domestic wastewater into its water source, the Re River. In particular, ammonium nitrogen levels exceeded the surface water standard for drinking water (0.2 mg/L or less), and the measured values fluctuated between 0.2 and 1.1 mg/L. This instability necessitated frequent and precise adjustments to the chlorine injection rate, resulting in unstable plant operation. Generally, the effective dosage of chlorine required is eight times the concentration of ammonium nitrogen, meaning that a higher concentration of ammonium nitrogen leads to an increased chlorine injection amount. Moreover, an increase in organic matters leads to a rise in hazardous THM, a suspected carcinogen, which are generated through a reaction with chlorine. The increase of ammonium nitrogen and organic matters in the raw water was thus a major factor in the water treatment problems. Therefore, it was necessary for the WTP to reduce the ammonium nitrogen and organic matters in the raw water by constructing a U-BCF system.

• Appropriateness of Project Design/Approach

In some past grant aid projects, there were cases where construction-related works borne by a recipient country, although

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

[3] ④: Very High, ③: High, ②: Moderately low, ①: Low

implemented, had issues such as poor quality, which in turn affected the overall project implementation schedule and the achievement of the project's outcomes. Drawing a lesson from these past experiences, it was decided for this project that the site preparation for the proposed U-BCF construction (part of the raw water reservoir reclamation work) would be implemented by the Japanese side, rather than being an obligation of the Vietnamese side. Since this site preparation was actually carried out by the Japanese side, it is considered that the lessons learned from similar past projects were effectively applied. Furthermore, no particular issues were identified with the project plan (design) or approach of this project.

<Coherence>

- Consistency with Japan's ODA Policy at the Time of Ex-Ante Evaluation

In its *Country Assistance Policy for the Socialist Republic of Viet Nam* (December 2012), the Government of Japan designated "response to fragility" as a priority area and stated its intent to support efforts to address the environmental issues emerging from rapid urbanization and industrialization. In addition, the *JICA Country Analysis Paper for Viet Nam* (March 2014) identified "addressing urban issues associated with rapid economic development and industrial clustering" as a key challenge. Therefore, at the time of the ex-ante evaluation, this project was consistent with Japan's ODA policies.

- Internal Coherence

During the implementation of this project, the "Project for the Dissemination and Demonstration of Water Purification Treatment Using Upward Flow Biological Contact Filtration" (an SMEs and SDGs Business Support Program) was carried out from 2016 to 2019.[4] This involved demonstration experiments of U-BCF in six cities[5] across Viet Nam and the formulation of a U-BCF business development plan. Hai Phong Water Joint Stock Company participated in these experiments, conducted training for water supply companies from other cities, and provided information on U-BCF. As a result, and as described later in "3 Effectiveness/Impacts," the likelihood of U-BCF being introduced at other WTPs in the country has increased. Therefore, it can be said that this project had internal coherence, as it contributed to the deployment of U-BCF in other cities within the country through coordination with this demonstration project.

- External Coherence

At the time of the ex-ante evaluation, the Asian Development Bank (ADB) had planned to support the expansion of the water treatment capacity at An Duong WTP from 100,000 m³/day to 200,000 m³/day, as well as improvements to the pipe network. This facility expansion included a plan to abolish the use of intermediate pumps in order to switch to a gravity flow water treatment process. To accommodate this transition to gravity flow, this project needed to increase the capacity of the intake pumps to raise the pump head at the intake point. At the time of the ex-post evaluation, it was confirmed that the facilities developed under the ADB loan and those constructed under this project were well-aligned, including the adaptations for the switch to the gravity flow system. The water treatment at the WTP was optimized from the perspectives of both quantity and quality, as the ADB loan expanded the treatment capacity up to 200,000 m³/day, while this project addressed the deterioration of raw water quality. Therefore, it can be said that this project had external coherence with the ADB-financed project.

<Evaluation Result>

In light of the above, the relevance and coherence of the project are high.[6]

2 Efficiency

<Project Outputs>

The outputs of this project are as described in "I. Project Outline – Contents of the Project" above. While not major, the following changes were made. However, these changes are considered to have no particular issues, as each was based on justifiable reasons and was made upon consultation and agreement between the executing agency and JICA.

- Quan Vinh Intake Pumping Station

(1) Changes to the number of stories, pile diameter, and location of the electrical building: The building was changed from the originally planned single-story structure to a multi-story one in order to accommodate electrical equipment for a future increase in water treatment capacity. Additionally, due to changes in traffic conditions around the proposed construction site, including an increase in large vehicle traffic, it became difficult to bring in the originally planned pile driver. Consequently, the pile diameter was reduced to allow for the use of a smaller pile driver, and the number of piles was increased to secure the necessary bearing capacity. Furthermore, a transformer facility, which was not present during the outline design, was installed within the proposed site by the executing agency. To avoid this structure, it became necessary to move the location of the electrical building 11.45 m from its originally planned position.

(2) Addition of chlorine injection equipment: After damage from golden mussels (*Limnoperna fortunei*) occurred at other WTPs operated by the executing agency, experimental results demonstrated that chlorine injection was an effective countermeasure. Therefore, it was decided to install a new chlorine injection equipment at the intake facility, similar to the existing equipment.

(3) Changes to the specifications and number of intake pumps: The executing agency requested a reduction in the number of pumps subject to renewal, as the equipment upgrade was to take place while the existing intake pumping station remained operational. Accordingly, the specifications were changed from four 160 kW units to three 230 kW units, thereby reducing

[4] The completion report of this project: URL https://openjicareport.jica.go.jp/pdf/12339255.pdf (accessed February 10, 2026)

[5] Hai Phong, Ho Chi Minh, Quang Ninh, Nam Dinh, Tien Giang, and Phu Tho (six cities in total)

[6] Relevance: ③, Coherence: ③

the number of pumps while increasing their individual capacity.

(4) Renovation of the water intake building: If the intake pumps were to be upgraded to 230 kW, the noise level would become approximately 90 dB, which would not comply with Viet Nam's national noise standards (below 70 dB during the day and 55 dB at night). To mitigate this, acoustic panels were installed on the walls of the existing pumping station building, and the windows were replaced with soundproof ones. However, as this required the windows and doors to be kept closed, lighting, ventilation, and air conditioning equipment were installed to ensure a good working environment for the resident monitoring operators.

(5) Provision of intake and transmission pipes: Although the initial plan was to utilize the existing intake and transmission pipes, additional pipes were procured at the request of the executing agency. The agency wished to enhance the facility's sustainability by replacing a portion of these pipes as a preventive maintenance measure alongside the project's implementation. (The installation work itself was carried out by the executing agency).

・ An Duong WTP

(1) Addition of chlorine injection equipment and extra pile foundation work for the electrical building: As a countermeasure against golden mussels, the chlorine injection room (including the installation of new sodium hypochlorite injection equipment for the U-BCF facility) was constructed as an integrated unit with the electrical room and monitoring room. This integration increased the overall load of the building, necessitating the addition of piles to the foundation work for the electrical building.

(2) Change in pavement specifications: As numerous construction works were underway simultaneously in Hai Phong City, procuring asphalt became difficult, leading to a change to concrete pavement. Additionally, the executing agency proposed a new on-site traffic plan. Although the areas around the U-BCF and the electrical building were initially intended only for light vehicles, this new plan involved using the temporary gate as a permanent entrance in the future and allowing heavy vehicles on certain routes. Consequently, based on this proposal, the area and thickness of the concrete pavement were also modified.

(3) Change in piping length: At the time of the outline design, the plan was to send treated water from the U-BCF to the existing chemical mixing tank, with a portion capped off with a branch valve in preparation for future expansion under the ADB project. However, by the time of the detailed design, the ADB project was underway, necessitating the connection of the pipeline to the receiving well designated for the ADB component. This required a change in the total piping length (from 556 m to 1,059 m).

<Project Inputs>

・ Project Period

The planned project period was a total of 30 months, from February 2016 (signing of the grant agreement) to July 2018 (completion of commissioning, inspection, handover, and the soft component). However, the actual period lasted a total of 71 months, from February 2016 (signing of the grant agreement) to December 2021 [official handover to the executing agency (owner)], significantly exceeding the plan (233 % of the plan). The main reasons why the actual period significantly exceeded the plan are as follows:

(1) Regarding the detailed design period, 12 months were required for accommodating design changes (including additional design work associated with the new installation of chlorine injection equipment as a countermeasure against golden mussels) and for coordination with related organizations. Additionally, 10 months were needed for the approval of the tender documents by the executing agency.

(2) Although the contract with the contractor was signed in August 2018, an Authorization of Payment (AP) was not issued for a long period due to the enforcement of a new decree on public expenditure management, and consequently, the advance payment to the contractor was not made. Citing this non-payment, the contractor did not commence construction work on the intake pumping station even after April 2019.[7]

(3) As the commencement of construction on the intake pumping station under this project was delayed, the executing agency proceeded with its own budget-funded project on the same site in November 2019. This necessitated a significant revision of the plans for the electrical building construction and pump layout, which were originally planned for this project. Consequently, a study for the redesign of the intake pumping station was conducted from January to November 2020. The study period, initially scheduled for approximately four months, was extended until November due to the impact of COVID-19. However, according to the executing agency, the impact of this study on the overall project delay was limited, as the finalization of the study and design changes were carried out in parallel with the construction of the intake pumping station.

[7] Until the commencement of construction work on the intake pumping station, from December 2018 to April 2019, consideration was given to redesign changes related to the pump capacity at the intake pumping station [this stemmed from a request by the executing agency to further modify the pump capacity and quantity, which had already been changed during the detailed design. The agency intended to retain three existing intake pumps (originally planned for disposal) for backup purposes, but this would have resulted in insufficient space in the pump room. However, as no agreement was reached among the parties concerned, these redesign changes were ultimately not implemented].

Table 1 Comparison of Project Period

Content	Plan	Actual
Grant Agreement~Detailed Design	2 months	3 months
Detailed Design (including field surveys and tendering procedures)	9 months	29 months
Construction Works	17 months	36 months
Soft Component	2 months	3 months

Source: Documentation provided by JICA; interviews conducted with the executing agency and the main consultant

・ Project Cost

The total planned project cost was 2,252 million yen (Japanese side: 2,196 million yen, recipient country side: 56 million yen), and the actual cost was 2,235 million yen (Japanese side: 2,207 million yen, recipient country side: 28 million yen), remaining within the plan (99 % of the plan). The actual project cost borne by the Japanese side was 2,191 million yen, but when adding the 16,008,300 yen for the cost of the study for the redesign of the intake pumping station mentioned above, the actual cost totaled 2,207 million yen, slightly exceeding the planned amount (2,196 million yen) (100.5 % of the plan). The costs borne by the recipient country were 28 million yen[8] against the planned 56 million yen, remaining within the plan (44.6 % of the plan). The reason for the actual costs being lower than planned was that the costs for land rental and obtaining necessary permits for project implementation were ultimately not required, and the costs for constructing new construction entrances and VAT refund fees were lower than anticipated.

<Evaluation Result>

Although the project cost was within the plan, the project period significantly exceeded the plan. Therefore, the efficiency of the project is moderately low.

3 Effectiveness/Impacts[9]

<Effectiveness>

[Quantitative Effects]

In this project, a target value was set only for “ammonium nitrogen concentration” as the quantitative effect indicator. As shown in Table 2, the actual value of this indicator has achieved the target value since the project’s completion. In addition, as this project also aimed to reduce the chlorine injection amount (as stated in the project objectives), the chlorine injection amount at the WTP was set as a supplementary indicator for the ex-post evaluation. The reasons why the actual value of this supplementary indicator exceeds the baseline value are as follows.

(1) In recent years, the deterioration of raw water quality has become more serious due to the inflow of industrial, agricultural, and domestic wastewater into rivers (especially during the rainy season, heavy rains cause pollutants to wash out from the soil, further worsening the raw water contamination, while sewage treatment plants have not been developed around the Re River, the water intake source). According to the water quality test results from the executing agency, over the past 10 years, the potassium permanganate consumption (which indicates the amount of organic matter in the water) in raw water has increased by an average of 26 %, ammonium nitrogen by an average of 12 %, dissolved manganese by an average of 38 %, and nitrite by an average of 40 %.

(2) In 2018, Viet Nam’s national water quality standards were revised, changing the limit for free residual chlorine in treated water from 0.5 mg/L or less to 1.0 mg/L or less.

(3) The size of the existing clear water reservoir was approximately 6,000 to 7,000 m^3, but approximately 20,000 m^3 was added by the ADB project, resulting in a total of approximately 26,000 to 27,000 m^3; therefore, the required amount of chlorine increased. In addition, the baseline value at the time of the preparatory survey was calculated based on the then-current water treatment volume (100,000 m^3/day), but at the time of the ex-post evaluation, this volume had been expanded to 160,000 m^3/day (average) by the ADB project.

Therefore, a simple comparison between the baseline and actual values is not possible. Additionally, in the preparatory survey, based on the average injection records over the past 10 years at An Duong WTP, it was calculated that the project implementation would reduce the chlorine injection amount from 91,250 kg/year to 71,467 kg/year (a reduction of 19,783 kg/year).[10] On the other hand, according to the chlorine injection records at An Duong WTP on January 14, 2025, the daily chlorine injection amount for the section equipped with U-BCF (the part covered by this project) was 2 g/m^3, while the amount for the section without U-BCF was 2.88 g/m^3. Thus, the reduction effect of the U-BCF is 2.88 - 2 = 0.88 g/m^3, and the annual reduction effect is calculated as 0.88 g/m^3 × 100,000 m^3/day (the treatment capacity of the U-BCF) × 365 days = 32,120 kg/year. Assuming that the above injection records are constant throughout the year, it is suggested that the reduction effect is higher than anticipated in the preparatory survey due to the impact of deteriorating raw water quality.

[8] However, regarding the VAT refund fees for the contractor, it appears that some costs were not eligible for the refund, and the exact amount is unknown.

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

[10] See Preparatory Survey Report, pp. 2-17 to 2-18: URL https://openjicareport.jica.go.jp/pdf/12231270_01.pdf (accessed February 10, 2026)

Table 2 Quantitative Effect Indicators of This Project

Indicator	Baseline Value 2013-2014 Planning Year	Target Value 2018 1 Year after Project Completion	Actual Value 2022 1 Year after Project Completion	Actual Value 2023 2 Years after Project Completion	Actual Value 2024 3 Years after Project Completion
(Indicator) Ammonium Nitrogen Concentration (mg/L)	0.2-1.1	≤ 0.2 at U-BCF exit	0.02-0.10 (Average 0.06)	0.02-0.24 (Average 0.07)	0.02-0.42 (Average 0.08)
(Supplementary Indicator) Chlorine Injection Amount at WTP (kg/year)	91,250	-	184,874	202,800	230,600

Source: Ex-Ante Evaluation sheet, preparatory survey report, questionnaire responses

Note: Regarding the actual ammonium nitrogen concentration values: in 2023, out of 47 days tested by Hai Phong Water Joint Stock Company's Water Quality Control Department, only one day showed 0.24 mg/L, and in 2024, out of 57 days tested by the same department, only one day showed 0.42 mg/L, slightly exceeding the target value.

[Qualitative Effects]

The implementation of this project was expected to yield qualitative effects such as (1) improved stability (ease) of operation of the WTP (due to the reduction of ammonium nitrogen concentration in the raw water) and (2) enhanced knowledge and technical skills of Vietnamese water business personnel regarding advanced water treatment through its introduction. Regarding (1), according to the executing agency, not only ammonium nitrogen but also dissolved manganese, nitrite, organic matter, etc., have been reduced by the U-BCF, contributing to the stable operation of the WTP. Regarding (2), in the knowledge assessments on U-BCF operation and maintenance conducted after the project's soft component implementation, all participants achieved a correct answer rate of 70-80 % or higher, and in the knowledge assessments regarding water quality management, the correct answer rate was 90 % or higher. Through the soft component and the self-efforts of the executing agency staff, knowledge and technical skills related to advanced water treatment have improved. Therefore, the qualitative effects of this project have materialized as expected.

<Impacts>

・ Contribution to the Distribution of Safe Drinking Water

The water quality data of the target WTP at the time of the preparatory survey (2014) and the ex-post evaluation (2023 and 2024)[11] are shown in the table below. At the time of the ex-post evaluation, the quality of the treated water met Vietnamese standards, and the U-BCF has reduced and stabilized the concentration of total THM, contributing to the distribution of safe drinking water.

Table 3 Water Quality Data of An Duong WTP

Item	Vietnamese Standard	Quality of Treated Water					
		Aug 3, 2014	Nov 12, 2014	Apr 13, 2023	Oct 18, 2023	Mar 13, 2024	Oct 3, 2024
Turbidity (NTU)	2	0.26	N/A	0.10	0.11	0.11	0.09
Free Residual Chlorine (mg/L)	≤ 1.0	1.05	N/A	0.78	0.76	0.81	0.64
Chemical Oxygen Demand (COD) (mg/L)	2	1.55	N/A	0.93	1.29	1.51	0.91
Chloroform (µg/L)	200	27.57	49.0	< 0.02	6.03	8.62	9.19
Bromodichloromethane (µg/L)	60	5.97	71.1	5.14	10.77	11.19	12.57
Dibromochloromethane (µg/L)	100	2.33	17.4	15.61	8.12	1.71	2.53
Bromoform (µg/L)	100	< 0.3	< 0.3	0.38	0.40	3.38	0.30
Total THM (µg/L)	-	35.87	137.5	21.13	19.29	28.28	15.40

Source: Preparatory survey report, questionnaire responses

・ Contribution to Savings in O&M Costs (Chemical Costs) of the Target WTP

Although this project was expected to contribute to savings in chemical costs by reducing chlorine injection, the actual amount has significantly increased. This increase is attributed to the recent deterioration of raw water quality caused by the inflow of

[11] The water quality data for both 2023 and 2024 was checked to confirm the trend over time.

industrial, agricultural, and domestic wastewater into the river (with a significant impact from Typhoon No. 11 on September 1, 2024 further worsening the quality), and the previously mentioned reasons: the revision of national water quality standards and the increase in water treatment volume. Therefore, a simple comparison of costs before and after the project implementation is not possible.

Table 4 Chemical Costs at An Duong WTP

Chemical	Quantity			Unit Price (VND)		Maintenance Cost (million VND)		
	Average 2004-2014	2023	2024	Average 2004-2014	2023/2024	Average 2004-2014	2023	2024
Poly Aluminium Chloride (PAC) (kg/year)	526,513	523,000	700,000	9,150	8,300	4,818	4,341	5,810
Chlorine (kg/year)	91,250	202,800	230,600	11,200	10,300	1,022	2,089	2,375

Source: Preparatory survey report, questionnaire responses

・ Other Positive and Negative Impacts

(1) Impacts on the Environment

This project did not fall under the sectors/characteristics likely to cause significant impacts or sensitive areas listed in the *JICA Guidelines for Environmental and Social Considerations* (April 2010), and its undesirable environmental impacts were judged not to be significant. Therefore, it was classified as Category B, and the preparation of an Environmental Impact Assessment (EIA) report for this project was not legally required under Vietnamese law. To meet the country's domestic emission and environmental standards, measures were planned during construction regarding air quality, water quality, noise, waste, etc., including maintenance of machinery, fuel selection, installation of settling ponds, use of low-vibration/noise-reduction type piling machines, and appropriate waste segregation and disposal. For the operational phase, measures such as installing silencers and sound-absorbing panels were planned for noise control.

According to the executing agency and the main consultant, monitoring related to air quality, water quality, noise, vibration, land subsidence, waste, etc., was conducted during the project implementation, and appropriate measures were taken in accordance with the aforementioned Environmental and Social Considerations Guidelines and Vietnamese domestic standards. Furthermore, as a noise countermeasure in this project, sound-absorbing panels were installed on the walls of the existing pump building, and windows were replaced with soundproof ones, making it possible to reduce the noise level to 45.7 dB.[12]

(2) Resettlement and Land Acquisition

This project involved the construction of the U-BCF and related facilities within the existing WTP site; therefore, resident resettlement and land acquisition were not required.

(3) Gender Equality, Marginalized People, Social Systems and Norms, People's Well-being, and Human Rights

Not applicable

(4) Other Impacts

At the time of the ex-post evaluation, the effectiveness of U-BCF is becoming recognized within Viet Nam. In the previously mentioned "Project for the Dissemination and Demonstration of Water Purification Treatment Using Upward Flow Biological Contact Filtration" (2016-2019), demonstration tests of U-BCF were conducted at WTPs in a total of six cities. According to the main consultant, in Ho Chi Minh City, a feasibility study was conducted with a subsidy from the Ministry of Economy, Trade and Industry (METI) towards introducing U-BCF (treatment capacity: 300,000 m^3/day). In the near future, the likelihood of U-BCF being introduced at other WTPs is increasing.

<Evaluation Result>

In light of the above, the implementation of this project has yielded effects mostly as planned. Therefore, the effectiveness and impacts of the project are high.

4 Sustainability

• Policy and System

In the *SEDP 2021-2025*, goals are set to achieve an access rate to clean/uncontaminated water of 95-100 % in urban areas and 93-95 % in rural areas during the plan period, as well as to ensure the safety of dams and reservoirs and prevent the pollution of water resources. Furthermore, in the Prime Minister's Decision No. 2502/QD-TTg (approving the development orientation for water supply in urban areas and industrial zones up to 2025), it is stated that by 2025, urban areas should achieve a 100 % coverage rate of clean water supply services through centralized water supply systems, a water supply volume per capita of 120 L/day, and water quality meeting regulated standards. To achieve this, enhancing learning from the experience of developed countries in the operation and management of water supply systems is emphasized. Therefore, the prospect of continued political commitment to the maintenance of the facilities and equipment developed under this project is considered high.

[12] In this ex-post evaluation, no exceedances of environmental standards or complaints from local residents were reported.

• Institutional/Organizational Aspect

Hai Phong Water Joint Stock Company, the executing agency of this project, has changed its company name since the time of the outline design (2014).[13] However, according to the company, there has been no change in its organizational structure, and the government (Hai Phong City People's Committee) holds 80.5 % of the shares. As of January 2025, the total number of employees at the company was 972, among whom the total number of staff at An Duong WTP was 72 (including 47 in operations and eight in repairs). Staffing levels have been streamlined through process automation within the WTP. The maintenance plan for the WTPs operated by the company is prepared by its Planning Department, and actual maintenance at An Duong WTP (including Quan Vinh Intake Pumping Station) is carried out according to this plan. When emergency repairs are needed, the WTP proposes an emergency repair plan to the Planning Department; the department then reviews the plan, reports to upper management, and grants approval. Additionally, the U-BCF's treated water quality and its operational status are also inspected and managed by the company's Water Quality Control Department. The O&M system for the WTP is well-established, and sufficient personnel are assigned to carry out proper O&M.

• Technical Aspect

At Hai Phong Water Joint Stock Company, prior to the implementation of this project, demonstration tests of U-BCF were conducted under the JICA grassroots technical cooperation project "Improvement Program for Purification Methods against Organic Matters" (2010-2012). On this occasion, Kitakyushu City Water and Sewer Bureau provided accepted trainees with training on the basic knowledge of U-BCF and the design related to the U-BCF experimental plant, as well as practical training on measurement methods for ammonium nitrogen, chemical oxygen demand (COD), and ultraviolet absorbance (E260) to observe its treatment effects. In addition, through the soft component of this project, necessary technology transfer related to the O&M of the U-BCF was carried out by the main consultant.[14] Furthermore, when recruiting new staff, Hai Phong Water Joint Stock Company selectively hires from seven domestic universities specializing in water supply technology. After recruitment, staff receive OJT and training from external experts (such as consultants). Notably, following the signing of a Memorandum of Understanding (MOU) with Kitakyushu City Water and Sewer Bureau (2024), staff are dispatched twice a year from the bureau to provide technical guidance and support. Also, once a year, company-wide training (for all staff) covering the entire water purification process is conducted, followed by a written examination. Moreover, at An Duong WTP, spot skills tests are conducted four times a year for the eight repair staff members. Overall, sufficient technical capacity for proper O&M of the WTP has been secured, and a human resource development system has also been established.

The maintenance manual provided by the contractor is still being used at the time of the ex-post evaluation. However, because the manual is very voluminous, detailed, and difficult to use, Kitakyushu City Water and Sewer Bureau prepared and provided a simplified version. At the time of the ex-post evaluation, both manuals are utilized.

• Financial Aspect

Hai Phong Water Joint Stock Company is a financially independent public corporation, and its necessary expenditures, including the maintenance costs for the project's target section, are covered by its revenue. Table 5 shows the company's recent profit and loss status; the financial resources required for the O&M of the U-BCF are funded by the company's business revenue, securing the financial resources necessary for proper maintenance.

Table 5 Profit and Loss Status of Hai Phong Water Joint Stock Company

(Unit: million VND)

	2022	2023
Revenue	969,365	1,029,240
Cost of Sales	600,299	636,928
Gross Profit	369,066	392,313
Financial Income	22,727	33,069
Financial Expenses	65,448	87,226
Selling Expenses	135,774	138,444
General and Administrative Expenses	87,699	90,682
Operating Profit	102,872	109,030
Other Income	14,968	12,036
Other Expenses	12,540	11,604
Other Profit	2,428	432
Profit Before Tax	105,299	109,461
Corporate Income Tax	19,140	20,100
Net Profit After Tax	86,159	89,362

Source: Questionnaire responses

Note: Of the above, the necessary costs for the O&M of the U-BCF (personnel costs, maintenance/repair costs, electricity costs, etc.) are approximately 3,800 million VND/year.

[13] Although the Japanese name remains unchanged, the English name has been changed from "Hai Phong Water Supply One Member Co., Ltd" to "Hai Phong Water Joint Stock Company".

[14] The soft component was implemented by Kitakyushu Water Service Co., Ltd., a partner of Kitakyushu City Water and Sewer Bureau.

• Environmental and Social Aspect

No negative impacts on the natural and social environment were observed; thus, there is no evidence of sustainability risk from an environmental and social perspective.

• Preventative Measures to Risks

At the time of the ex-post evaluation, no particular risks related to O&M were identified.

• Current Status of Operation and Maintenance

Routine daily maintenance and periodic inspections necessary for the proper operation of the U-BCF have been carried out. At the time of the ex-post evaluation, no malfunctions or problems were found, and the facility is performing as designed. In 2023, an incident occurred where activated carbon flowed out from the U-BCF, leading to the cleaning of the support gravel in all basins. The cause was identified as follows: shortly after the start of operation, chlorine injection control was not well managed, leading to a large outbreak of golden mussels; juvenile mussels entered the activated carbon, grew, died, and their remaining shells created gaps within the activated carbon, causing it to flow out through these gaps. In May 2024, an MOU regarding the O&M of the U-BCF was signed between Kitakyushu City Water and Sewer Bureau and Hai Phong Water Joint Stock Company. It was agreed that the bureau would provide technical support for O&M free of charge (with travel expenses borne by the company). According to the company and the bureau, the activated carbon issue has not occurred since then, and the maintenance status remains satisfactory.

<Evaluation Result>

In light of the above, the O&M of this project faces no issues regarding relevant policies and systems, organizational structure, technical capacity, or financial status. Sustainability is ensured, and there are no concerns regarding environmental and social considerations or other risks. Therefore, the sustainability of the project effects is very high.

III. Recommendations & Lessons Learned

• Recommendations to Executing Agency

None

• Recommendations to JICA

At the time of the ex-post evaluation, the U-BCF installed by this project has been properly operated and maintained, contributing to the distribution of safe drinking water at the target WTP. On the other hand, sewage treatment plants have still not been developed around the Re River, the water intake source, and the contamination of the raw water continues to worsen. In the future, if the raw water contamination becomes significantly more severe, there is a concern that the U-BCF alone may no longer be sufficient. Therefore, as the donor agency, it is recommended to urge the Vietnamese government to promote the development of sewage treatment facilities in the Re River basin.

• Lessons Learned

(1) [Points to Note for Smooth Project Implementation]

In this project, the project period was significantly extended. According to the executing agency, it took nearly three years from the preparatory survey to the implementation of the detailed design. During this time, various circumstances changed, such as the progress of the ADB project and the occurrence of damage from golden mussels, resulting in numerous output changes. Although major changes did not occur in this project, approval from the higher organization, the People's Committee, was required each time the need for an output change arose. The time required for these approval procedures also contributed to the delay in project implementation. When implementing projects with implementing agencies having a similar organizational structure in the future (where the executing agency does not have decision-making authority over output changes), JICA, the executing agency, the main consultant, and the contractor should strive for prompt implementation from the preparatory survey through the detailed design. Additionally, to ensure smooth project implementation, it is considered necessary at the planning stage for JICA and the executing agency to agree beforehand that changes after the detailed design stage should be avoided as much as possible.

(2) [Setting Quantitative Effect Indicators Aligned with Project Content]

In this project, only the ammonium nitrogen concentration at the U-BCF exit was set as a quantitative effect indicator. However, the U-BCF also has the effect of reducing other substances such as potassium permanganate consumption (which indicates the amount of organic matter in the water), dissolved manganese, and nitrite. Since the target WTP needs to treat these other substances as well to distribute safe drinking water, when deploying U-BCF to other cities etc. in the future, it might be considered advisable, from the perspective of appropriately measuring project effects, to include these other substances in the quantitative effect indicators.

(3) [Effectiveness of Collaboration with the Main Consultant]

In this project, after its completion, an MOU regarding the O&M of the U-BCF was signed between Kitakyushu City Water and Sewer Bureau and Hai Phong Water Joint Stock Company, under which the bureau provides technical support free of charge. This has significantly contributed to the smooth introduction and stable operation of an advanced technology like U-BCF, which

is unfamiliar in developing countries including Viet Nam. This serves as a good reference case for implementing projects that introduce advanced technologies, and initiatives involving active and continuous support by entities possessing advanced technologies like the bureau should be considered.

IV. Non-Score Criteria

- Performance
- Objective Perspective: According to the executing agency, JICA provided appropriate support from the project planning stage through to the handover of the U-BCF facilities after completion, fulfilling its expected role as a project partner and contributing to the project's outcomes.

- Additionality

At Hai Phong Water Joint Stock Company, following the confirmation of U-BCF's effectiveness through demonstration tests conducted under the JICA grassroots technical cooperation project "Improvement Program for Purification Methods against Organic Matters" (2010-2012), a small-scale U-BCF was introduced at the city's Vinh Bao WTP in 2013 using the company's own funds. Subsequently, this project was implemented through JICA grant aid to introduce U-BCF to the company's main WTP. Based on the outcomes of these projects, progress is being made towards deploying U-BCF at WTPs across Viet Nam. This can be described as an innovative initiative where a grassroots technical cooperation project, utilizing technology possessed by a Japanese local government, led to nationwide deployment.

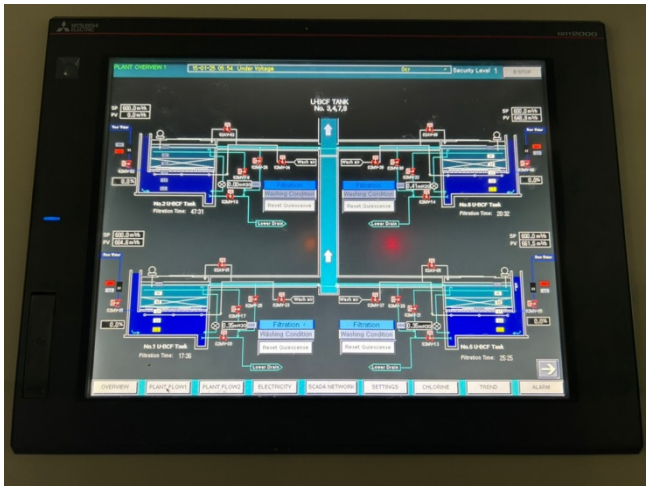


Photo 2: U-BCF control panel (source: taken by the evaluator)

Photo 3: Top view of the U-BCF (source: taken by the evaluator)

(end)