

Republic of Indonesia

FY2017 Ex-Post Evaluation of Japanese Grant Aid Project

“The Project for Urgent Reconstruction of East Pump Station of Pluit in Jakarta”

External Evaluator: Tokiko Ito, Octavia Japan Co., Ltd.

## 0. Summary

This project aimed at restoring the drainage function of the Pluit Pump Station by carrying out urgent reconstruction of the East Pump Station which had been in dysfunction and maintenance of the sea tide dike at the Pump Station located in North Jakarta City in the Special Capital City Region of Jakarta Province (hereafter referred to as “Jakarta Province”), and thereby mitigating the flood damage in the drainage area of the Pump Station and the Jakarta metropolitan area<sup>1</sup>. At the time of ex-post evaluation, this project has been relevant to the development policy like the *National Medium-Term Development Plan of Indonesia* which aims to reduce flood-prone areas by improvement of water resource management and reduces flood risks, and development needs, as well as Japan’s ODA policy. Therefore its relevance is high. Although the project cost was within the plan, efficiency of the project is fair as the project period exceeded the plan. Regarding the effectiveness, it is judged that the indicators as the designed drainage capacity of the whole Pluit Pump Station and East Pump Station were satisfied. Meanwhile, in Jakarta Province, other flood control and drainage control projects are being implemented. In addition, various factors such as the rainfall amount and depth of water channels and reservoirs, etc. are involved in the occurrence, scale and damage expansion of flood. Therefore, regarding impact, it is difficult to judge that flood damage was mitigated by this project alone. However, when the drainage capacity of the Pluit Pump Station had not been restored by this Project, flood damage is considered to be expanding. Thus, it is judged that the project has supported the mitigation of flood damage. In addition, there are no particular problems in the institutional, technical and financial aspects of the operation and maintenance of this project, and the sustainability of this project effects is high.

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

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<sup>1</sup> In this project, the area of Jakarta is distinguished as followings: the Jakarta metropolitan area, about 24 million residents = indirect beneficiaries, the Special Capital City Region of Jakarta Province, Jakarta city center or center of Jakarta, about 662.33 km<sup>2</sup>, about 9.14 million residents = secondary direct beneficiaries, and the North Jakarta City in the drainage area of the Pluit Pump Station (34.2 km<sup>2</sup>), approximately 0.18 million residents = primary direct beneficiaries (Source of population is the estimation of the government in 2008). The highlighted part of the map on the left side of Fig. 1 shows the western, central and east flow system, which are the jurisdictional areas of the executing agency, Water Resources Agency of Jakarta Province. The southern end of the drainage area of the Pluit Pump Station is Central Jakarta City in the central flow system.

## 1. Project Description



Project Location



East Pump Station of Pluit after reconstruction<sup>2</sup>

### 1.1 Background

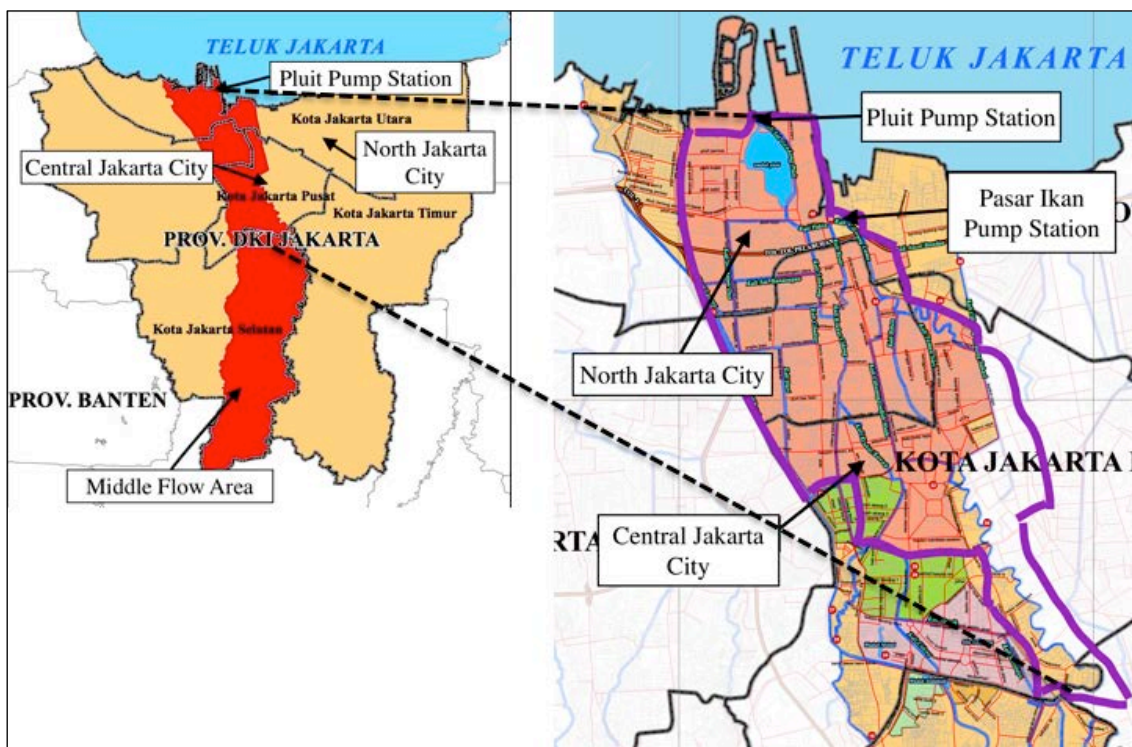
The Jakarta metropolitan area is vulnerable to floods from topographical conditions, and flood damage has been repeated over the years. Also, in addition to floods caused by the rainfall inundation and inundation by river water<sup>3</sup> due to the excessive population concentration, formation of disorderly densely populated areas, ground subsidence due to excessive pumping up of groundwater, delays in measures for flood control and drainage and inadequacies of drainage facilities, the frequency of floods caused by the climate change increase, and economic damage has been enormous. The Pluit Pump Station is an important facility responsible for the drainage of inland water in Jakarta Province, consisting of three pump stations: East, Central, and West. Among them, the aging of the East Pump Station progressed. The cracks occurred in the side walls, sea tide dike, of the drainage canal and the seawater flowed out of the canal of the Pump Station. There was concern about the loss of function of the entire East Pump Station due to the accompanying large-scale piping destruction<sup>4</sup>. If the entire Pump Station lost its function, the drainage control function in the target area would be suspended, and it was predicted that a large-scale flood damage would occur in areas including densely populated North Jakarta City. In order to improve this situation, the Government of Indonesia requested

<sup>2</sup> Source: Yachiyo Engineering Co., Ltd.

<sup>3</sup> According to the Ministry of Land, Infrastructure, Transport and Tourism, while the water in a river is called “foreland water”, the water outside the embankment (river) is called “inland water”. The rainfall inundation is the flooding caused by the failure of drainage of rainfall due to the drainage capacity of drainage canals etc. draining into rivers. The inundation by river water is the flooding of houses and fields caused by the overflowing of water from or collapse of embankments.

<sup>4</sup> Piping destruction is a phenomenon in which soil particles are washed away by osmotic force, and a pipe-like water way is formed in the ground. Once the piping occurs partly, the dynamic water gradient in the soil contacting it increases, the osmotic force increases, and piping progresses further. It causes destruction of the reclaimed land or excavated ground.

for the support of reconstruction of the Pump Station by the Grant Aid of the Government of Japan.



Source: Evaluator processed based on the document by Water Resources Agency of Jakarta Province

Figure 1: Drainage area of the Pluit Pump Station (indicated by bold line in the figure on right) and a related pump station.

## 1.2 Project Outline

The objective of this project is to restore the drainage control function of rainwater and sewage and to restore the tide-keeping function in center of Jakarta and drainage area of the Pluit Pump Station by urgent reconstruction of the Pluit Pump Station located in North Jakarta City in Jakarta Province, thereby contributing to the mitigation of damage caused by the flood.

Grant Limit / Actual Grant Amount	74 million yen / 72 million yen (Detailed Design) 1,985 million yen / 1,825 million yen (Construction)
Exchange of Notes Date / Grant Agreement Date	January 2011 / February 2011 (Detailed Design) August 2011 / September 2011 (Construction)
Executing Agencies	Supervisory Responsibility Agency & Executing Agency:

	Ministry of Public Works and Housing Executing Agency: Water Resources Agency of the Special Capital City Region of Jakarta Province
Project Completion	November 2014
Main Contractor	Hazama Ando Corporation Co., Ltd.
Main Consultant	Yachiyo Engineering Co., Ltd.
Basic Design	October 2009 - July 2010
Related Projects	<p><b>【Technical Cooperation】</b>  “The Institutional Revitalization Project for Flood Management in JABODETABEK” (March. 2007-March.2010)  ( Technical Assistance Project Related to ODA Loan)  “Project for Capacity Development of Jakarta Comprehensive Flood Management” (October, 2010-October, 2013)  <b>【Japanese ODA Loan】</b>  “The Climate Change Program Loan” (2008, 2009, 2010)  <b>【Other International Organizations and Aid Agencies etc. 】</b>  World Bank “Jakarta Urgent Flood Mitigation Project” (2012-2019)</p>

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Tokiko Ito, Octavia Japan Co., Ltd.

### 2.2 Duration of Evaluation Study

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

Duration of the Study: August 2017 – August 2018

Duration of the Field Study: October 2, 2017 – October 17, 2017, January 28, 2018 – February 3, 2018.

### 3. Results of the Evaluation (Overall Rating: A<sup>5</sup>)

#### 3.1 Relevance (Rating: ③<sup>6</sup>)

##### 3.1.1 Consistency with the Development Plan of Indonesia

The Government of Indonesia has developed the *drainage and flood control basic plan* in 1973 and *Jakarta Flood Control and Drainage Plan* in 1993 and set it up to develop pump stations and drainage canals in drainage trunk lines of existing rivers. At the time of this project planning, one of the important strategic programs was to reduce flood damage through comprehensive water resource management in the *National Medium-Term Development Plan* (2010-2014).

At the time of ex-post evaluation, the Government of Indonesia positioned the reduction of flood-prone areas and ensuring water resistance through flood management as one of strategic priority issues to realize economic independence in the *National Medium-Term Development Plan (2015-2019)*. Also, *the Sectoral Strategic Plan of Public Works and National Housing (2015-2019)* stated the reduction of flood risks by improving water resource management, like improvement of coastal infrastructure facilities. In addition, Jakarta Province developed *Medium-Term Development Plan of Jakarta Province (2013-2017)*, and as one of the strategies to solve significant and urgent issues, the development and maintenance of drainage facilities and infrastructure facilities is stated in order to sustainably maintain economic activities in response to the threats of various floods<sup>7</sup>.

Thus, the implementation of this project is consistent with the development policy of Indonesia at the time of planning and ex-post evaluation.

##### 3.1.2 Consistency with the Development Needs of Indonesia

The Pluit Pump Station, the target of this project, is an important facility responsible for inland water drainage of a large area of 34.2 km<sup>2</sup> out of the drainage area including center of Jakarta, about 42.1 km<sup>2</sup>. At the time of planning, the East Pump Station had been aged more than 45 years since construction, and piping destruction had occurred. There was concern about the loss of function of the entire Pump Station. And if the drainage control function in the target

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<sup>5</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>6</sup> ③: High, ②: Fair, ①: Low

<sup>7</sup> Floods occurring in Jakarta Province are analyzed as having three major factors. i) Extremely strong rainfall to the upper river causing overflow of the river and flooding of the residential area. ii) Extremely strong rainfall at downstream of the lower terrain and Jakarta. iii) High tide. These three factors are thought to be the causes of the major flood that lead to major economic losses in Jakarta Province in 2002 and 2007. (Source: *Special Capital City Region of Jakarta Province Medium-Term Development Plan 2013–2017*, p119)

area are suspended, a large-scale flooding damage was expected to occur. In particular, the drainage area of the Pluit Pump Station includes the center of Jakarta where important facilities such as the Presidential Palace and administrative agencies of Jakarta Province are located. In order to improve such situation, reconstruction of the Pump Station was an urgent issue.

While, at the time of ex-post evaluation, measures to deal with various flood causes are being promoted by related administrative organizations mainly the Directorate General of Water Resources of Ministry of Public Works and Housing, the supervisory responsibility agency and executing agency of this project, here after referred to as “Directorate General of Water Resources”, and the Water Resources Agency of Jakarta Province, the executing agency of this project. In the *National Capital Integrated Coastal Development (1<sup>st</sup>Phase: 2014-2018)*, the development of a sea tide dike surrounding the Jakarta bay and new residential areas and transportation routes for countermeasures to land subsidence and flood and securing of alternative water sources to the groundwater for countermeasures of ground subsidence etc. have been planned, after 2<sup>nd</sup> phase. The Directorate General of Water Resources and the Water Resources Agency of Jakarta Province have implemented countermeasures against floods such as strengthening embankments of rivers flowing in Jakarta Province and dredging of reservoirs by *Jakarta Emergency Dredging Initiative (2015-2017)*.

From the above, the reduction of flood damage due to flood control and drainage management in Jakarta Province is regarded as a priority issue even at the time of ex-post evaluation. The necessity of securing stable drainage capacity of the Pluit Pump Station is high. Thus, consistency with the development needs is recognized both at the time of planning and ex-post evaluation.

### 3.1.3 Consistency with the Japan’s ODA Policy

In the Ministry of Foreign Affairs’ *Country Assistance Plan for Indonesia (November 2004)*, the support for “building a democratic and fair society” was a priority area and priority item. In this, it was supposed to support the countermeasures to natural disasters like frequent floods for the rural sustainable development as “improvement of basic public services”, and to support the measures to climate change and development of urban residents’ living environment, including countermeasures to natural disaster as “environmental conservation and disaster prevention”. Based on the assistance plan, JICA’s *Country Assistance Implementation Report for Indonesia (July 2009)* positioned the urgent disaster countermeasures and the climate change countermeasures as assistance programs. This project supports the natural disaster

countermeasures and the climate change countermeasures related to the above priority area and priority item in Jakarta Province, and the consistency with the Japan's ODA policy is recognized.

From the above, this project has been 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

Table 1: Outputs of the Project (Plan/Actual)

	Plan (2009: Before the project starts)	Actual (2017: Ex-Post Evaluation)
<b>【Japanese Side】 Reconstruction of Pluit Pump Station and attached facilities</b>		
1	Construction of East Pump House: Reinforced Concrete structure, steel pipe pile foundation, 3-story building, and floor area of approximately 400 m <sup>2</sup> .	As Planned
2	Installation of pump facility in East Pump Station: 3 units of discharge pump facility (Vertical mixed flow type, 5.0 m <sup>3</sup> /sec/unit), 3 units of aboveground pipe line system (diameter 1,500mm), 1 set of emergency generator facility (1,500kVA), 3 units of screen and auxiliaries, and 1 unit of horizontal conveyer.	As Planned
3	Reconstruction of sea tide dike: Extension of approximately 145m of sea tide dike, Cantilever steel pipe sheet pile and counterweight embankment type, diameter 1,200mm	As Planned
<b>【Indonesia】</b>		
1	Maintenance of access road for loading construction materials	As Planned
2	Provision of disposal sites of demolished construction debris and management and disposal of waste	As Planned
3	Relocation of power receiving facility	As Planned
4	Alternate drainage facility during reconstruction of East Pump Station	As Planned
5	Relocation of anchored ships and relocation of Marine Police Station and related facilities	As Planned
6	Preparation, clearance and implementation of Environmental Management Plan and Environmental Monitoring Plan	As Planned
7	Other general necessary undertakings by the recipient country for Japanese Grant Aid	As Planned

Source: JICA Preparatory Survey Report, Answers to the questionnaire from the executing agency

The outputs of Japanese side and Indonesia side were mostly implemented as planned. However, during the project implementation, the contract was changed 5 times between the

consultant of this project, hereafter referred to as “Consultant”, and the Government of Indonesia with the consent of JICA headquarters concerning the construction methods and structure etc. The purpose of the contract change was to ensure drainage capacity during the construction, improvement of the certainty and reliability of blocking of water, and shortening the construction period, etc. The specific contents are the structure of the connection between the east and west end of the sea tide dike and existing revetment, the construction method and structure of the vent part of sea tide dike, and the construction method of removing the underground structure of existing building of the East Pump House, and so on. According to the Directorate General of Water Resources and the Consultant, the reasons why these changes occurred were because “it was impossible to investigate the details at the time of the detailed design survey as there were illegal vessels at the sea tide dike facing the Pluit Pump Station, the existing house was old and the project was planned in the situation that there was no material such as its completion drawing etc., identification of existing structures was impossible even by investigations by divers during the construction period as the transparency in the water was low and it were identified as a result of draining, and requests of the Government of Indonesia were taken account etc.”. Based on the limitation of the survey period at the time of the detailed design study and the points that could not be predicted, it is considered that changes of the contract were unavoidable.



Photo 1: Overall view of the East Pump Station after reconstruction<sup>8</sup>



Photo 2: From the west side of the sea tide dike after reconstruction

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

Regarding the total project cost of this project, while the initial plan was about 2,229 million

<sup>8</sup> Source: Yachiyo Engineering Co., Ltd.



yen, the amount to be borne by the Japanese side was 2,059 million yen and that of Indonesian side was about 170 million yen, the actual amount by the Indonesian side was not available. The actual amount of Japanese side was 1,897 million yen and was within the plan, 92% compared to the plan.

#### 3.2.2.2 Project Period

This project was planned to be completed in 34 months from July 2011, including the detailed design period<sup>9</sup>. The actual period of the Japanese side was 41 months from July 2011 to November 2014 and exceeded the plan, 121% compared to the plan<sup>10</sup>. According to the Consultant and the person in charge of the project in Ciliwung-Cisadane River Basin Development Agency under the Directorate General of Water Resources, which was in charge of the project during the project implementation, “the project period was exceeded because of the followings: ① in response to the requests of the Government of Indonesia to reduce the number of pumps to stop, it was decided that construction work of the sea tide dike in front of the Central and West Pump Station was done after the completion of the reconstruction of the East Pump Station, ② the change of construction method of the existing East Pump House accompanied some preparation work, and ③ the construction period was reset after about 1 month of construction interruption due to the flood occurred in January 2013.” As a result, during the project implementation, the deadline of Consultant’s work and contractor’s performance were extended for 7 months each. There were also works that progressed in parallel at the same time, and the project was completed in November 2014, which took about 7 months for ① that was implemented after the completion of the East Pump Station in March 2014.

From the above, although the project cost was within the plan, as the project period exceeded the plan, efficiency of the project is fair.

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<sup>9</sup> Although the project period is 36 months in the ex-ante evaluation chart, the starting point is unknown. Thus, the progress chart described in the Preparatory Survey Report of the project is adopted as the plan as its basis is clear, and the starting point is set as at the time of the contracting the detailed design. The extended period was the main construction period, and it was actually 32 months against the planned 25 months.

<sup>10</sup> The construction by the Indonesian side was completed by November 2014.

### 3.3 Effectiveness and Impacts<sup>11</sup> (Rating:③)

#### 3.3.1 Effectiveness

##### 3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the East Pump Station of Pluit, at the time of the project planning, the function of all 4 pumps, each 3.2 m<sup>3</sup>/sec of drainage capacity, had been stopped due to piping destruction. Through this project, 3 pumps, each 5.0 m<sup>3</sup>/sec of drainage capacity, were in place. As an indicator of the quantitative effects, at the time of planning, ① the drainage capacity of the Pluit Pump Station was set as an operation indicator, and ② the probability scale of rainfall in the drainage area was set as an effect indicator. At the time of ex-post evaluation, ③ the drainage capacity of the entire Pluit Pump Station was set as a complementary indicator of the operation indicator. The corresponding information is obtained through this study, and the results of analysis are shown below.

#### 1) Drainage capacity of East Pump Station of Pluit

Table 2: Drainage capacity of the East Pump Station of Pluit (designed capacity)

(Unit : m<sup>3</sup>/sec)

Baseline 2009	Target 2014 Completion year	Actual		
		2015 1 year after completion	2016 2 years after completion	2017 3 years after completion
3.2m <sup>3</sup> ×2pumps =6.4 (Drainage capacity of 2 pumps made available for emergency measures)	Normal Time: 5.0m <sup>3</sup> ×2pumps = 10 (<-0.9mPP <sup>12</sup> , up to one pump stand-by)	10	10	10
	Emergency Time: 5.0m <sup>3</sup> ×3pumps = 15 (-0.9mPP≤, All pumps being operated)	15	15	15

Source: Preparatory Survey Report on the project for before the project starts, Answers to Questionnaire for after the project completion.

According to the person in charge in the Operation and Maintenance System of Central Flow System Section of Coastal and River of Central Flow System<sup>13</sup>, hereafter referred to as “the Section”, of the Water Resources Agency of Jakarta Province, “in principle, the operators operate the pumps according to the water level of the Reservoir and following the operation

<sup>11</sup> Sub-rating for Effectiveness is to be put with consideration of Impacts.

<sup>12</sup> “PP” means the lowest sea level, “Priok Peil”, set at the Tanjung Priok port in 1925. It is the standard of water level in Indonesia. This report also uses this as the standard water level. If the water level is lower than PP, mPP becomes negative.

<sup>13</sup> At the time of the ex-post evaluation, this section is responsible for the operation and maintenance of the Pluit Pump Station at the Water Resources Agency of Jakarta Province.

rules of the Pluit Pump Station (Supplementary Material Table 1) <sup>14</sup>”. According to the chief of the Section and the operators, “although the drainage capacity of the pumps is not actually measured, the maintenance work has been carried out up to the time of the ex-post evaluation after completion of the East Pump Station. And the pumps were generally operating without problems<sup>15</sup>, and it is considered that the drainage capacity fulfills the designed capability. Also, the Emergency Time occurs about several times in a year, rainy season, but by the time of ex-post evaluation there is no problem with drainage at the time of operation”. As a result, it is judged that the actual value of the drain capacity of the East Pump Station has reached the target value both at the normal time and the emergency time.

## 2) Drainage Capacity of the entire Pluit Pump Station

Table 3: Drainage Capacity of Pluit Pump Station (Designed Capacity)

(Unit: m<sup>3</sup>/Sec)

Baseline	Target	Actual					
		2014	2015	2016	2017		2018
					Jan - Feb	Mar - Dec	Jan
2009	Completion year	1 year after completion	2 years after completion	3 years after completion		2 <sup>nd</sup> field study of ex-post evaluation	
Normal Time: n/a	34	34	34	34	n/a	34	
Emergency Time: 40.4	49	49	49	49	33	49	

Source: Preparatory Survey Report on the project for target, Answers to Questionnaire for after the project completion.

The target value at the normal time, 34m<sup>3</sup>/sec, is the total of the designed capacity according to the principle of temporarily stopping one pump at each Pump Station and is 34 m<sup>3</sup>/sec in total; East Pump Station, 5 m<sup>3</sup>/sec x 2 units, Central Pump Station, 4 m<sup>3</sup>/sec x 3 units, and West Pump Station, 6 m<sup>3</sup>/sec x 2 units. The target value at the emergency time is the total of the designed capacity of all the pumps and is 49m<sup>3</sup>/sec; East Pump Station, 5 m<sup>3</sup>/sec x 3 units, Central Pump Station, 4 m<sup>3</sup>/sec x 4 units, and West Pump Station, 6 m<sup>3</sup>/sec x 3 units. The actual results for the period of 2015 - February 2017 were calculated along the operation rules of the Section in the Water Resources Agency of Jakarta Province (Supplementary Material Table 1) at

<sup>14</sup> According to the operator of the Pump Station, “in addition to the reservoir water level, rainfall amount in upstream, weather forecast etc. are also the standards for judging the starting-up of pump operation. In addition, although not specified in the operation rule, each pump in each Pump Station will be on stand-by after operating a certain hours”.

<sup>15</sup> As mentioned later in Indicator 3), there is a case when a pump temporarily stopped.

the time of ex-post evaluation. Between March and December 2017, the Central Pump Station was not in operation in order to repair its electronic cable. For this period, since the operation performance of the East and West Pump Station are irregular, it is decided not to calculate the value at the normal time. Based on the designed capacity, during the repair of the Central Pump Station, the drainage capacity at the emergency time was 16 m<sup>3</sup>/sec below the target value. However, according to the person in charge of the Section of the Water Resources Agency of Jakarta Province, “while only the East and West Pump Station were operated during the repair period, there was no problem in drainage status.”

From the above, at the time of ex-post evaluation, it is judged that the drainage capacity of the entire Pluit Pump Station generally reached the target value of the drainage capacity.

3) Settings of the rainfall probability scale indicating drainage capacity of Pluit Pump Station  
(At the time of Planning)

Table 4: Amount of 24-hour Rainfall and Water level of the Pluit Reservoir against the Rainfall Probability Scale set at the time of planning<sup>16</sup>

	Baseline	Target	Actual
	2009	2014 Year of completion	
Rainfall Probable Year	1/5 probable year	1/10 probable year	2014 - 2017
Amount of 24-hour Rainfall (mm/24hr)	220.7	267.0	n/a
Water level of the Pluit Reservoir (mPP)	-1.18	-0.36	n/a

Source: Preparatory Survey Report on the project for Target, Documents provided by Water Resources Agency of Jakarta Province for amount of rainfall, and Answers to the questionnaire for after the project completion.

The effect indicator set at the time of planning is the rainfall probable year indicating the drainage capacity of the Pluit Pump Station. However, there is no data available directly as the “rainfall probable year”. Also, as the rainfall changes every year since the time of project planning, the probability scales of rainfall calculated at the time of project planning and ex-post evaluation are different, and it is considered that the rainfall probability scale differs depending on the year of reference. Therefore, for the ex-post evaluation, as shown in Table 4, it was considered that the 24-hour rainfall and the water level of the Pluit Reservoir that were used to

<sup>16</sup> The interpretation of the amount of 24-hour rainfall and the water level of the reservoir is as follows. For example, if the drainage capacity of the Pump Station functions as designed after the recovery, when the amount of 24-hour rainfall is 267.0 mm/24hr, which is the rainfall probability of 1/10 years, calculated water level of the Pluit Reservoir is -0.36 mPP at the highest.

set the probable year at the time of the project planning are used as notes. However, as a result, it was judged that it cannot be used for the evaluation judgment because of the following reasons.

First, the sources and the measurement points of the 24-hour rainfall adopted at the time of planning were unknown. In addition, the 24-hour rainfall data of the Water Resources Agency of Jakarta Province obtained for the ex-post evaluation were measured at 16 points in a wide area of Jakarta Province, and there was a large difference in rainfall of each point<sup>17</sup>. They also include points that are not necessarily in the drainage area of the Pluit Pump Station. It is considered that the heavy rain in a limited area affects the average value, and the influence on the water level of the Pluit Reservoir may be different depending on measurement points. Therefore, it is judged that it was not appropriate to use the average value of 16 points for the analysis. In addition, since a new pump station has been developed upstream of the Pluit Pump Station before the project completion, it is considered that the conditions of the Pluit Reservoir associated to the drainage capacity and the rainfall have changed since the time of project planning<sup>18</sup>.

Second, regarding the water level of the Pluit Reservoir, before and after the project completion, in the Jakarta metropolitan area, multiple flood control and drainage countermeasure projects such as a large-scale dredging and cleaning of Pluit Reservoir and waterways and river embankment strengthening projects have been carried out by the Ciliwung-Cisadane River Basin Development Agency and the Water Resources Agency of Jakarta Province as mentioned above (3.1.2 Relevance, Relevance to the Development Needs). According to the Consultant and the Water Resources Agency of Jakarta Province, “the water level of the Pluit Reservoir is affected by sediments of reservoirs, dredging situation, high tide, etc.” Therefore, it is judged that it is not appropriate to judge the drainage capacity based on the water level set at the time of project planning. In addition, the data on the water level of the Pluit Reservoir could not be obtained as it was not compiled throughout the period after completion of the project until the ex-post evaluation. Based on the above, it is judged that it is difficult to judge the effect of the project based on the probable year calculated at the time of project planning.

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<sup>17</sup> As an example, on February 9, 2015, the average amount of 24-hour rainfall at 16 measuring points in Jakarta Province was 180.6 mm/24hr. It was 367 mm/24hr at Sunter Kodamar that recorded the maximum amount. It was 12 mm/24hr at Pompa Cideng that recorded the lowest amount.

<sup>18</sup> In the latter half of 2013, the Pasar Ikan Pump Station was completed approximately 3.4 km upstream of the Pluit Reservoir where Pluit Pump Station is located. It has 6 large pumps, 5.0 m<sup>3</sup>/sec each, and 4 small-scale pumps, 250 mm<sup>3</sup>/sec each, and when all large pumps are operated in the emergency time, the drainage capacity will be 30 m<sup>3</sup>/sec.

For reference, between after the project completion, November 2014, and the ex-post evaluation month, September 2017, there is no record that the maximum value of the average of 24-hour rainfall of the 16 points exceeded 220.7mm/24hr that is the amount of the rainfall for the 1/5 probable year<sup>19</sup>. Therefore, it could not be confirmed from the average of actual 24-hour rainfall whether the drainage capacity of 1/10 probable year which is the target value is achieved. According to the person in charge in the Section of the Water Resources Agency of Jakarta Province, “at the Pluit Pump Station, all the pumps may be operated several times a year. But after the project is completed, there have been synergistic effects with the flood control projects of the rivers in the Province, and it is recognized that floods due to the rise in the water level of the Reservoir has not occurred except during the flood in February 2015, as described later<sup>20</sup>”.

On the other hand, on February 9, 2015, the average 24-hour rainfall in Jakarta Province recorded the maximum value, 180.6mm / 24hr, after the project completion. On the next day, the highest water level of the Pluit Reservoir recorded +1.50mPP. This greatly exceeds the set water level of the 1/10 probable year at the time of planning. A large-scale flood occurred at that time. And according to the Regional Agency for Disaster Management, it recorded flooding of up to the highest 150 - 200 cm in various parts of Jakarta Province. According to the Water Resources Agency of Jakarta Province, this is because “the Pluit Pump Station stopped for several hours from 11 o'clock on that day”. Electricity supply from the state-owned electric power company ceased due to measures to prevent electric leakage in the city, and the East Pump Station suspended<sup>21</sup>. In the Pluit Reservoir, the high tide also overlapped, and the water level rose. As they waited for the water level to drop due to safety consideration, it took time to switch to the private generator. During a few hours, only the Central and Western Pump Station were in operation at the Pluit Pump Station.

According to Deputy Director of the Directorate General of Water Resources and the chief of the Section of the Water Resources Agency of Jakarta Province, “it is thought that the suspension of the East Pump Station of Pluit for several hours have greatly influenced the

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<sup>19</sup> Although it is outside the drainage area of the Pluit Pump Station, as shown in Note 17, there are records exceeding this amount depending on the measurement point.

<sup>20</sup> For example, the records of each week at the end of April and August 2017 of the Pluit Pump Station showed that the water level of Pluit Reservoir ranged between -2.00 and -1.65 mPP and between -1.90 and -1.65 mPP each. This includes the time when the Pump stopped. According to the operator, “they start up the pumps when the water level of Reservoir is around -1.70 mPP”.

<sup>21</sup> After this incident, by the time of the ex-post evaluation, an alternative power source was secured. It has been improved so that the power supply from the state-owned electric power company to the Pump Station will not be stopped.

expansion of the flood in Jakarta Province<sup>22</sup>. It is thought that this case has demonstrated the drainage function of the Pluit Pump Station is significantly associated with the flooding in central Jakarta”. Based on the above, in order to mitigate the expansion of flood damage, it is considered necessary for all Central, East and West Pump Station of Pluit Pump Station to operate soundly.

### 3.3.1.2 Qualitative Effects (Other Effects)

1) Risk prevention and alleviation of land subsidence, piping occurrence, and sea level rise etc.

The area around the Pluit Pump Station has been exposed to the land subsidence and rise of sea level due to climate change, etc. and has faced with the risk by the loss of the Pump Station. At the East Pump Station, the pump of the aboveground pipe line system was installed by this project, and at the time of ex-post evaluation, it is confirmed that the pump operators visually inspect if the land subsidence occurred or not at the pipe. In addition, the sea tide dike in front of the Pump Station was rehabilitated, and the influence of the high tide had not occurred by the time of ex-post evaluation. It seems that it became possible to respond to the sea level rise and land subsidence due to climate change. And, although it is not frequent, seawater is stopped by using the stop logs<sup>23</sup> installed in the drainage canal in front of the Central and West Pump Stations and the repair and inspection have been carried out. According to the operators of the Pump Station, “Piping destruction has not occurred in the Central and West Pump Stations”, and it is thought that the risk of the loss of drainage function of the Central and West Pump Stations has been reduced<sup>24</sup>. From the above, it is judged that the Pump Station has become facilities with structures capable of preventing and mitigating the risk of occurrence of various problems.

### 3.3.2 Impacts

#### 3.3.2.1 Intended Impacts

1) Mitigation of flood damage around Jakarta (Quantitative Effects)

In the Water Resources Agency of Jakarta Province and the Regional Agency for Disaster

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<sup>22</sup> It was said that “it was reported to the President of Indonesia and the Governor of Jakarta Province that the suspension of the East Pump Station became a cause of this flood expansion”.

<sup>23</sup> Stop Log is a structure that stacks square lumbers that can be inserted into and removed from a water gate or a revetment opening to serve as a weir.

<sup>24</sup> On the other hand, although it was not the facility targeted for this project, water leakage was seen from the side of the drainage canal of the sea side of the Central Pump Station in the field observation at the time of the ex-post evaluation. According to the consultant, “it is thought that water leakage is caused by the water pressure up to the sea water level in the drainage canal”.

Management, there is no data compiled on flood damage before the completion of the project and the scale and damage of all floods occurred after the completion of the project. Therefore the trend of the situation of the occurrence and damage of floods before and after the project completion could not be captured. Therefore, as shown in Table 5, the scale and damage situation of floods which represent large-scale floods occurred after the start of the project were confirmed.

Table 5: Flood Damage in Jakarta Province

Date of Flood	Amount of Rainfall Average in Jakarta Province)		Damage				Operation of Pluit Pump Station etc.
			Jakarta Province		North Jakarta <sup>25</sup>		
	Max in 24-hour (mm/24hr)	Monthly (mm/month)	District Town	Household The affected Victim	District Town	Household The affected Victim	
① Jan. 2013	n/a	621.9	35 124	506,164 1,226,487 38	5 24	11,349 78,445 0	West & Central Operated
② Jan. 2014	95.1	1,075.0	37 123	70,459 235,634 0	6 25	1,356 3,445 0	West & Central Operated Pasar Ikan Operated
③ Feb. 2015	180.6	639.0	38 133	64,458 231,566 5	6 29	25,695 91,820 3	West & Central Operated East temporally suspended Pasar Ikan Operated

Source: Water Resources Agency of Jakarta Province & Jakarta Province for Rainfall, Regional Agency for Disaster Management for Damage.

Regarding the three floods, maximum value of average 24-hour rainfall, average monthly rainfall, damage situation of Jakarta Province and North Jakarta City where the Pluit Pump Station is located in the Province, the operation situation of Pluit and Pasar Ikan Pump Station were respectively confirmed (Table 5). However, from these data, it was not possible to verify the correlation between the operation situation of the Pluit Pump Station and the flood damage situation. According to the chief of the Section of the Water Resources Agency of Jakarta Province, the main factors of the expansion of flood damage of the flood ① were thought to be “the outdoor water inundation due to the destruction of the channels in the center of Jakarta in addition to the inland water inundation”. As for the flood ③, as mentioned above, temporary suspension of the Pluit Pump Station is considered to be a factor of flood damage expansion. Therefore, factors of flood generation and damage expansion are various, and affected area and the damage situation are considered to differ. Also, as confirmed by the Effectiveness

<sup>25</sup> The Pluit Pump Station is located in North Jakarta City in Jakarta Province. Since various flood control and drainage projects are being conducted in the province, it is decided to check the damage situation of North Jakarta including the area around the Pump Station where drainage effect of the Pump Station is likely to appear.



(Quantitative Effect), various projects for drainage and flood control have been implemented in Jakarta Province before and after the project, and stakeholders concerned with the Directorate General of Water Resources altogether have the view point that “it is difficult to measure the impact of the project alone on flood damage, because there are multiple factors of floods other than drainage capacity of pump stations”. Therefore, it is judged that it is difficult to judge the impact of the Pluit Pump Station on the mitigation of the flood damage from the above-mentioned available data.

However, when the flood ③ occurred, its maximum value of the average 24-hour rainfall was more than that of the flood ② in the table 5, but its scale of damage in Jakarta Province was almost the same as the flood ②. The magnitude of the damage of North Jakarta City of the flood ③ greatly exceeded that of the flood ②. In addition, although the average monthly rainfall of the flood ② is larger than that of flood ③, the average rainfall for one week including 3 days before and after the day recording the highest 24hour rainfall was 42.1 mm for the flood ② and 44.6 mm for the flood ③. In the flood ③, it is considered that there was a large amount of rain in a short time. It is also possible that the 24-hour rainfall was large in the Northern area and the damage scale of North Jakarta City may have increased. But it is considered highly probable that if the East Pump Station of Pluit was functioning normally without suspension, the flood damage was further mitigated. Furthermore, regarding the monthly rainfall in Jakarta Province, there is no particular trend to increase or decrease before and after the project completion<sup>26</sup>. Under such circumstances, if the frequency, scale or damage of floods have been mitigated, it is considered that the effect of this project and other flood control and drainage projects may have been influenced. According to the chief of the Section of the Water Resources Agency of Jakarta Province, “apart from large-scale floods, the number of floods that are remembered is decreasing especially in the flood-prone areas around the Pluit Pump Station. There is an impression that flood damage in Jakarta Province is mitigated”. From the above, although it was not possible to judge whether there is impact on flood damage by this project alone, it is thought that this project is supporting the mitigation of flood damage around the center of Jakarta by the synergistic effect with other projects. However, because the quantitative data that can be the basis of persuasive logic are not available, qualitative effects

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<sup>26</sup> Comparing the average monthly rainfall in Jakarta Province between 2010 and November 2014, before the Project completion, and between December 2014 and 2016, after the project completion, the amount of the rainfall of the latter exceeded the former in 2 months in the rainy season and 3 months in the dry season. It is conceivable that the average amount will be affected when a torrential rain in a limited area or large-scale rainfall occurs, and it is necessary to pay attention to a simple comparison. However, it is considered that there is no tendency of rainfall to increase or decrease particularly before and after the completion of the project. (Source: Statistics of Jakarta Province, Jakarta in Figures 2011-2017)

are also analyzed.

## 2) Improvement of living and hygiene environment of the beneficiaries by realizing mitigation of flood damage (Qualitative Effects)

In the ex-post evaluation, a key informant interview survey was conducted on the administrative agencies of a district and towns and the residents in the vicinity of the Pluit Pump Station in North Jakarta City.<sup>27</sup> According to the administrative agencies of towns, “in the past, floods occurred 4 or 5 times a year, but in recent years there is an impression that the major damage has decreased”. According to the former chiefs of the Neighboring Assembly, “in the vicinity of the Pluit Pump Station, floods caused inundation about twice a month in the previous rainy seasons, and there were places where water was inundated for 40 to 50 cm for 2 to 4 days for 5 to 6 times a year. However, the number of floods that had damaged daily life is decreasing from the impression of the flooding hour and depth in houses. From February 2015, there is no flooding that remained in memory”.

According to the former chiefs of the Neighboring Assembly, “once the flood occurred, the number of symptoms of diarrhea tended to increase”. According to a mother in her 20s in the area, “there was a lot of inundations caused by floods before and the child became dermatitis. Cholera and dengue were also occasionally occurring. Recently, the flood has decreased, and the occurrence of infectious diseases has not been heard”. However, according to the mayor of Penjaringan Town, “the hygiene environment is originally bad around the poor area. Improvement of the environment around the Pluit Reservoir can be seen through the development of the Reservoir side and the measures against illegal residents (relocation to newly-built public housings etc.), implemented for flood control since 2015”.

Meanwhile, according to the former chiefs of the Neighboring Assembly and a mother, “with the decrease in flood frequency and damage, the stress to prepare for the flood of the local residents is relieved, and that they live with a sense of security more”. According to the

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<sup>27</sup> In the drainage area of the Pluit Pump Station, Water Resources Agency of Jakarta Province mediated to select the Mayer of Penjaringan District, Secretary, the Mayor of Penjaringan Town and the Mayer of Pluit as representatives of the administrative agencies. Regarding the residents, two former chiefs of the Neighboring Assembly in the eastern area of the Pluit Pump Station were elected as persons who grasped the situation before and after the Project completion. The interview with a woman in order to grasp the hygiene environment was also conducted. Penjaringan District has jurisdiction over the drainage area of the Pluit Pump Station. Penjaringan Town has jurisdiction over the area from the east to south side of Pluit Pump Station including the poor area. Pluit Town has jurisdiction over the area of the west side of Pluit Pump Station including the residential area of wealthy people. The area in the east side of the Pump Station is an area below sea level surrounded by the Pluit Reservoir, the sea separated by a sea tide dike, harbor facilities and rivers flow from the center of Jakarta. It is considered to be the poor area in Jakarta Province with a dense population and there are also illegal residents.

administrative agencies of a district and towns and the former chiefs of the Neighboring Assembly, “the drainage area of the Pluit Pump Station is long vulnerable to floods, and flood controls have been implemented and flood damage has been mitigated recently. It is considered that the area depends on Pump Station which plays an important role”.

As described above (Impact, Quantitative Effects), it is considered that there is no trend of increase or decrease in monthly rainfall before and after completion of the project. Although it is necessary to pay attention to the fact that the interview survey was subjected to a small group and it is not the opinion of the concerned entire people, but from the above, in the area, the floods that remains in memory decreases after the large-scale flood in February 2015. It is seen that the mitigation of the flood damage to living has been realized, and the hygiene environment is improved somewhat. In other words, it is thought that it is not caused by this project alone, but it can be inferred that this project plays a role in mitigating floods.

### 3) Mitigation of damage to economic activities of important facilities in the flooded area (Qualitative Effects)

In the ex-post evaluation, interviews with economic facilities in the Pluit drainage area were conducted<sup>28</sup>. According to the fisheries corporation and companies that had had damages of floods, “there were flood damages 4 to 5 times a year, and buildings, equipment, etc. were damaged. It used to be necessary to move electronic equipment, fixtures and goods prior to a flood, there were also business suspension due to blackouts, and many companies were economically damaged<sup>29</sup>. There were many complaints from companies in the fishing port. A lot of companies inundated even in February 2015. Since then, no damage that remained in memory has occurred and the stress on flood occurrence and economic damage has been relieved”. In the thermal power plant, “there have been no damage to generator and power generation due to its own countermeasures at a time of flood, but there is the impression that damages such as inundation in the premises that used to occur before had been mitigated”.

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<sup>28</sup> As a result of consultation with the Directorate General of Water Resources, the Water Resources Agency of Jakarta Province mediated to select the interviewees as follows: the fisheries corporation (Perusahaan Umum Perikanan Indonesia), Jakarta Port Branch, which is under the jurisdiction of the Ministry of State Enterprises, a frozen food processing and exporting company located in the port of Jakarta, which had been affected by the floods, a shoemaker located in the east side of the Pluit Pump Station and a thermal power plant (PT. Pembangkitan Jawa Bali (PJB) Muara Karan Unit) located in the western coast of the Pluit Pump Station.

<sup>29</sup> According to the fisheries corporation, regarding the economic damage of one large flood accompanied by inundation, “there are over 100 companies in the entire port, about 110 ha, of jurisdiction. And the damage will be totally about 100 billion Indonesian Rupiah, hereafter referred to as “IDR”, 840 million yen, or more”, and according to the interviewed frozen food company, “about 20 million to 30 million IDR, about 170,000 to 250,000 yen”. 1yen=118.64IDR (exchange rate of October 1, 2017).

As mentioned above, although it is necessary to pay attention to the constraints of the obtained data and the relevance of the rainfall amount and the factors of the floods, there are impressions that the flood damages are mitigated. If the entire Pluit Pump facilities are functioning soundly in February 2015, it is also inferred that flood damage of companies in the port was further mitigated. Although clear impact cannot be demonstrated, it is judged that this project supports the mitigation of flood damage to economic activities of important facilities located in the drainage area.

4) Impact on the economic activities etc. of approximately 24 million residents of the Jakarta metropolitan area (Qualitative Effects)

The drainage area of the Pluit Pump Station includes the center of Jakarta where the government agencies and many companies are located, and many working people live in the metropolitan area and commute to work. According to the chief of the Section of the Water Resources Agency of Jakarta Province, “the flood in the center of Jakarta affects the living opportunities of workers in the surrounding area as well as the means of commuting, and indirectly affecting our daily lives. If the pump station in the central basin does not function even at one location, it will have a major obstacle to the drainage in the center of Jakarta. It is very important for all pump stations to demonstrate the planned drainage capacity for flood control in the center of Jakarta”. This study cannot measure the impact of this project alone on economic activities etc. of approximately 24 million residents of the Jakarta metropolitan area, as the implementation of other flood control and drainage projects and various flood factors are taken into consideration. However, it is judged that as long as its designed drainage capacity is maintained, the Pluit Pump Station mitigates the flood damage in the center of Jakarta and supports the mitigation of the damage of the economic activities in the Jakarta metropolitan area by synergistic effects with other pump stations, flood control and drainage projects.



Photo 3: Pluit Pump Station  
Aboveground pipe line system



Photo 4: Pluit Pump Station  
The reservoir water level is visually monitored

### 3.3.2.2 Other Positive and Negative Impacts

#### 1) Impacts on the Natural Environment

At the time of planning, this project was to reconstruct the existing facilities, and the environmental impact assessment (EIA) was judged unnecessary. However, according to the Consultant, “environmental monitoring in accordance with simpler environmental management plan and environmental monitoring plan approved by Environment Agency of Jakarta Province was conducted”. However, at the time of project evaluation, both the Directorate General of Water Resources and the Water Resources Agency of Jakarta Province did not store data, and the Water Resources Agency of Jakarta Province did not establish an environmental monitoring implementation system. Therefore, through the interviews with the Consultant, the administrative agencies of a district and towns around the Pluit Pump Station and the former chiefs of the Neighboring Assembly of residential area of the eastern side, it was confirmed that there was no occurrence of exhaust gas generation, noise, vibration or traffic accidents during the project implementation or after the project completion. According to the chief of the Section of the Water Resources Agency of Jakarta Province, “an appropriate response will be carried out if necessary”. It is considered that there is a low possibility that a negative environmental impact has occurred after the completion of the project.

#### 2) Resettlement and Land Acquisition

It was confirmed that this project was mainly to reconstruct the existing facilities and there was no new land acquisition through the interview with the chief of the Section of Water Resources Agency of Jakarta Province. By the time the project start, the number of illegal

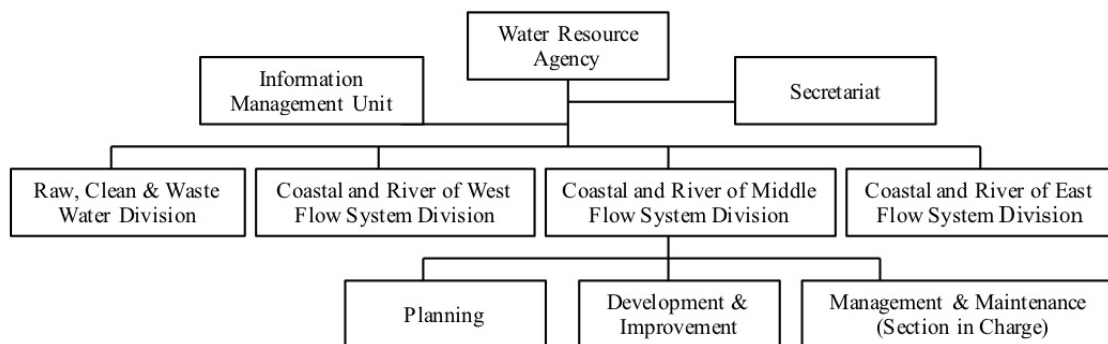
residents in the Pluit Reservoir side of the Pump Station had moved to the public housings constructed by the Jakarta Province and World Bank projects. It was confirmed that there were no complaints, etc. and that there was no problem in the relocation process through the interview with the former chiefs of the Neighboring Assembly of the area concerned.

From the above, this project has mostly developed the effect as planned. Therefore, effectiveness and impacts of the project are high.

### 3.4 Sustainability (Rating: ③)

#### 3.4.1 Institutional Aspect of Operation and Maintenance

The executing agency during the project implementation and the supervisory responsibility agency after the project completion of this project is the Directorate General of Water Resources. Meanwhile, the Water Resources Agency of Jakarta Province has jurisdiction over the operation and maintenance of the reconstructed Pump Station. The organization chart of the Water Resources Agency of Jakarta Province is shown in the Figure 2.



Source: Created by the evaluator based on the document by Water Resources Agency of Jakarta Province

Figure 2: Organizational Chart of Water Resources Agency of Jakarta Province

At the time of ex-post evaluation, the total number of organization staff in the Water Resources Agency of Jakarta Province as a whole is 5,578. In the Management and Maintenance Section of the Coastal and River of Central Flow System Division, it is 343 people including 219 operators of 17 Pump Stations including the Pluit Pump Station<sup>30</sup>. At the time of

<sup>30</sup> In Jakarta Province, the organizational structure has changed in 2014. The Water Resources Agency of the Jakarta Province at the time of ex-post evaluation was formerly the Public Works Bureau of the Province. The organizations were separated in 2014, and the Water Resources Agency which has jurisdiction over pump stations became an

the ex-post evaluation, at the Pluit Pump Station, under one chief, 14 operators are divided into 2 teams of 7 people each, and with a shift system of every 24 hours, the operation and maintenance of the Pump Station is carried out<sup>31</sup>. When visiting the Pluit Pump Station during the field study, it was confirmed that the number of operators was sufficient to manage the Pump Station through interviews with operators. Regarding the operation and maintenance, the operators carry out the basic inspection and repair and outsource if necessary.

Furthermore, after completion of the project, the Directorate General of Water Resources and the Ciliwung-Cisadane River Basin Development Agency are not involved in the operation and maintenance of the Pluit Pump Station. It had been decided that the reconstructed East Pump Station facilities and the facilities related to sea tide dike were to be transferred from the Ciliwung-Cisadane River Basin Development Agency to the Water Resources Agency of Jakarta Province as assets after the completion of the project, but they have not been transferred by the time of the ex-post evaluation. According to the chief of the Section of the Water Resources Agency of Jakarta Province, “it means that the budget and personnel are allocated on the assets which are not owned by Jakarta Province, and it is essential to transfer them from the viewpoint of auditing”. The Water Resources Agency of Jakarta Province is aware that it is the competent authority of the East Pump Station of Pluit, and in terms of the budget and personnel allocation, the entire Pluit Pump Station is regarded as one facility. The East Pump Station of Pluit is operated and maintained without being separated from the Central and West Pump Stations by the Water Resources Agency of Jakarta Province. Based on the above, it is judged that there is no big concern regarding the institutional aspect of operation and maintenance of this project at the time of ex-post evaluation.

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independent organization. In addition, prior to the organizational separation, under the Water Resources Conservation Department which was the competent department at that time, competent divisions were organized based on a work contents such as water resource conservation planning, facilities management and utilization, and flood control facility maintenance. At the time of ex-post evaluation, divisions are organized by regional jurisdiction.

<sup>31</sup> At the time of planning, there were a total of 12 operators, and by the time of the ex-post evaluation, 2 members have been increased.

### 3.4.2 Technical Aspect of Operation and Maintenance

Under the jurisdiction of the Water Resources Agency of Jakarta Province, 14 operators are allocated. Lead by 3 operators with the experience of from 11 to 13 years, 8 operators who have attended the training of operation and repair of the equipment of electrical system implemented by the contractor during the project are also assigned to the Pluit Pump Station.



Photo 5: An operator operating the pumps at East Pump House

According to the operation rules of the Water Resources Agency of Jakarta Province, they have sufficient knowledge of operation of the Pump Station through the use of this project's operation and maintenance manual as necessary. The repair and inspection of electrical systems may be outsourced to private contractors as necessary, but minor repairs can be handled by the operators. New operators learn the knowledge and skills of the method of operation and maintenance of all pumps of the Pluit Pump Station through on-the-job training and a training that is held about once a year. From the above, it is judged that there is no particular problem on the technical aspects of operation and maintenance.

### 3.4.3 Financial Aspect of Operation and Maintenance

Table 6 shows the expenses of operation and maintenance, including personnel expenses of contract staff of 17 pump stations<sup>32</sup>, of the Coastal and River of Central Flow System Division of Water Resources Agency of Jakarta Province. According to the Section, the personnel expenses of regular staff and the water and utility expenses of the pump stations are not included in the table because they are under the jurisdiction of other division within the Water Resources Agency of Jakarta Province.

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<sup>32</sup> According to the Section of the Water Resources Agency of Jakarta Province, 307 persons including a part of office workers and operators are contract employees among the 343 persons in the Section.



Table 6: Operation and maintenance expenses of Coastal and River of Central Flow System  
Division, Water Resources Department of Jakarta Province

(Unit: 10billion IDR)

Financial Year	Budget	Actual	Human Expenses of Operators in Pluit Pump Station <sup>33</sup>	
			Budget	Actual
2015	52.941	9.975	n/a	0.421
2016	45.441	27.455	n/a	0.671
2017	58.414	24.739	n/a	0.714
2018	59.295	n/a	0.827	n/a

Source: Created by the evaluator from the documents by Coastal and River of Central Flow System Division, Water Resources Agency of Jakarta Province

Although there is an increase/decrease in actual results according to fiscal years, the approved budget is on an upward trend. The personnel expenses of operators of the Pluit Pump Station are also on the rise. Through interview with the chief of the Section, it is confirmed that the expenses related to the operation and maintenance work of the Pluit Pump Station, including the repair cost of the Central Pump Station and the construction of the monitoring cabin of the Reservoir water level, have been spared without problems in FY 2017, and there is no problem of prospect of the future budget allocation. Based on those points, concerning the financial aspect including the operation and maintenance expenses, there is no concern at the time of ex-post evaluation. From the above, it is judged that there is no particular shortage in the operation and maintenance budget of this project, and it is judged that no major problems on the financial aspect can be seen.

#### 3.4.4 Status of Operation and Maintenance

At the time of the ex-post evaluation, through observation at the time of field study and interview, it is confirmed that the East Pump Station of Pluit has no malfunction or damage for the operation performance, there is no damage to the sea tide dike and it is demonstrating its function as a pump station through the operation and maintenance of inspection and repair.

Regarding the spare parts, the storage situation is not particularly problematic. For the equipment for which it takes time to obtain spare parts, measures like controlling room temperature to avoid failures, etc. are being addressed. It is confirmed that there is no particular problem in the procurement system of spare parts through the observation and interview.

Regarding the day-to-day operation situation of the Pump Station, operating pumps, operating

<sup>33</sup> At the time of ex-ante evaluation, the assumed amount of personnel expenses for FY2010 was 366 million IDR.

time and water level, through the visual inspection and interview at the field survey, it is confirmed that almost all records are taken, but a part of information, pump temperature etc., related to the mechanical and electrical characteristics has not been recorded. However, the operators check the pump temperature at any time. In addition, regarding the periodic maintenance items of facilities defined by the project: drainage pipes, civil engineering facilities, and sea tide dikes, there was no regular schedule or record for such checking as the deterioration situation of the sea tide dike structure and main facility: cracks, defects, peeling of concrete framework, leakage, ground subsidence and collapse etc. However, it is said that a visual inspection has been carried out by the operator. According to the chief of the Section of the Water Resources Agency of Jakarta Province, “all the monitoring items have not been recognized due to the replacement of the section chief”. Although no problems have occurred by the time of ex-post evaluation, it is considered necessary to carry out these inspection works in order to grasp the risk of future problems.

From the above, no major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Regarding the current status of the operation and maintenance, there are some issues to be improved in thorough monitoring and inspection, but no major problems have occurred at the time of ex-post evaluation. Therefore, sustainability of the project effects is high.

## **4. Conclusion, Lessons Learned and Recommendations**

### **4.1 Conclusion**

This project aimed at restoring the drainage function of the Pluit Pump Station by carrying out urgent reconstruction of the East Pump Station which had been in dysfunction and maintenance of the sea tide dike at the Pluit Pump Station located in North Jakarta City in Jakarta Province, and thereby mitigating the flood damage in the drainage area of the Pump Station and the Jakarta metropolitan area. At the time of ex-post evaluation, this project has been relevant to the development policy like the *National Medium-Term Development Plan of Indonesia* which aims to reduce flood-prone areas by improvement of water resource management and reduces flood risks, and development needs, as well as Japan’s ODA policy. Therefore its relevance is high. Although the project cost was within the plan, efficiency of the project is fair as the project period exceeded the plan. Regarding the effectiveness, it is judged that the indicators as the designed drainage capacity of the whole Pluit Pump Station and East

Pump Station were satisfied. Meanwhile, in Jakarta Province, other flood control and drainage control projects are being implemented. In addition, various factors such as the rainfall amount and depth of water channels and reservoirs, etc. are involved in the occurrence, scale and damage expansion of flood. Therefore, regarding impact, it is difficult to judge that flood damage was mitigated by this project alone. However, when the drainage capacity of the Pluit Pump Station had not been restored by this project, flood damage is considered to be expanding. Thus, it is judged that the project has supported the mitigation of flood damage. In addition, there are no particular problems in the institutional, technical and financial aspects of the operation and maintenance of this project, and the sustainability of this project effects is 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

- Facilities by this project are still assets of the Ciliwung-Cisadane River Basin Development Agency at the time of ex-post evaluation. Although there is no problem at the time of ex-post evaluation, there is a possibility that obstacles may arise in the future allocation of personnel and budget to facilities that are not assets of the Water Resources Agency of Jakarta Province and furthermore, operation and maintenance there. The Directorate General of Water Resources should obtain necessary information from JICA appropriately so as to transfer assets promptly and proceed with the procedure.
- The periodic inspections and record of checking the electrical system of the Pluit Pump Station and the deterioration situation of the sea tide dike and the main facility, etc. are not thoroughly conducted. In order to ensure the durability of the facility and the stability of long-term drainage capacity as a facility to prevent flood damage expansion, it is recommended that the inspection methods according to the facility manual and the operation and maintenance manual of Pluit Pump Station are confirmed, and the operation and maintenance is ensured.
- At the time of ex-post evaluation, the drainage capacity of the entire Pump Station becomes unstable due to aging of the West Pump Station. In order to mitigate flood damage in central Jakarta, it is said that it is necessary that all pumps should function soundly. In order to secure the long-term effect, it is recommended to deal with the repair of the West Pump Station early by raising funds, etc.

#### 4.2.2 Recommendation to JICA

None

#### 4.3 Lesson Learned

Necessity for setting appropriate indicator for the Effectiveness, Quantitative Effect.

In this project, the probability scale of rainfall, rainfall probable year, was set as an effect indicator with regard to the quantitative indicator of the project effect on the recovery of drainage capacity of the Pump Station. However, it was an indicator that is difficult to judge the effect of restoring drainage capacity for the following reasons. The rainfall probability scale itself is not a numerical value showing the drainage capacity of a pump station directly. It is calculated from the past rainfall amount. There is a possibility that it may change depending on the reference year. If the rainfall of the set probability scale did not occur, it cannot be grasped whether the effect is expressed or not. The measurement point and the source of the rainfall which calculated the rainfall probability scale at the time of planning are unknown, and the rainfall amount cannot be grasped. The water level of the adjacent reservoir which is associated with the rainfall probability scale would be influenced by the external conditions like the drainage environment in a wide area where multiple large-scale drainage and flood control projects have been implemented and has been changed by the time of the ex-post evaluation. The rainfall probability scale may have been reasonable when a project evaluation is implemented immediately after the completion of a project or if it is used for a design basis of the drainage capacity. From now on, in a similar project, it is considered worth considering that setting the available indicators of the direct effect of the recovery of the drainage capacity without being affected by the changes over time or the change of the environment etc. Regarding the rainfall amount, it is necessary to clarify the measurement conditions, which measurement point data comes from, if the data is an average value of plural measurement points or not, and which source used, etc.

**Supplementary Material Table 1 Capacity and Operation Rule of Pluit Pump Station**

Reservoir Level (mPP)	Discharge Amount Total (m <sup>3</sup> /Sec)	Discharge Amount of Each Pump (m <sup>3</sup> /Sec)									
		East			Central				West		
		1	2	3	1	2	3	4	1	2	3
Above -0.8		Same as below									
-0.9	49.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0	6.0	6.0	6.0
-1.0	37.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0	6.0		
-1.1	31.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0			
-1.2	31.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0			
-1.3	26.0		5.0	5.0	4.0	4.0	4.0	4.0			
-1.4	22.0	5.0	5.0		4.0	4.0	4.0				
-1.5	18.0		5.0	5.0			4.0	4.0			
-1.6	14.0	5.0	5.0		4.0						
-1.7	8.0				4.0	4.0					
-1.8	8.0				4.0	4.0					
-1.9	4.0					4.0					
-2.0											

Source: Water Resources Agency of Jakarta Province