

Kingdom of Thailand

FY2018 Ex-Post Evaluation of Japanese Grant Aid Project

“The Rehabilitation Project of the Outer Bangkok Ring Road”

External Evaluator: Nobuyuki Kobayashi, OPMAC Corporation

0. Summary

By road improvement work (raising the height of the road), this project is to ensure that transportation in the event of flood conditions on the industrial road between Bangkok and Ayutthaya in the eastern part of the Outer Ring Road (Route 9) can remain open, thereby contributing to smooth logistics and increasing industrial production in the industrial areas that depend on the road. Consistent with the purpose of this project, the development strategy from the planning phase through to the ex-post evaluation maintained emphasis on ensuring traffic at the time of floods in the area near the project road. The implementation of this project is relevant to the development needs of Thailand and Japan's ODA policy and therefore, its relevancy is high. The actual cost of the Japanese side was within the plan. The project's scope change required a design change and therefore the project period exceeded the plan. Thus, its efficiency is fair. The traffic volume and the number of impassable days due to flooding achieved their targets. Regarding the confirmation of the qualitative effects of the project, an identifiable effect was realized for securing the traffic route under stormy weather. It is presumed that this project partially contributed to revitalizing logistics around the project area and increasing the number of enterprises in the industrial parks. Therefore, its effectiveness and impact are high. In terms of the organizational/institutional aspect, the executing agency set a clear division of responsibilities for operation and maintenance, and sufficient personnel were assigned. Regarding technical considerations, it is feasible to operate and maintain Route 9 with the executing agency's technological level. Regarding financial considerations, the toll revenue exceeded the expenditure for operation and maintenance and sufficient budget was allocated. In terms of the project's operation and maintenance current status, routine maintenance was properly implemented, and no serious damage was found in the infrastructure developed by the project. In consideration of the above factors, the sustainability of the effects is high for this project.

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

1. Project Description



Project Location



The improved Section of Route 9

1.1 Background

The Outer Ring Road (Eastern Portion) Route 9, which was improved by this project, is a trunk road connecting the industrial area near Ayutthaya with several other locations including the Bangkok metropolitan area, the Suvarnabhumi International Airport, and the Laem Chabang Port. Completed in 1999, the national highway is a motorway constructed with the support of a Japanese ODA loan project. The Thai government funded the construction work to widen the highway and the work was completed in 2009. As a result of the widening work, the highway became a high standard motorway with four lanes in both the north and south directions, plays an important role in the logistics of Thailand. In 2011 a large-scale flood lasting for about a month damaged roads and trunk roads including Route 9. The paralysis of the transportation network caused by the flood had serious impacts not only on Thailand but also on global supply chains because domestic and foreign companies who had manufacturing sites near Ayutthaya could not rely on the transportation network for such a long period.

A flood of the same scale will possibly occur again after 2012. In addition to repairing damaged road infrastructure as a short-term response, securing traffic networks in the event of a flood became a development issue from a medium- to long-term perspective. In order to recover from a large-scale flood, the Japan International Cooperation Agency (JICA) commenced the Project for the Comprehensive Flood Management Plan for the Chao Phraya River Basin in November 2011 as a technical cooperation for development planning (emergency support studies). This project was proposed in the above study. In the beginning of 2012, the Thai government requested the Japanese government to provide grant aid assistance for the rehabilitation plan on flood control for the Outer Ring Road (Eastern Portion) Route 9.

1.2 Project Outline

This project is to ensure transportation of the industrial road between Bangkok and Ayutthaya at the time of flood by the road improvement work (raising the road) in the eastern part of the Outer Ring Road (Route 9), thereby contributing to smooth logistics and increase of industrial production in the industrial area¹.

Grant Limit / Actual Grant Amount	5,480 million yen/ 3,926million yen
Exchange of Notes Date /Grant Agreement Date	July 2012 / August 2012
Executing Agency	Department of Highways (DOH), Ministry of Transport
Project Completion	April 2015
Target Area	Ayutthaya Province, Pathum Thani Province
Main Contractor (s)	Hazama Ando/Toa Road/World Kaihatsu Kogyo
Main Consultant (s)	CTI Engineering International
Preparatory Survey	December 2011 - October 2012
Related Projects	<ul style="list-style-type: none">- Technical Cooperation “Project for the Comprehensive Flood Management Plan for the Chao Phraya River Basin”- ODA-loan project “Outer Bangkok Ring Road (East Portion) Construction (I)/(2)”- Grant Aid “The Flood Prevention Project of East Side of the Pasak River in Ayutthaya”

2. Outline of the Evaluation Study

2.1 External Evaluator

Nobuyuki Kobayashi, OPMAC Corporation

2.2 Duration of Evaluation Study

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

Duration of the Study: August 2018 – October 2019

Duration of the Field Study: December 3, 2018 – December 28, 2018

¹As the ex-ante evaluation sheet for this project does not mention the project’s effect corresponding to its impact, “smooth logistics and increasing industrial production in the industrial area” was added as the impact. This project was expected to improve the reliability of logistics in the event of a flood for the industrial parks around Ayutthaya and, by reinforcing the supply chain, result in more corporate investment and the expansion of industrial production.

2.3 Constraints during the Evaluation Study

Efficiency is usually based on a comparison between the planned total cost and the actual total cost. In this case, the project's total costs and actual costs would be the sum of the cost borne by both the Japanese side and the Thai side. In this project, decisions by the Thai government to implement part of the project significantly changed the project scope. Due to the difference this scope change caused between the planned project scope and the actual one, the planned and the actual amounts of total cost are not directly comparable. Furthermore, the actual cost borne by the Thai side during the project period was not made explicit. For these reasons, only the planned and the actual costs taken by the Japanese side were compared. For consistency with the above adjustment, the project was deemed "completed" based on the completion of the construction and consulting services borne by the Japanese side.

3. Results of the Evaluation (Overall Rating: A²)

3.1 Relevance (Rating: ③³)

3.1.1 Consistency with the Development Plan of Thailand

At the planning phase of the project, "Master Plan on Water Resource Management" was formulated in consideration of the substantial damage caused by the 2011 flood. The master plan had three goals, including to "prevent and minimize loss and damages from medium- and large-scale flood". In addition, the master plan includes the "Action Plan of Integrated and Sustainable Flood Mitigation in the Chao Phraya River Basin" with a medium-term perspective. The plan mentioned measures to secure a means of transportation in the event of a flood as "a work plan for response to specific area." In addition, this project was included in the medium-term plan among DOH's development program (emergency recovery, medium-term plan, long-term plan) on flood control.

At the time of the ex-post evaluation, the plan succeeding the Master Plan on Water Resource Management was still in the process of obtaining government approval. The Thai government still used the master plan. In addition, the DOH formulated The Highway Development Plan to Mitigate Impact of Disaster (2014) during the project implementation. This plan covered the period from 2017 to 2022 and planned to improve road standards (widening and elevating) for securing transport during floods in central Thailand (11 provinces) and proposed the improvement of Route 305 which lays adjacent to the improved section of Route 9 under this project.

The project purpose of this project included "ensuring transportation of the industrial road between Bangkok and Ayutthaya at the time of flood" and this part is consistent with the reduction of flood damage in the area near the Chao Phraya River, which the Master Plan on

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

³ ③: High, ②: Fair, ①: Low

Water Resource Management aimed at. At the time of planning, this project was included in the medium-term plan among the flood control plans of DOH. At the time of the ex-post evaluation, the sector plan to ensure traffic during floods in central Thailand was formulated. The national road adjacent to the improved section of the project was included in the plan. Therefore, it is concluded that ensuring transportation at the time of floods was emphasized in the project area at the time of both planning and at ex-post evaluation. Thus, the purpose of this project was consistent with the content of the plans.

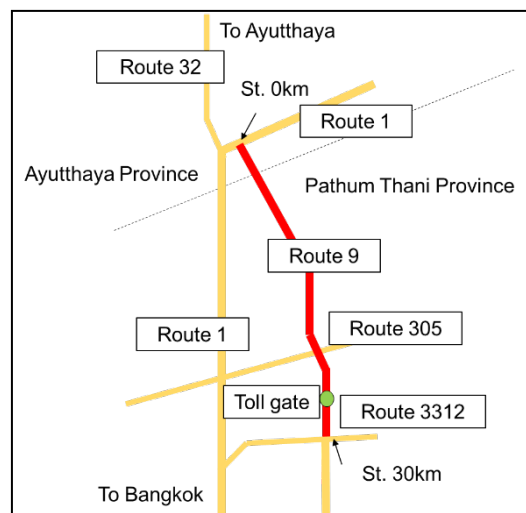


Figure 1: The improved section of Route 9 (in red)

3.1.2 Consistency with the Development Needs of Thailand

At the planning phase of the project, Route 9 was a part of the logistically important road connecting the industrial area near Ayutthaya with Suvarnabhumi International Airport, Laem Chabang Port and the Eastern Seaboard Area. Many domestic companies and foreign companies had operational sites in the industrial parks near Ayutthaya. As the flood in 2011 inundated the highway for about a month and severely affected road transport, both Thai companies and global companies encountered problems in their supply chain. Route 9 had a section parallel to Route 1, which passed through the center of Bangkok. On the other hand, Route 9 was an outer ring road and more efficient in terms of travel time. In addition, Route 9 was a wide motorway with four lanes on each side and an industrial road suitable for freight transportation.

At the time of the ex-post evaluation, Route 9 remains a part of the main road linking the industrial area near Ayutthaya to important logistical destinations. Among the major industrial parks in Ayutthaya Province, four industrial parks (Rojana, Hi-Tech, Bang Pa-In, and Saha rattana nakorn) have available data for both “before” and “after” the project. In these industrial parks, the number of companies increased from 448 companies before the project (2011) to 517 companies at the time of the ex-post evaluation (2018). The number of Japanese-affiliated companies increased from 269 before the project (2011) to 278 at the time of ex-post evaluation (2018). Throughout the project period, the industrial area near Ayutthaya maintained its position as a major manufacturing site for both Thai and global companies.

The importance of the Route 9 in logistics has not changed between “before” and “after” of the project. The section of Route 9 improved by this project is a part of the main road linking the industrial area near Ayutthaya to important logistical locations and the Route 9 can transport

freight more efficiently than the Route 1. At the time of both planning and ex-post evaluation, the industrial area near Ayutthaya has been an important manufacturing site for Thai and global companies.

3.1.3 Consistency with Japan's ODA Policy

At the planning phase of this project, the Ministry of Foreign Affairs' Country Assistance Policy for the Kingdom of Thailand (2012) stated that Thailand accepted Japanese-affiliated companies (the Japanese Chamber of Commerce, Bangkok had 1,400 members) and had become a partner of important economic activities in regards to the significance of the assistance to the country. The basic goal of the Country Assistance Policy was the "promotion of mutual benefit and contribution to regional development, based on strategic partnership." In addition, priority areas included "sustainable economic development and responses to a matured society" and in line with the 2011 flood, mentioned the acceleration of flood protection. As this project improved the highway and the road improvement work benefitted Japanese-affiliated companies in the Ayutthaya area, the project is relevant with the significance of the Country Assistance Policy (emphasizing that the country was an economic partner for Japan) and the basic strategy of the policy (benefits both sides based on strategic partnership). In addition, specific measures in priority areas include the promotion of measures to cope with the 2011 flood, which is consistent with the project scope of this project (raising the highway for the preparation of floods).

This project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

Out of the four north-bound lanes of Route 9 (section from Station 0 km to Station 30 km), the project carried out work on some sections in which the road was not high enough and prone to flooding. Regarding the work to raise the height, the road was designed for a flood level set in consideration of the large-scale flood in 2011 (3.089 m to 3.588 m above sea level). In the event of a flood with a similar level as the 2011 flood, two lanes of the rehabilitated road would not be inundated, and the remaining two lanes would be flooded up to a maximum of 20 cm, which is a level at which cars could still travel. The planned and actual outputs of this project are as shown in the following table.

Table 1: Output of the Project (Plan and Actual)

Plan	Actual
a) Civil Work <ul style="list-style-type: none"> • Raising Work (Route 9 (Section from Station 0km to Station 30 km), four lanes of the north bound, total length of improvement approximately 15 km) • Construction of toll station (10 toll booths, raising of maintenance sidewalk) • Interchange b) Consulting services <ul style="list-style-type: none"> • Tender assistance • Construction supervision* 	a) Civil Work <ul style="list-style-type: none"> • Raising Work (Route 9 (Section from Station 0km to Station 30 km), four lanes of the north bound, total length of improvement approximately 12 km) • Interchange b) Consulting services <ul style="list-style-type: none"> • Same as the plan (left)

Source: documents provided by JICA, answers for the questionnaire to the executing agency

Note: * In consideration of the urgency of this project, the detailed design (D/D) was carried out within the preparatory survey after G/A. Therefore, the consulting service of this project did not include D/D.

Major changes in the technical specification of this project were: 1) the toll station and its surroundings were excluded from the project, 2) a change in the method of raising work, and 3) an increase in the number of lanes for the temporary detour road. On the first point, the Thai side changed the project's output by deciding to expand/install 15 additional toll booths in each direction at their own expense. By the time of the ex-post evaluation, construction work for the additional toll booths (both northbound and southbound traffic) and the surrounding sections had been completed. On the second point, after a quality examination of existing paved sections with a height of less than 30 cm, it was decided to undertake overlay⁴ instead of new construction. However, the planned height of the road had not changed. On the third point, temporary detour roads were increased by two lanes (from three lanes to four lanes, for both northbound and southbound traffic) to mitigate traffic congestion and prevent traffic accidents during construction.



Photo 1: Section surrounding the Toll Station (Out of the Project Scope)

3.2.2 Project Inputs

3.2.2.1 Project Cost

In this project, the project scope was significantly changed by the Thai side decision to implement work out of the original project scope. Due to the difference between the planned and the actual project scope, the planned and actual amounts for the total project cost were not comparable. Furthermore, the actual cost borne by the Thai side during the project period was

⁴ Work to put a new layer of asphalt concrete on existing pavement

not made explicit. For these reasons, a comparison was made only for the planned and actual amounts of the costs borne by the Japanese side.

The Japanese side cooperation amount was estimated at JPY 5,480 million in the planning phase. The cost reduction associated with the above-mentioned output change calculated at 740 million yen (for construction of additional toll stations and work on surrounding sections) was taken out of the project scope. The recalculated planned cost to be borne by the Japanese side reflecting this reduction was JPY 4,740 million. The actual cost was JPY 3,926 million, 83% of the recalculated planned cost for the Japanese side, and within the plan. The actual cost breakdown was civil work 3,717 million yen and consulting service 209 million yen. The decrease in the cost for the Japanese side was mainly due to a highly competitive tender. Six companies bid for the civil engineering contract of this project, and the winning contract price was approximately 60% of the estimated price.

On the cost borne by the Thai side, it was difficult to compare the planned and actual amounts because the Thai side costs could not be calculated during the project period⁵. However, it was assumed that there was no significant increase because land acquisition was not conducted during the project period and the Thai side costs were mainly related to payment of fees.

Table 2: Project Cost of the Project (Plan and Actual)

	Plan	Plan (Adjusted)	Actual	% of Plan
Cost for Japanese side	JPY5,480 million	JPY4,740 million	JPY3,926 million	83%
Cost for Thai side	JPY6.7 million	—	—	—
Total Project Cost	JPY5,486.7 million	—	—	—

Source: Ex-ante evaluation report, documents provided by JICA

3.2.2.2 Project Period

While the planned project period was 24 months (January 2013-December 2014), the actual was 28 months (January 2013-April 2015). The actual project period was 117% of the plan and exceeded the plan⁶. The project period was extended because the change of the project scope related to the construction of additional toll stations and work on its surrounding sections required a design review.

Table 3: Project Period of the Project (Plan and Actual)

Plan	Actual
Project period: January 2013 - December 2014 (24 months)	Tender Period: January 2013 - May 2013 (5 months)
	Construction Period: June 2013 - April 2015 (23 months)

Source: documents provided by JICA

⁵ The cost born by the Thai side was 1,180 million baht, including the construction of the additional toll booths and related improvement work areas to surrounding sections.

⁶ The start of the project was defined as the commencement of the consulting service contract, and the plan assumed that the commencement of the consulting service contract was that of tender preparation.

Although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness and Impacts⁷ (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the planning phase of this project, “the number of impassable days due to flooding” was set as an effect indicator but a target year was not set for the indicator. Given the content of the indicator, it would be achieved at the time of project completion and the same target value would be maintained until the ex-post evaluation. Since the ex-post evaluation of a road sector project would generally analyze traffic volume as the quantitative effect of any newly constructed or upgraded infrastructure, the indicator was used as the operation indicator. However, the main purpose of this project is to secure traffic in the event of a flood. For this reason, in order to judge the project’s Effectiveness and Impact, the target traffic volume was assumed to be the same level as 2010 and an equal weight was applied to both indicators (“the number of impassable days due to flooding” and “traffic volume”).

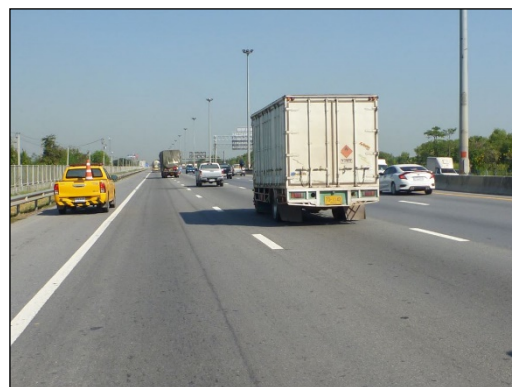


Photo 2: The Section Improved
by this Project

(1) Traffic Volume (Annual Average Daily Traffic)

As shown in the following table, DOH continuously collected traffic volume at two locations in the north-bound lanes of the section improved by this project (the section from Station 0 km to Station 30 km). The breakdown of traffic volume in 2010 and 2017 is shown in Table 5 and Table 6. In a “Before” and “After” comparison of the project, the traffic volume at both locations was on the rise, and eventually achieved its target (2010 traffic volume). Meanwhile, since the traffic volume of trucks was also on the rise, it is judged that at the time of the ex-post evaluation the project road was being used as an industrial road.

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

Table 4: Annual Average Daily Traffic (Route 9, north-bound)

unit: vehicles/day

	Baseline	Target	Actual		
	2010	2017	2015	2016	2017
		2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion
Annual Average Daily Traffic (Station 1.50 km)	25,001	Same as left	42,479	48,935	64,127
Annual Average Daily Traffic (Station 20.50 km)	29,596	Same as left	57,442	65,619	64,382

Source: documents provided by JICA and the executing agency

Note: The target level is assumed to be the same level as 2010 because the main purpose of this project is to secure traffic during floods (not increase traffic).

Table 5: Breakdown of Traffic Volume by Type of Vehicle (Route 9, Station 1.50 km)

unit: vehicles/day

Types of Vehicle	2010	2015	2016	2017
Car (7 person or less)	6,017	8,616	10,914	21,590
Car (8 person or above)	4,910	7,813	6,119	7,277
Minibus	39	164	146	74
Medium Bus	0	74	102	41
Bus	55	168	242	200
Mini Truck (4 wheel)	6,398	10,088	14,737	23,027
Truck (6 wheel)	2,737	4,982	5,697	3,828
Truck (8 wheel)	2,392	3,412	3,767	2,991
Double Truck	2,453	3,828	3,833	2,902
Trailer Truck	0	3,334	3,378	2,197
Total	25,001	42,479	48,935	64,127

Source: documents provided by the executing agency

Table 6: Breakdown of Traffic Volume by Type of Vehicle (Route 9, Station 20.50 km)

unit: vehicles/day

Types of Vehicle	2010	2015	2016	2017
Car (7 person or less)	7,470	14,240	13,973	19,555
Car (8 person or above)	2,862	12,622	11,014	9,802
Minibus	15	78	92	54
Medium Bus	17	102	151	46
Bus	69	190	243	170
Mini Truck (4 wheel)	12,465	8,322	19,126	22,373
Truck (6 wheel)	2,710	6,846	6,924	3,982
Truck (8 wheel)	1,502	5,602	4,707	2,842
Double Truck	2,486	3,990	4,986	2,861
Trailer Truck	0	5,450	4,403	2,697
Total	29,596	57,442	65,619	64,382

Source: documents provided by the executing agency

(2) The Number of Impassable Days Due to Flooding

As shown in the following table, since project completion, the section improved by the project has not incurred a full day in which the road became impassable. The annual precipitation for 2017 in Central Thailand was approximately 30% more than that of the past 30 years (2017: 1,649 mm, average: 1,276 mm). Nevertheless, the section improved by the project had not been impassable for any full day in that year and the freight transportation using Route 9 had not stopped. From the above, it is judged that this indicator achieved the target.

Table 7: The Number of Impassable Days Due to Flooding

unit: day/year

	Baseline	Target	Actual		
	2011	2017	2015	2016	2017
		2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion
The Number of Impassable Days Due to Flooding	10	0	0	0	0

Source: documents provided by JICA and the executing agency

Note: Although the target year was not set in the planning phase, the target was expected to be achieved at the project completion and to be maintained until the ex-post evaluation.

3.3.1.2 Qualitative Effects (Other Effects)

As part of this ex-post evaluation, interviews were conducted with logistics officers and drivers⁸ of the companies that had operation sites in the industrial parks in Ayutthaya Province. In addition, a focus group discussion⁹ with the executing agency staff was carried out to understand the qualitative effects of the project. The results of the information collected are as follows.

(1) Project Effects during Stormy Weather

Drivers stated that the risk of slippage was reduced after the project as the road surface became less puddled in times of rain. The executing agency staff's focus group discussion found that, after the project, the clogging of drainage pipes was resolved and the adverse effects of stormy weather on logistics were reduced as a project effect. According to the logistics officers, traffic accidents that occurred in rainy conditions caused traffic congestion for about 1 to 2 hours. Arrivals and shipments of cargo had not been delayed due to long period road closures. On the other hand, in "Before" and "After" comparisons, logistics officers were not aware of any noticeable improvement in arrival times. As Route 9 was a high-standard

⁸ On December 12-14 and 24, 2018, key informant interview was conducted at 13 companies (10 Japanese-affiliated companies, 2 foreign companies, 1 Thai company) in 4 industrial parks in Ayutthaya Province (Rojana, Hi-Tech, Bang Pa-In, and Saha rattana nakorn).

⁹ On December 17, 2018, seven DOH staff engaged in planning, implementation, operation and maintenance of the highway improved by this project participated in the focus group discussion.

motorway even before the implementation of this project, it was presumed that regularity of cargo transport had already been secured.

(2) Driving Comfort

Truck drivers stated that, irrespective of weather conditions, driving comfort had improved. Specifically, after the project completion, both pavement surface unevenness and vibration were reduced. As a result, the drivers had the opinion that driving comfort was improved and fatigue was reduced. The focus group discussion conducted by the executing agency staff mentions: that the road surface condition improved due to the use of road pavement materials more resistant to wear; that logistics became smoother not only under stormy weather; and that traffic accidents were reduced.

3.3.2 Impacts

3.3.2.1 Intended Impacts

This project had not set an indicator to quantitatively measure impact at the planning phase. For this reason, this ex-post evaluation set indicators on impact and made a “Before” and “After” comparison of the project.

(1) Traffic Volume in Adjacent Sections in the Ayutthaya Province

As shown in Figure 1, Route 9 is connected to Route 1 and Route 32 in Ayutthaya Province. By comparing the traffic volume in 2010 with that of 2017 (Average Daily Traffic for Route 1 and Annual Average Daily Traffic for Route 32), both total traffic volume and the traffic volume of trucks increased in Route 1. For Route 32, the traffic volume of trucks (2010: 48,158 vehicles, 2017: 52,204 vehicles) increased but the total traffic volume decreased (see the table below). From the traffic volume of the adjacent sections, it is judged that the logistics related to the industrial parks in Ayutthaya were active. The inflow from Route 1 affected the traffic volume increase in the above sections, therefore the traffic volume may not be considered solely by the improvements of this project. Nevertheless, by securing safe traffic routes unaffected by weather conditions, it is inferred that this project partially contributed to an increase in trucks for the adjacent sections in Route 1 and Route 32, both of which are major logistical routes.

Table 8: Breakdown of Traffic Volume by Type of Vehicle (Route 1, Station 60.80 km)

unit: vehicles/day

Types of Vehicle	2010	2015	2016	2017
Car (7 person or less)	26,546	40,266	38,620	40,214
Car (8 person or above)	16,732	17,984	19,402	21,032
Minibus	6,119	5,183	6,107	7,113
Medium Bus	790	704	1,608	2,237
Bus	3,004	5,625	6,280	7,280
Mini Truck (4 wheel)	10,406	13,451	14,331	15,558
Truck (6 wheel)	6,623	11,874	12,853	14,177
Truck (8 wheel)	6,837	7,878	8,770	9,432
Double Truck	5,125	7,075	7,962	8,588
Trailer Truck	4,652	6,188	6,934	7,562
Total	86,834	116,228	122,867	133,193

Source: documents provided by the executing agency

Table 9: Breakdown of Traffic Volume by Type of Vehicle (Route 32, Station 1.24 km)

unit: vehicles/day

Types of Vehicle	2010	2015	2016	2017
Car (7 person or less)	30,526	46,510	32,438	33,034
Car (8 person or above)	28,687	6,636	8,351	9,169
Minibus	13,203	4,860	8,533	8,854
Medium Bus	12,585	2,254	6,129	6,385
Bus	13,473	579	5,457	5,681
Mini Truck (4 wheel)	11,842	33,838	27,265	27,679
Truck (6 wheel)	10,814	6,362	6,007	6,296
Truck (8 wheel)	9,669	3,575	6,237	6,428
Double Truck	8,780	2,428	5,951	6,119
Trailer Truck	7,053	3,090	5,787	5,882
Total	146,632	110,132	112,155	115,527

Source: documents provided by the executing agency

(2) Number of Companies in the Major Industrial Parks in Ayutthaya Province

After the large-scale flood in 2011 there were concerns that companies would withdraw from the industrial parks in Ayutthaya Province. In this ex-post evaluation, “Before” and “After” information of the project was available from four major industrial park locations in Ayutthaya Province (Rojana, Hi-Tech, Bang Pa-In, and Saha rattana nakorn). The number of companies with operational sites in these industrial parks increased from 448 before the project (2011) to 517 at the time of the ex-post evaluation (2018). The number of Japanese affiliated companies increased from 269 before the project (2011) to 278 companies at the time of the ex-post evaluation (2018) (see the following table). Companies did not withdraw despite the concerns raised after the flood in 2011. The management company of Rojana Industrial Park stated that Route 9, a disaster resistant highway with high standards, was one of the factors contributing to the attraction of the industrial park. As the number of companies with operational sites in

the industrial parks increased, it is inferred that this project partially contributed to increased industrial production in Ayutthaya Province.

Table 10: Number of Companies in the Major Industrial Parks in Ayutthaya Province

unit: companies

Name of Industrial Parks	Total		Japanese-affiliated	
	2011	2018	2011	2018
Saha rattana nakorn	90	96	32	36
Hi-Tech	115	143	74	72
Bang Pa-In	25	36	16	20
Rojana	218	242	147	150
Total	448	517	269	278

Source: JETRO, Industrial Estate Authority of Thailand, and Rojana Industrial Park

(3) Plan to Use Route 9 at the Time of Floods

Companies having operational sites in the industrial parks in Ayutthaya Province were interviewed in order to assess their plans to use Route 9 in the event of a flood. Interviewed companies suggested that it was difficult to make a precise plan to use a specific road in their business continuity plans because of the difficulty in making assumptions regarding the situation after a flood had occurred. However, a logistics company did have a plan in case of a large-scale flood, to use Route 9 in order to relocate its operation site and move cargo to Laem Chabang Port. Another logistics company stated that the company may use Route 9 for moving cargos because their customer's flood relocation site was located near Bangkok. Furthermore, a manufacturing company also assumed that they would use Route 9 to move to an evacuation site.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

At the planning phase, this project was classified into Category B¹⁰ based on the "Guidelines for Environmental and Social Consideration" of the Japan International Cooperation Agency (2010). The project did not require an environmental impact assessment under the laws/regulations of the country because the project expanded the existing roads. During the construction period of the project, the contractor conducted environmental monitoring (such as air quality, water quality and vibration/noise) every three months in line with the monitoring plan, and the construction supervision consultant examined the monitoring results. According to the interview with the construction supervision consultant, no serious issue in violation of the environmental standards occurred. Furthermore, mufflers on construction vehicles were

¹⁰ For Category B, the impact affects the site itself in general, such that there is little irreversible impact, and ordinary measures can deal with environmental impact.

replaced to control exhaust gas during the project implementation. As the civil work of this project mainly involved raising existing roads, there was no new land acquisition, and additional environmental and social burdens can be considered insignificant. According to the executing agency, although environmental monitoring has not been conducted since the project completion, no issues have been raised by the environmental authority. According to the executing agency, the area around the improved roads was farmland located away from residential areas and residents had not complained about noise.

(2) Resettlement and Land Acquisition

As aforementioned, land acquisition and resettlement were not conducted as the project expanded the existing road.

(3) Prevention Measures for Traffic Accidents during the Construction Phase

As Route 9 was a motorway with fast moving vehicles there were concerns that traffic accidents would increase due to a sharp reduction of road-width and sudden curves necessary for road construction detours. Therefore, this project took the following measures for the prevention of traffic accidents during construction.

- Evacuation spots were set every 500m for prevention of secondary accidents
- Warning leaflets were distributed at the toll station one week before changing a detour route (distributed at every time when changed lanes in a detour route, three times in total).
- Signboards were installed 1km before the detours
- Construction work were broadcast by radio announcement

Although traffic accident measures were implemented, both the number of accidents per year and per 10,000 passing vehicles for section Station 0 km to Station 35 km on Route 9 including the target section of this project increased during the period from 2013 to 2014 in the construction phase (see the following table). However, if traffic accident measures were not taken, the number of accidents might have been greater. The effectiveness of traffic accident measures cannot be determined.

Table 11: Numbers of Accidents per Year and per 10,000 Passing Vehicles for Route 9
(Section from Station 0 km to Station 35 km)

	Numbers of Accidents per Year (Vehicles)	Annual Average Daily Traffic* (Vehicles/Day)	Numbers of Accidents per 10,000 Passing Vehicles (Vehicles)**
2010	73	54,131	0.0369
2011	94	81,630	0.0315
2012	137	88,470	0.0424
2013	150	97,019	0.0424
2014	195	105,620	0.0506
2015	135	108,693	0.0340
2016	128	118,760	0.0295
2017	114	118,955	0.0263

Source: documents provided by the executing agency

Note 1: * Average of Station 1.50km and Station 20.50km

Note 2: ** Number of accidents per year ÷ (Annual average daily traffic x 365 days) x 10,000 vehicles

This project has largely achieved its objectives. Therefore effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional / Organizational Aspect of Operation and Maintenance

At the time of the ex-post evaluation, the executing agency DOH conducted operation and maintenance of the section improved by this project. DOH's division of work related to operation and maintenance activities on the improved section of the road is as follows.

Inter-City Motorways Division: The division was responsible for intercity motorway activities such as (1) formulation of construction and maintenance plans, and (2) management of toll revenue (Route 7 and Route 9). DOH had a total staff of 50, of which 15 were engineers.

Intercity Motorway District: The district was responsible for intercity motorway activities such as (1) implementation of routine maintenance, and (2) procurement of periodic maintenance (Route 7 and Route 9). A total of 40 staff, of which 10 were engineers. The district was not engaged in periodic maintenance directly because periodic maintenance was outsourced to contractors.

Regarding periodic maintenance, the DOH conducted quality tests of materials, and the committee within the DOH reviewed the quality inspection of civil works after construction and decided on acceptance of the civil works. Based on the interviews with the staff engaged in maintenance work at the Intercity Motorway District, their opinion was that the district did not face a shortage of staff and, thus, the number of staff did not negatively affect maintenance work.

The division of responsibilities for operation and maintenance was clear, and no problems were pointed out on staffing levels of the district directly involved in the maintenance of the project facilities. An institutional/organizational arrangement was in place for quality control of the operations commissioned to the private sector. Therefore, it is judged that in terms of the institutional/organizational aspect there is no problem that could affect the sustainability of the project effects.

3.4.2 Technical Aspect of Operation and Maintenance

The improvement work by this project was mainly raising the height of the motorway, and the technology level required for operation and maintenance was considered the same as that of the existing motorways. As the Intercity Motorway District was engaged in the operation and maintenance of motorways before the implementation of the project, the district is considered to have acquired the skills for the operation and maintenance of the section improved by the project.

The DOH prepared road maintenance manuals, and the staff of the Intercity Motorway District could obtain the manuals via the Internet and use them for operation and maintenance. The road maintenance manuals covered both routine maintenance and regular maintenance.

The DOH carried out regular training once a year for staff engaged in operation and maintenance, for activities such as planning, technical specifications, inspections, and contract management. For DOH, approximately 100 people participated in the training annually. In addition, E-learning training on maintenance was also set up, and about 100 people participated in the training annually. According to interviews with staff engaged in operation and maintenance, the staff participated in training a few days every year (such as operation and maintenance, internal rules/procedures).

The improvement work by this project was raising the existing road height, and the executing agency could maintain the highway by its technical capacity. The manuals on operation and maintenance were prepared and the district in charge of operation and maintenance work used the manual. Staff engaged in the operation and maintenance activities had opportunities to participate in training, and the training contents included quality inspection after construction work. Therefore, it is judged that there is no problem that could affect the sustainability of the project effects in terms of the technical aspect.

3.4.3 Financial Aspect of Operation and Maintenance

For the toll roads managed by DOH (Route 7 and Route 9), the budget for operation and maintenance was allocated from the toll revenue of these highways. Toll revenues were pooled in a fund managed by the Ministry of Finance. The fund was separated from DOH's general

budget and could not be spent on operation and maintenance of roads other than the Route 7 and the Route 9.

The revenue of the toll roads under DOH and the expenditure for operation and maintenance are as shown in the following table. The expenditure for operation and maintenance in the past three fiscal years¹¹ was less than the toll revenue. The expenditure for operation and maintenance covered routine maintenance, periodic maintenance, and emergency maintenance. "Other operating expenses" are mainly personnel expenses for DOH staff. According to the interview with DOH staff, the toll revenue is enough for routine maintenance and can cover periodic maintenance to a certain extent.

Table 12: Toll Road Revenue under DOH and the expenditure for operation and maintenance (Route 7 and Route 9)

	unit: million baht		
	2015	2016	2017
Toll Revenue	5,366.5	5,663.2	6,024.0
Expenditure for operation and maintenance	3,603.8	4,730.4	3,944.2
Maintenance	903.7	1,489.1	1,192.2
Other operational maintenance	2,700.1	3,241.3	2,752.0

Source: documents provided by the executing agency

It is concluded that in terms of the budget for operation and maintenance, the amount necessary to operate and maintain the portion of the highway improved by the project was allocated. The toll revenue was separated from the executing agency's general budget and is not affected by the budget allocation to the executing agency. Therefore, it is judged that in terms of the financial aspect there is no problem that could affect the sustainability of the project effects.

3.4.4 Status of Operation and Maintenance

The maintenance activities that the Intercity Motorway District usually conducted are shown in the following table. Moreover, the district oversaw special maintenance (such as repair) and rehabilitation if a road is severely damaged.

Table 13: Maintenance Activities by the Intercity Motorway District

Type	Activities
Routine Maintenance	Pavement maintenance (cleaning, weeding, pot hole repair), maintenance of structures such as darning facilities and bridges, maintenance of traffic signs, road inventory*, etc.
Periodic Maintenance	Overlay, seal coat**, etc.

Source: Questionnaire answers and interview with the executing agency staff

Note 1: * Records on the present condition of road assets

Note 2: ** Work to disperse asphalt and aggregate on existing pavement and to perform surface treatment

¹¹ The fiscal year of the Thai government is from October 1 to September 30. For example, FY2017 started on October 1, 2016 and ended on September 30, 2017.

On the section improved by the project, inspection was conducted every day, and it was confirmed by site survey that routine maintenance such as cleaning, weeding, and pothole repair were properly conducted. After the project completion, routine maintenance had not been implemented on the project section. Due to heavy vehicle traffic, there were slight rutting and hair cracks of longitudinal direction on the outermost lane



Photo 3: Cracks on the Pavement

of Route 9. For the section from Station 10km to Station 30 km (north-bound lanes) of Route 9 including the section improved by this project, the International Roughness Index (IRI)¹² was 2.21 m/km on average for the four lanes and show no negative impact on driving comfort.

Subsidence after raising the height of the highway was a concern because the embankment structure for the section improved by this project was built on soft ground. According to the construction supervision consultant, the executing agency should have measured subsidence 6 months and one year after the completion, but the measurement was not carried out. The contractor did measure subsidence at the time of the defect inspection, and it was confirmed that no serious subsidence had occurred. Subsidence had not been measured after the defect inspection. Based on the interviews with the staff engaged in operation and maintenance, subsidence did not occur at the time of ex-post evaluation in the highway including the section with overlay on existing pavement.

Although minor damages were found on the project section, these were not serious damages which could negatively affect traffic. Operation and maintenance were properly implemented. Therefore, it is judged that there is no problem that could affect the sustainability of the project effects in terms of the current status.

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

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

By road improvement work (raising the height of the road), this project is to ensure that transportation in the event of flood conditions on the industrial road between Bangkok and Ayutthaya in the eastern part of the Outer Ring Road (Route 9) can remain open, thereby

¹² In general, IRI 4 m/km is considered the upper limit for comfortable driving at 80 - 100 km/h.

contributing to smooth logistics and increasing industrial production in the industrial areas that depend on the road. Consistent with the purpose of this project, the development strategy from the planning phase through to the ex-post evaluation maintained emphasis on ensuring traffic at the time of floods in the area near the project road. The implementation of this project is relevant to the development needs of Thailand and Japan's ODA policy and therefore, its relevancy is high. The actual cost of the Japanese side was within the plan. The project's scope change required a design change and therefore the project period exceeded the plan. Thus, its efficiency is fair. The traffic volume and the number of impassable days due to flooding achieved their targets. Regarding the confirmation of the qualitative effects of the project, an identifiable effect was realized for securing the traffic route under stormy weather. It is presumed that this project partially contributed to revitalizing logistics around the project area and increasing the number of enterprises in the industrial parks. Therefore, its effectiveness and impact are high. In terms of the organizational/institutional aspect, the executing agency set a clear division of responsibilities for operation and maintenance, and sufficient personnel were assigned. Regarding technical considerations, it is feasible to operate and maintain Route 9 with the executing agency's technological level. Regarding financial considerations, the toll revenue exceeded the expenditure for operation and maintenance and sufficient budget was allocated. In terms of the project's operation and maintenance current status, routine maintenance was properly implemented, and no serious damage was found in the infrastructure developed by the project. In consideration of the above factors, the sustainability of the effects is high for this project.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Examination of traffic accident measures and assessment of introduction in other works

The road improved by the project is a motorway. Drivers were prone to accidents due to fast driving speeds and the sudden decrease in the width of the road as well as increase in curves, caused by the installation of a construction roundabout. In fact, the number of accidents and the number of accidents per AADT 10,000 vehicles increased during the construction. However, this project took several preventative measures. During the construction, warning leaflets were distributed at the toll station one week before changing a detour route and the implementation of construction works was announced to alert to drivers via radio broadcast. These preventative measures for traffic accidents had not taken in Thailand ever. In order to prevent traffic accidents during construction of motorway, it is desirable for the executing agency to examine these measures and assess their introduction in other construction works.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

Monitoring when a maintenance work goes beyond routine activities

Since the road improved by this project had an embankment structure built on soft ground, significant subsidence could have damaged pavement after the construction. For this reason, the executing agency had agreed to measure subsidence at the 6 month and one year intervals after the completion, but the executing agency did not do so. It was not discovered that the executing agency did not measure subsidence in accordance with the agreement until the defect inspection. When a construction supervision consultant recognizes that the executing agency needs to carry out inspection beyond routine works (such as settlement measurement), it is desirable that the necessity should be shared with JICA and JICA office should monitor its implementation appropriately.