Thailand

Wat Nakorn-In Bridge and Connecting Road Construction Project (I) (II)

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Field Survey: September 2006

1. Project Profile and Japan's ODA Loan

Map of project area

Rama V Bridge (formerly the Wat Nakorn-In Bridge) constructed by this project

1.1 Background

A distinct lack of road capacity became apparent in the suburbs (which lie within the Outer Ring Road) due to the expansion of the urban zone in the Bangkok metropolitan area. Particularly in the area along the western bank of the Chao Phraya River from northern Bangkok to southern Nonthaburi Province, road congestion during the morning and evening rush hour became serious, because adequate bridges across the Chao Phraya River were not being built, even though farmland was rapidly being turned to residential and commercial use and traffic volume on existing roads and bridges was increasing markedly. In southern Nonthaburi Province, which is the site of this project, the only road bridges spanning the Chao Phraya River were the Phra Nang Klao Bridge toward the north and the Rama VII Bridge toward the south. Moreover, there were only two trunk roads which connected the Chao Phraya River and the Outer Ring Road, the northerly Rathan Thibet Road and the southerly Nakorn Chai Sri Road. For this reason, these roads and bridges experienced chronic congestion in the morning and evening; moreover, because no north-south trunk road existed in that area, vehicles that were bound north or south had to travel via central Bangkok, further exacerbating the traffic congestion in the metropolitan area.

1.2 Objective

The objective of this project is to ease traffic congestion in the Bangkok metropolitan region, particularly between the eastern and western areas (at the connection to the Outer Ring Road),

by constructing the Wat Nakorn-In Bridge on the Chao Phraya River and trunk roads (the East-West Road and North-South Road) that connect to it, thereby contributing to the economic development of the western part of the metropolitan area.

1.3 Borrower/Executing Agency

Borrower: Kingdom of Thailand

Executing Agency: Department of Rural Roads, Ministry of Transport

1.4 Outline of Loan Agreement

Item	Phase I	Phase II
Loan Amount/Loan Disbursed Amount	7,226 million yen/4,628 million yen	10,000 million yen/6,474 million yen
Exchange of Notes/Loan Agreement	September 1995/September 1995	September 1996/September 1996
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	2.7% 25 years (7 years) General untied	
Final Disbursement Date	July 2004	January 2005
Main Contractors	Italian-Thai Development PCL (Thailand), Sumitomo Construction Co., Ltd. (Japan)	CH. Karnchang Public Company Limited (Thailand), Thai Obayashi Corp., Limited. (Thailand) / Chainunt Construction co., Ltd (Thailand), M.C. Construction (1979) Co. Ltd. (Thailand), Sermsanguan Construction Co., Ltd. (Thailand) / Unique Engineering and Construction Co., Ltd (Thailand), Tokyu Construction (Japan), Kajima Corporation (Japan), etc.
Consultant Services	None	None
Feasibility Study (F/S), etc.	F/S 1998 (prepared by Thailand's Public Works Department, Ministry of Interior)	

2. Evaluation Result

2.1 Relevance

2.1.1. Relevance at time of appraisal

In the 7th National Economic and Social Development Plan (1992-1996), the three major goals are stated as (1) maintenance of solid economic growth, (2) dispersion of income to regional

areas, and (3) promotion of human resources development, environmental protection, and quality of life improvement. Development of the Bangkok metropolitan area, which is the center of political and social activity, is a necessity for maintenance of Thailand's solid economic growth. Promotion of infrastructure development in the Bangkok metropolitan area, and within that, solving the problem of traffic congestion in Bangkok, is one of the highest priority issues.

At the time of the appraisal (1995), there existed almost no mass transportation facilities in an orbital system in the Bangkok metropolitan area. Road transportation was the primary means of transportation, but development of the road network had not kept pace with the increase in the number of vehicles in the metropolitan area that was spurred by Thailand's economic growth, thus traffic congestion in the metropolitan area was steadily worsening every year. Moreover, the east-west flow of road traffic was restricted by the Chao Phraya River, and this further exacerbated the traffic congestion. At that time, there existed 12 bridges spanning the Chao Phraya River (including one for rail only), but it could not be said that the number of bridges was adequate. A priority issue for easing traffic congestion was construction of a new bridge, together with development of an efficient road network.

The area along the western bank of the Chao Phraya River from northern Bangkok to southern Nonthaburi Province, which is the site of this project, experienced a marked increase in traffic volume due to the rapid switch of farmland to residential and commercial use as the metropolitan area expanded. Moreover, in the area along the western bank of the Chao Phraya River, there were only two road bridges that crossed the Chao Phraya River and only two east-west trunk roads that connected the river to the Outer Ring Road. Also, there was no north-south trunk road in the area between the river and the Outer Ring Road, thus in the morning and evening, a serious congestion problem was created by vehicles traveling between central Bangkok and the Outer Ring Road. For this reason, construction of a new bridge and trunk roads was required for traffic traveling between the area along the western bank of the Chao Phraya River and central Bangkok, thus the relevance of this project was high.

2.1.2. Relevance at time of evaluation

In the 9th National Economic and Social Development Plan (2002-2006), priority was placed on the development goals of poverty eradication and rectification of the income gap. As a development strategy, the aim was to (1) develop human resources and the social security system, (2) develop sustainable rural villages and cities, (3) conduct natural resource management and environmental conservation, (4) implement macroeconomic policies, (5) strengthen national competitiveness, (6) strengthen science and technology, and (7) achieve

good governance. Among these, with regard to (5), the importance of increasing the efficiency of Thailand's logistics system and of developing the traffic system through improvements was mentioned.

In the Master Plan of Transport (1999-2006) prepared by Thailand's Ministry of Transport and Communication, emphasis is placed on the combination of diverse transportation modes in order to achieve efficiency and mass transport. One of the stated development strategies is strengthening of competitiveness in transportation systems.

The Wat Nakorn-In Bridge (currently known as the Rama V Bridge), the East-West Road (currently known as the Nakorn In Road), and the North-South Road (currently known as the Ratcha Phruk Road) which were constructed by this project connect the area along the western bank of the Chao Phraya River and metropolitan Bangkok and function as part of the road network along the western bank of the Chao Phraya River, which complements the Outer Ring Road road. Thus, the necessity of this project remains high.

2.2 Effectiveness

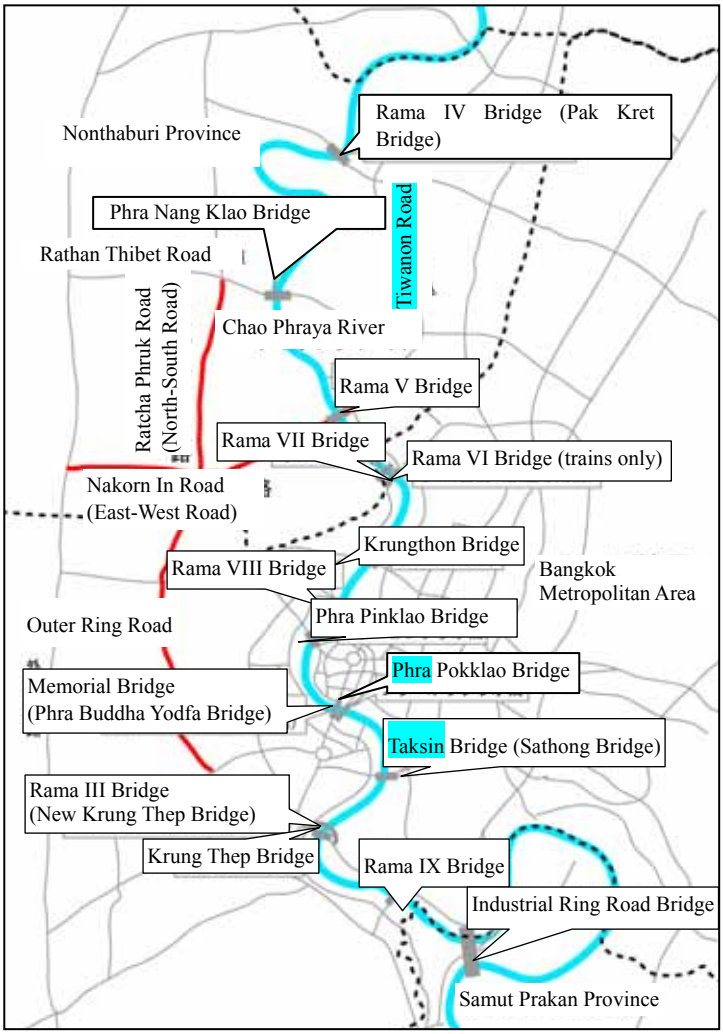
2.2.1 Outputs

The main outputs planned in this project were, in Phase I, the construction of Wat Nakorn-In Bridge (currently known as the Rama V Bridge) (total length 950 meters) and the East-West Road (currently known as the Nakorn In Road) (total length 12 km), and in Phase II, the construction of the North-South Road (currently known as the Ratcha Phruk Road) (total length 18 km). The outputs of this project were implemented as planned in both Phase I and Phase II.

2.2.2 Project Period

Whereas the overall project period for Phases I and II was September 1995 to December 1999 (4 years 4 months), the actual project period was September 1995 to December 2003 (8 years 4 months), representing a delay of 4 years, or 181% of the planned project period. The main reason for the delay of the project was a setback in the land acquisition (causing construction overruns of 66 months in Phase I and 24 months in Phase II). The delay was due to the time required for the Thai government to take budget measures for the land acquisition and was also due to the fact that, despite having received the consent of 90% of the landowners by the end of 1999 regarding the land acquisition, negotiations with some landowners concerning compensation became protracted because they were not satisfied with the amount of government compensation. This delay in land acquisition subsequently led to a delay in the overall construction period. Other reasons for the delay include the delay in selection of

Figure 1: Map of Project Site



consultants (causing a 13-month construction overrun in Phase I), the delay in selection of the contractors (causing an 8-month construction overrun in Phase I), and the delay in the construction (causing a 14-month construction overrun in Phase I and a 10-month overrun in Phase II).

2.2.3 Project Cost

Whereas the total project cost for Phases I and II was 54,196 million yen (of which the ODA loan portion was 17,226 million yen), the actual project cost was 39,038 million yen (ODA loan portion, 11,102 million yen), representing a cost underrun of 15,158 million yen, or 72% of the planned project cost. Looking at each phase, in Phase I whereas the planned project cost was 20,558 million yen (ODA loan portion, 7,226 million yen), the actual project cost was 15,794 million yen (ODA loan portion, 4,628 million yen), which is 77% of the planned project cost. In Phase II, whereas the planned project cost was 33,638 million yen (ODA loan portion, 10,000 million yen), the actual project cost was 23,244 million yen (ODA loan portion, 6,474 million yen), which is 67% of the planned project cost. The main reason that may be cited for the decrease in project cost is the savings on construction cost due to competitive bidding.

2.3 Effectiveness

2.3.1. Traffic volume

(a) 2005 traffic volume forecast

With regard to the traffic volume, because there is no data on the average annual daily traffic (AADT) (vehicles/day) for either the planned or the actual level, an evaluation was conducted using the comparative analysis results for hourly traffic volume during the morning and

evening peak times (PCU[1]/hour) which was obtained from an existing study implemented at the site.

Table 1: Comparison of Predicted and Actual Traffic Volume for 2005

Study Sites	Direction	Morning Peak (07:00~08:00)			Evening Peak (17:00~18:00)		
		Plan	Actual	% of Plan	Plan	Actual	% of Plan
Rama V Bridge	eastbound	826	2,816	341%	979	3,164	323%
	westbound	2,551	2,198	86%	2,583	3,118	121%
	total	3,377	5,014	148%	3,562	6,282	176%
Nakorn In Road (East-West Road) Point A	eastbound	1,134	2,062	182%	934	1,932	207%
	westbound	981	2,220	226%	1,120	3,959	353%
	total	2,115	4,282	202%	2,054	5,891	287%
Nakorn In Road (East-West Road) Point B	eastbound	1,143	2,378	208%	1,161	1,546	133%
	westbound	1,170	1,354	116%	1,326	1,646	124%
	total	2,313	3,735	161%	2,487	3,192	128%
Ratcha Phruk Road (North-South Road) Point C	southbound	475	1,789	377%	640	1,158	181%
	northbound	295	1,005	341%	432	1,540	356%
	total	770	2,794	363%	1,072	2,698	252%
Ratcha Phruk Road (North-South Road) Point D	southbound	1,249	2,196	176%	1,352	1,117	83%
	northbound	1,103	1,328	120%	1,647	2,037	124%
	total	2,352	3,524	150%	2,999	3,154	105%
Ratcha Phruk Road (North-South Road) Point E	southbound	1,394	1,972	141%	1,437	1,237	86%
	northbound	393	1,873	477%	802	1,309	163%
	total	1,787	3,845	215%	2,239	2,546	144%

Note: The predicted level for traffic volume for 2005 is adopted from an F/S prepared in 1991. For the Rama V Bridge, the predicted level for traffic volume is a prediction for 2006.
source: Ratcha Phruk Road Project Benefit Monitoring and Evaluation Report, 2005.

Figure 2: Traffic Volume Study sites

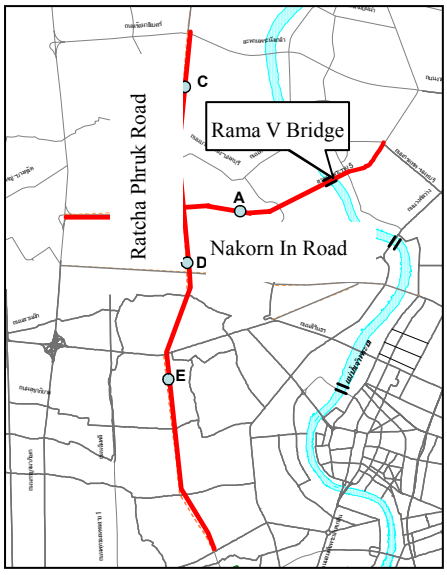


Table 1 offers a comparison of the predicted and actual traffic volume for 2005 during the morning and evening peaks on Rama V Bridge, Nakorn In Road (East-West Road), and Ratcha Phruk Road (North-South Road). [2] The actual traffic volume (total of both directions) ranges from a minimum of 1.05 times to a maximum of 3.63 times the volume predicted in the plan, thus the achievement ratio of the planned levels is extremely high. Factors attributable to the significant growth of the traffic volume over the predicted level include advances

[1] PCU (Passenger Car Unit) indicates the total number of vehicles (including trucks, buses, motorbikes, etc.) in terms of passenger cars. The figures for trucks, buses, motorbikes, and other vehicles are multiplied by fixed coefficients to convert them to units equivalent to passenger cars.

[2] Following the completion of the project, the names were changed. The Wat Nakorn-In Bridge became known as the Rama V Bridge. East-West Road became known as Nakorn In Road. North-South Road became known as Ratcha Phruk Road.

in the social and economic development of the area, acceleration of usage of project's roads by development and expansion of the road network along the western bank of the Chao Phraya River which connects to the project's roads (Figure 4), and the fact that the number of vehicles registered in Bangkok increased at an annual average of 6%, a rate that exceeded the population increase between 1991 and 2004, with registrations increasing from 210,000 vehicles in 1991 to 430,000 vehicles in 2004。

2.3.2. Number of traffic accidents

To the extent indicated by the official traffic accident figures, the average monthly number of traffic accidents was in an uptrend from 2005 through 2006.[3] Moreover, totaling the accident data for 2004 to 2006, 75% (66 cases) of accidents were concentrated on Nakorn In Road (East-West Road). The likely causes of this are the fact that the traffic volume is larger on Nakorn In Road than on Ratcha Phruk Road (North-South Road) and the fact that more motorbikes use Nakorn In Road. Moreover, there is a striking number of traffic accidents at the intersection of Nakorn In Road (East-West Road) and Ratcha Phruk Road, which is a rotary-type intersection. As a measure for this, it is necessary to change the rotary to an intersection with a traffic signal or to construct either an overpass (flyover) or underpass. The executing agency, the Department of Rural Roads in the Ministry of Transport, recognizes the need for this; a traffic signal has already been installed and is scheduled to be in operation by the first half of 2007.[4] The department is conducting a study concerning construction of an underpass in the future.

Table 2: Number of Traffic Accidents

	Accidents (cases)	Injuries (persons)	Fatalities (persons)
2004*	2 (0.2)	5 (0.6)	0 (0)
2005	32 (2.7)	32 (2.7)	8 (0.7)
2006	55 (4.6)	54 (4.5)	5 (0.4)

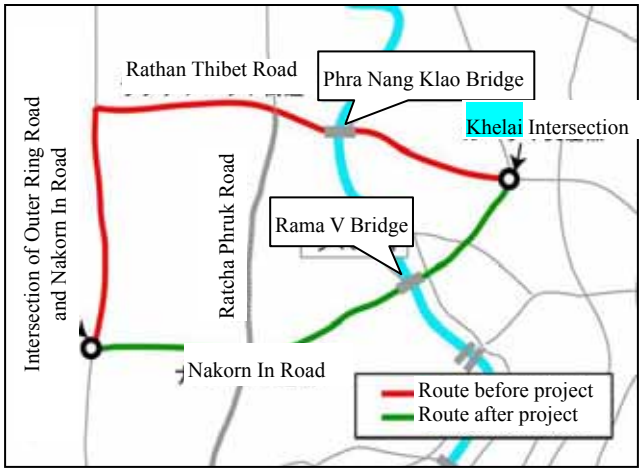
*Data for 2004 is for the nine-month period from April through December.
Figures in parentheses are monthly averages.
(source) Bureau of Maintenance and Road Safety, MOT

[3] Because the 2004 data is for the 9-month period from April to December, it cannot be directly compared to the data for 2005 and 2006. However, in view of the two accidents during the 9-month period, it may be surmised that average monthly accidents began their uptrend after 2004.

[4] As of February 2007, the installation of a traffic signal at the intersection of Nakorn In Road and Ratcha Phruk Road was completed, and discussions were held among Thailand's Ministry of Transport, local police, and local government concerning the method of operating the traffic signal.

2.3.3. Time saving

Figure 3: Two Specified Points on Each Side of the Chao Phraya River



Regarding time-saving effects, properly speaking, a comparison should be made of the travel time before and after project implementation and then the amount of time saved should be evaluated. However in the case of this project, there is no data on the travel time on a specified section of road prior to the project to serve as a basis for comparison. Thus for this study, two specified points were chosen provisionally on each side of the Chao Phraya River (the Khelai intersection on the east side of the Cha Phraya River and the interchange of the Outer Ring Road and Nakorn In Road (East-West Road) on the west side of Chao Phraya River). By measuring and comparing the travel time on the route used prior to the project (via Rathan Thibet Road and Phra Nang Klao Bridge[5]) and on the route after the project (via Nakorn In Road (East-West Road) and Rama V Bridge), an attempt was made to hypothetically evaluate the time-saving effects.

Table 3: Comparison of Travel Time on Two Specified Road Sections before and after the Project

	Route	Distance	Direction	Time Required (Minutes)		
				Morning Peak Time	Evening Peak Time	Off-Peak Time
Before Project	Rathan Thibet Road Phra Nang Klao Bridge	17.5 km	eastbound	45	29	20
			westbound	18	23	16
After Project	Nakorn In Road (East-West Road) Rama V Bridge	14.2 km	eastbound	14	18	11
			westbound	11	15	7.5

source: Results of sample study conducted in September and December 2006 by the evaluation study team.

Judging from the results of the sample study conducted at the time of ex-post evaluation, the travel time on the two specified road sections on each side of the Chao Phraya River was halved overall after the project versus before the project. The probable cause is that the new route after the project is shorter distance-wise and congestion is relatively low compared to prior to the project. However, because road traffic is now different from that in 1995 when this project was planned, the above analysis results are for reference purposes only. Meanwhile in the beneficiary survey, 88% of respondents acknowledged that the project was effective in shortening travel time. From the above, the project may be recognized as having had an effect

[5] Because naturally Nakorn In Road and Rama V Bridge did not exist prior to this project, it was assumed that, when passing through the area of the above-mentioned two road sections, vehicles generally used the existing Rathan Thibet Road and Phra Nang Klao Bridge.

on shortening travel time.

2.3.4. Congestion

Looking at the degree of congestion as of 2005,[6] the highest amount is 0.88 during the evening peak in the westbound lane at Point A on the Nakorn In Road (East-West Road). Other sites reached only 0.22 to 0.70 even at peak times, thus the flow of traffic on the project's roads and bridge is smooth overall. However, according to Nonthaburi Province, recently traffic congestion is occurring during the morning and evening peak times as the traffic volume is increasing. It is acknowledged that the congestion at Rama V Bridge in particular is becoming a bottleneck. The same problem was pointed out in the beneficiary survey.

Table 4: Congestion on Project's Roads and Bridge in 2005

(unit: traffic volume/traffic capacity)

Study Sites	Direction	Morning Peak (07:00~08:00)	Evening Peak (17:00~18:00)
Rama V Bridge	eastbound	0.63	0.70
	westbound	0.49	0.69
Nakorn In Road (East-West Road) Point A	eastbound	0.46	0.43
	westbound	0.49	0.88
Nakorn In Road (East-West Road) Point B	eastbound	0.53	0.34
	westbound	0.30	0.37
Ratcha Phruk Road (North-South Road) Point C	southbound	0.40	0.26
	northbound	0.22	0.34
Ratcha Phruk Road (North-South Road) Point D	southbound	0.49	0.25
	northbound	0.30	0.45
Ratcha Phruk Road (North-South Road) Point E	southbound	0.44	0.27
	northbound	0.42	0.29

source: Ratcha Phruk Road Project Benefit Monitoring and Evaluation Report, 222002005.

Nakorn In Road (East-West Road)

2.3.5. Economic Internal Rate of Return (EIRR)

The economic internal rate of return (EIRR) at the time of the plan was calculated by assuming a project life of 20 years, and calculating the costs of construction, consulting service, and operation and maintenance expense, and taking as benefits the effects of vehicle operation cost-saving and the effects of time saving. The EIRR in the Phase I was 22.8% and in Phase II was 24.9%. The EIRR for both phases was 21.3%. In the ex-post evaluation, when the EIRR was recalculated using the same conditions as at the time of planning, the EIRR in the Phase I was 43.7% and in Phase II was 42.2%. The EIRR for both phases was 37.8%. The reasons why the EIRR that was recalculated for the ex-post

[6] Meaning of degree of congestion figures: 1.5 and above = chronic congestion, 1.0 -1.5 = congestion primarily during morning and evening, less than 1.0 = smooth traveling.

evaluation exceeded that of the plan are because, while the benefits increased because the actual traffic volume far exceeded the predictions in the plan, the costs were reduced because the actual project cost was approximately 70% of the estimate in the plan, and as a result, the internal rate of return rose.

2.4 Impact

2.4.1. Impact on easing congestion

In the project plan, it was anticipated that one impact of the project would be easing of congestion. As is clear from the actual traffic volume in 2005 as shown on Table 1, on Rama V Bridge and Nakorn In Road (East-West Road), traffic volume is high in the eastbound direction during the morning peak and conversely in the westbound direction during the evening peak. Moreover on Ratcha Phruk Road (North-South Road), it can be seen that traffic volume is high in the southbound direction during the morning peak and conversely in the northbound direction during the evening peak. From this, a behavioral pattern can be discerned wherein residents of the northwestern suburbs of Bangkok, including Nonthaburi Province, travel into Bangkok in the morning via the two routes of Nakorn In Road (East-West Road)/Rama V Bridge and Ratcha Phruk Road (North-South Road), and in the evening this pattern is reversed when they travel from central Bangkok toward the northwest.

Table 5: Comparison of Traffic Volume in 2005 on 10 Major Bridges on the Chao Phraya River

(unit: PCU/hour)

	Morning Peak	Evening Peak
Rama V Bridge	5,014	6,282
Rama VII Bridge	3,520	3,877
Krungthon Bridge	2,996	4,475
Rama VIII Bridge	4,198	3,948
Phra Pinklao Bridge	6,345	7,260
Memorial Bridge	3,240	3,465
Phra Pokklao Bridge	6,140	3,926
Taksin Bridge	4,864	4,912
Rama III Bridge	4,247	3,327
Krung Thep Bridge	3,691	3,643

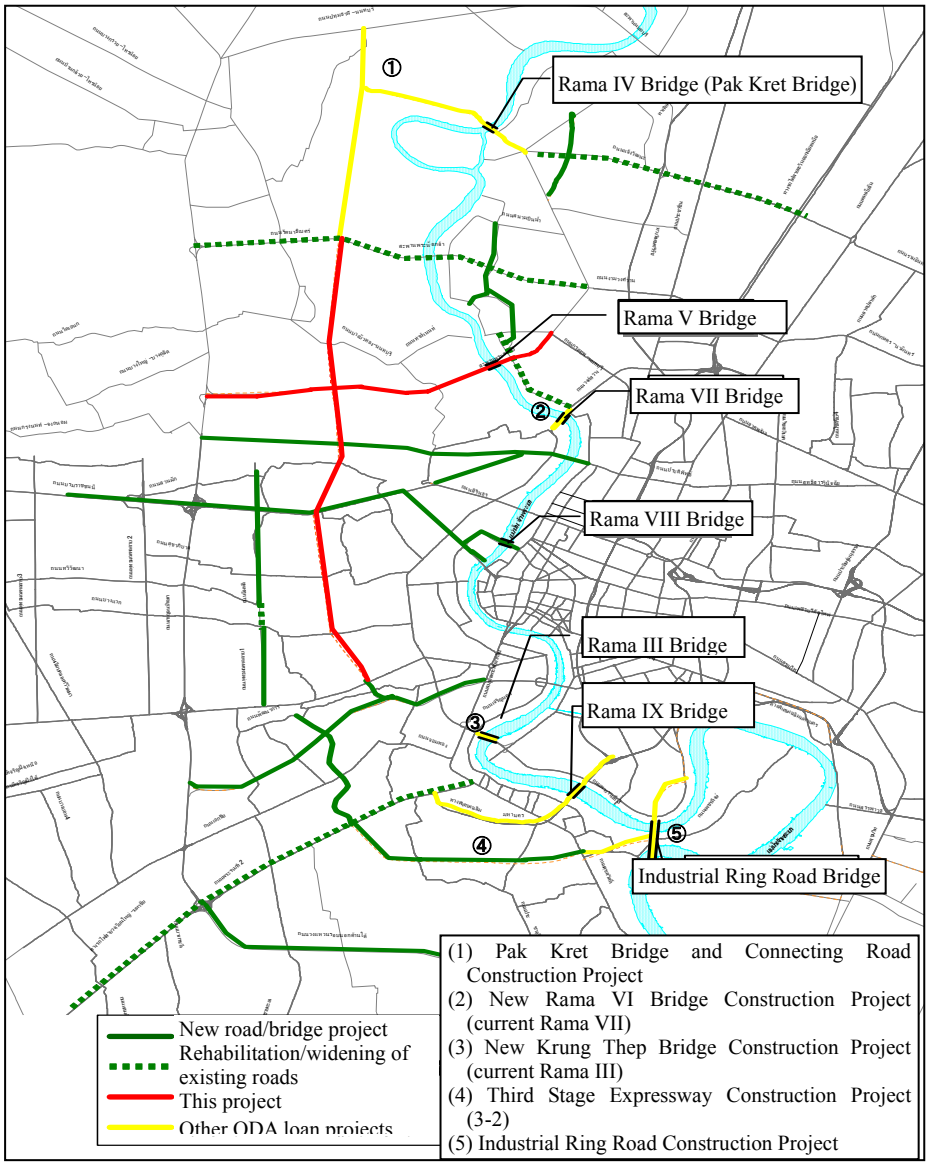
Note: Traffic volumes above are the total of eastbound and westbound traffic.

Source: Ratcha Phruk Road Project Benefit Monitoring and Evaluation Report, 2005.

Prior to project implementation, the most common route of land transportation between the northwest suburbs of Bangkok and the city center was via the Rama VII Bridge. Following project implementation, the available options for land transport were increased between the northwest suburbs of Bangkok and the city center due to the new development of the east-west route which connects to central Bangkok via Nakorn In Road (East-West Road) and Rama V Bridge and the new development of the north-south route which leads to central Bangkok via Ratcha Phruk Road (North-South Road). For this reason, many vehicles that previously used the route over Rama VII Bridge have begun to use the above-mentioned east-west route and north-south route. Table 5 displays the traffic volume in 2005 on 10 major bridges that span the Chao Phraya River. Rama V Bridge ranks third in terms of traffic volume during the morning peak and second during the evening peak, and this shows that, among the 10 major bridges, it is

a high-volume bridge, with many vehicles using it.

Figure 4: Development of Road Network on the West Side of Chao Phraya River since 1991



Moreover, as shown in Figure 4, since 1991 when the F/S for this project was conducted in the the project site area along the west bank of the Chao Phraya River, road development has proceeded simultaneously on new construction of other roads and bridges that include ODA loan projects and on widening of existing roads, greatly developing the road network in the area. As the road network develops, part of it, including this project's roads and bridge, are playing a role as a new route for commuting to work and school and for distribution, because it connects the area along the west bank of the Chao Phraya River and central Bangkok.

Furthermore, in the results of the beneficiary survey, 44% of respondents acknowledged that congestion was eased during the peak times. From the above, it may be surmised that this project had a certain impact on easing congestion on existing roads and bridges.[7]

2.4.2. Impact on promotion of regional development along the roads

In the project plan, it was anticipated that one impact would be promotion of regional development along the roads. Following project implementation, the building of residential and commercial developments in the project area progressed rapidly. For example, during the ten years from 1996 to 2006, there were a total of 60 residential construction projects (total area, 184 hectares) either completed or underway in all of Nonthaburi Province, and 6,144 housing units were constructed. The majority of those are located along Nakorn In Road (East-West Road) and Ratcha Phruk Road (North-South Road).

Moreover, the number of registered manufacturers and business in Nonthaburi Province increased by 26-fold, from 78 companies in 2000 to 1,989 companies in 2006. Of these 1,989 companies, 555 of them (28% of the total) are located in the city of Nonthaburi (Muang county), which is the site of this project. Of the 1,989 companies, those experiencing conspicuous increase are all housing or transport-related companies, including lumber processing (221 companies), furniture (209 companies), plastic manufacturing (112 companies), metal (284) companies, and transport (268 companies). As a matter of reference, central government offices, including the Ministry of Public Health, Ministry of Commerce, and Ministry of Justice, are relocating to Nonthaburi Province.

Table 6: Registered Manufacturers and Businesses in Nonthaburi Province

(unit: company)

	2000	2003	2004	2005	2006
Number of Manufacturers and Businesses	78	166	1,721	1,873	1,989

source: Nonthaburi Provincial Industry Office

Table 7: Gross Provincial Product (GPP) of Nonthaburi Province

(unit: million baths)

	1998	2003	2004	2005	% of increase
GPP	72,163	76,141	83,749	95,085	2.5%
Per capita GPP	791	1,014	1,083	1,158	5.4%

Note: The above are constant prices using 1998 as the baseline.
The percent of increase is the 8-year average for 1998-2005.
source: Office of National Economic and Social Development Board

Table 8 shows the changes in land usage in Nonthaburi Province from 2003 through 2006. During those four years, farmland decreased 29,254 rai (4,681 hectares), or 15%. Meanwhile, residential land increased by 24,454 rai (3,913 hectares). Environmental preserves increased

[7] However, to accurately understand the impact of the project on easing of congestion, it is necessary to conduct a separate macro-type study on time-series changes in traffic volume on existing roads and bridges in the project site, the condition of development of the overall road network in the Bangkok metropolitan area since 1991, and changes in the socioeconomic environment in the metropolitan area.

by 3,900 rai (624 hectare), and industrial and commercial land grew by 900 rai (144 hectare). In short, of the decrease in farmland, 83.6% was transferred to housing, 13.3% to environmental preserves, and 3.1% to industrial and commercial use. This substantiates the above-mentioned advance in development of residential and commercial land.

Table 8: Changes in Land Use in Nonthaburi Province from 2003 to 2006

(unit: rai; 1 rai =0.16 hectare)

Land Use Classification	2003		2004		2005		2006	
	Area	%	Area	%	Area	%	Area	%
Residential	151,521	38.96	151,695	39.00	170,796	43.91	175,975	45.24
Industrial/Commercial	4,900	1.26	5,200	1.34	5,800	1.49	5,800	1.49
Agricultural	193,293	49.70	191,779	49.31	170,478	43.83	164,039	42.18
Environmental Preserve Area	11,100	2.85	12,140	3.12	13,740	3.53	15,000	3.86
Education/Recreation	3,525	0.91	3,525	0.91	3,525	0.91	3,525	0.91
Government/Public Facilities	5,402	1.39	5,402	1.39	5,402	1.39	5,402	1.39
Roads and Streets	6,802	1.75	6,802	1.75	6,802	1.75	6,802	1.75
Rivers and Canals	12,396	3.19	12,396	3.19	12,396	3.19	12,396	3.19
Total	388,939	100.00	388,939	100.00	388,939	100.00	388,939	100.00

source: Nonthaburi Provincial Government

Table 9: Changes in Land Prices in the Project Site Area

(unit: million baths/hectare)

Location	Government purchase price (project period)	Publicly assessed price, 2004-2007
Nakorn In Road	25	49.6～87.5
Ratcha Phruk Road Section 1	16	25
Ratcha Phruk Road Sections 2 and 3	25	25～75

source: Land Department, Ministry of Interior

The land price in the project site area reflects the progress of development in the area, with a price increase of 1.6 to 3.5 times between the time the land was acquired for the project and the publicly assessed price for 2004 to 2007 (Table 9). Furthermore, in the results of the beneficiary survey as well, numerous people acknowledged as favorable impact the changes in the socioeconomic environment of the project site area, including the expansion of various private services, expansion of the housing business, population growth, and the rise in land prices. From the above, this project's impact on promotion of regional development along the roads may be adequately recognized.

2.4.3. Environmental Impact

In the project plan, it was anticipated that one impact would be environmental improvement due to reduction of exhaust gas as a result of easing of congestion on existing roads. To accurately grasp this impact, it would be necessary to collect the required scientific data by measuring air pollution such as SO^2, NO^2, and suspended particulate matter along the existing roads and to conduct a comparative analysis of the conditions before and after the project. However, such data does not exist. Moreover, no environmental monitoring study was implemented following project completion at the project site, and comparable scientific data

could not be obtained. Consequently, it is difficult to evaluate the project's impact on environmental improvement through reduction of exhaust gas. However, according to Nonthaburi Province, most of the road traffic in the project site is composed of small and medium vehicles, with few large vehicles passing through. For this reason, no major problems regarding exhaust gas, noise, or vibration are seen.

With regard to other environment-related impact, this project cut 1,198 trees (397 in Phase I; 801 in Phase II). Moreover, due to the population increase accompanying the expansion of housing construction projects that progressed rapidly following the project, there occurred a capacity shortage in the existing sewage treatment and garbage disposal facilities in the project area, creating a new issue for the local government.

2.4.4. Social impact of land acquisition and resident relocation

Despite having received the consent of 90% of the landowners by the end of 1999 regarding the land acquisition, negotiations with some landowners concerning compensation became protracted because they were not satisfied with the amount of government compensation. The land acquisition procedure itself was conducted appropriately, and aside from the delay, no significant problems occurred. Moreover, there was no resident relocation associated with the project. Table 10 shows a comparison of the planned and actual land acquisition.

Table 10: Comparison of Planned and Actual Land Acquisition

	Plan		Actual		
	Land area	Owners	Land area	Owners	Trees Cut
Phase I	83.20 ha	513 households	78.72 ha	537 households	397
Phase II	n.a.	367 households	117.60 ha	372 households	801
Total	-	880 households	196.32 ha	909 households	1,198

source: Department of Rural Roads, Ministry of Transport

2.4.5. Results of the beneficiary survey

In this study, a beneficiary questionnaire survey was conducted in order to understand what sorts of effects the project had on area residents' life and living environment. The subjects of the survey were 120 ordinary households located along the Nakorn In Road (East-West Road) and the Ratcha Phruk Road (North-South Road) as well as 30 local passenger

Interview survey of ordinary household

transport services[8] that operate in the project area. [9]

(1) Changes in means of transportation

The common means of transportation for ordinary households prior to project implementation were private car (47%), bus (48%), and boat (35%). In addition to land transport, inland water transport using canals, such as by boat, was commonly used. Following project implementation, there was a shift to private car (66%), bus (35%), motorbike (28%) and taxi (26%). There was a large shift from use of both land transport and inland water transport to use primarily of land transport, and there was an increase in the usage of private means of transportation, such as private cars and motorbikes.

Table 11: Changes in Means of Transportation (ordinary households)

(%)

	Before	After
Private car	47	66
Motorbike	23	28
Bicycle	2	2
Boat	35	9
Bus	48	35
Taxi (4-wheel)	18	26
Small 3-wheeled taxi (*tuk-tuk*)	1	3
Bus made from remodeled truck	3	2
Walking	13	5

Note: Multiple responses from single respondent possible

(2) Improved access to various services

Ninety-eight percent of ordinary households replied that access to various services had improved following the project. Among these, those that were recognized for their high degree of improvement were access to markets and stores (58%), healthcare services (41%), and public agencies' services (37%). Moreover, 97% of passenger transport services replied that, following the project, the number of passenger transport services increased. Among their responses, those who recognized the greatest increase were bike taxis (62%), followed by buses (41%), and taxis (41%). While 60% of passenger transport services replied that the number of passengers increased, 62% replied that the frequency of transport trips had declined. The increase in the number of passenger transport services means that the options and opportunities for available means of transport have expanded for local residents, and it is likely that passengers increased for this reason. On the other hand, the decline in the frequency of transport trips per each passenger transport service is likely due to the effects of more private cars, more competing transport services, and changes in transport service routes.

[8] The 30 passenger transport services included 10 small three-wheeled taxis (*tuk-tuks*), 9 bike taxis, 5 taxis (4-wheel), 4 buses, and 2 buses made from remodeled trucks (*song taew*).

[9] The beneficiary survey was conducted using the individual interview method with a questionnaire (multiple choice) prepared beforehand with a sample of 150 respondents (120 ordinary households and 30 passenger transport services) selected through random sampling (the survey sample was selected randomly in five locations, near Rama V Bridge, Nakorn In Road, and Ratcha Phruk Road). The parameter was the total population of 1.16 million persons (2005 estimate) in Nonthaburi Province.

(3) Improvement in convenience of roads

Ninety-six percent of ordinary households replied that the convenience of roads improved following the project. The responses included, in order from most to least, improvement in riding comfort (89%), time-saving (88%), easing of congestion at peak times (44%), and vehicle operation cost-saving (18%). Previously, because trunk roads were not adequately developed in the project area, local residents mainly used existing local roads and canals when traveling to and from central Bangkok, and these roundabout routes often required extra time. Because trunk roads running north, east, south, and west were built in this area by the project and were connected to existing roads, the road network in this area was expanded, enabling movement in a shorter time in places where access had formerly been poor. As a result, it appears that the convenience of the roads was improved for residents.

(4) Impact on the socioeconomic environment

Eighty-one percent of all ordinary households and passenger transport services gave a positive overall evaluation of the impact of the project on the socioeconomic environment. There was recognition of positive impact, from highest to lowest, on expansion of various private services (72%), expansion of housing businesses (68%), population growth (59%), rise in land prices (51%), changes in land usage (37%), and improved mobility/connectivity (36%), etc. However, 60% of the total responded that negative impact also occurred at the same time. The main responses were increase in traffic accidents (70%), increase in crime (41%), changes in community due to development (40%), changes in land usage (40%), and population growth (24%).

Nonthaburi Province, which is the site of the project, was a rural village area known for its cultivation of fruit such as durian and flower cultivation. Because it was located adjacent to

Table 12: Recognition of Impact on the Socioeconomic Environment (overall)
(%)

	Positive Impact	Negative Impact
Recognize much	48	23
Recognize some	33	37
Recognize little	11	19
Recognize none	7	20
Don't know	1	1

Table 13: Reasons Why Socioeconomic Impact is Recognized as Positive or Negative

	(%)
Reasons Positive Impact is Recognized	
Expansion of various private services	72
Expansion of housing businesses	68
Population growth	59
Rise in land prices	51
Changes in land usage	37
Improved mobility/connectivity	36
Increase in employment opportunities	15
Increase in income	12
Reasons Negative Impact is Recognized	
Increase in traffic accidents	70
Increase in crime	41
Changes in community due to development	40
Changes in land usage	40
Population growth	24
Increase in vehicles	8
Decline in income	2

Note 1: These are reasons indicated by respondents who selected "recognize much," "recognize some," or "recognize little" as to positive or negative impact on the socioeconomic environment.
Note 2: Multiple choice

Bangkok just across the Chao Phraya River, in recent years it has developed as a bed town of the metropolis, with residential and commercial development progressing rapidly. This is accompanied by various environmental changes, such as a shift in land usage from farmland to residential land and an influx of population from the urban center. Changes such as these have exerted considerable influence on the traditional community way of life from the viewpoint of the long-term residents. For this reason, opinions are divided, and depending on the respondent, the changes are not necessarily viewed as positive.

(5) Environmental impact

With regard to environmental impact as well, the evaluations are mixed, with both positive and negative views. Out of all respondents, 32% replied that the project had a positive impact on the environment, but the majority (61%) replied that they recognized no positive impact. The reasons given for positive impact, in order from most frequently mentioned, were reduction of air pollution, reduction of noise, and reduction of vibration. Meanwhile, 48% of respondents said that they recognized negative environmental impact, and 37% responded that they recognize no negative environmental impact. The reasons given for negative impact, in order from most frequently mentioned, were increase in air pollution, increase in noise, increase in vibration, and increase in garbage.

Table 14: Recognition of Environmental Impact (overall)

(%)

	Positive Impact	Negative Impact
Recognize much	18	23
Recognize some	14	25
Recognize little	5	14
Recognize none	61	37
Don't know	2	1

Table 15: Reasons Why Environmental Impact is Recognized as Positive or Negative

	(%)
Reasons Positive Impact is Recognized	
Reduction of air pollution	75
Reduction of noise	46
Reduction of vibration	27
Reduction of garbage	7
Reasons Negative Impact is Recognized	
Increase in air pollution	62
Increase in noise	76
Increase in vibration	45
Increase in garbage	23
Reduction of greenery	2
Increase in sewage and polluted water	2

Note 1: These are reasons indicated by respondents who selected "recognize much," "recognize some," or "recognize little" as to positive or negative environmental impact.
Note 2: Multiple choice

From the above results, it is surmised that the views of individual respondents differ due to differences in geographical location, depending on the distance of their living environs from the project's roads and bridge, and due to changes in traffic routes of road users before and after the project. To summarize overall, given that (1) the largest percentage of responses recognized neither positive nor negative impact and (2) responses that recognized negative impact (48%) exceeded the responses that recognized positive impact (32%), this indicates that exhaust gas and noise are in an uptrend in the area near the road due to the increase in traffic volume.

(6) Satisfaction and issues with the project

Table 16: Satisfaction with project (overall)

	(%)
Very satisfied	55
satisfied	42
Not very satisfied	2
Completely dissatisfied	1

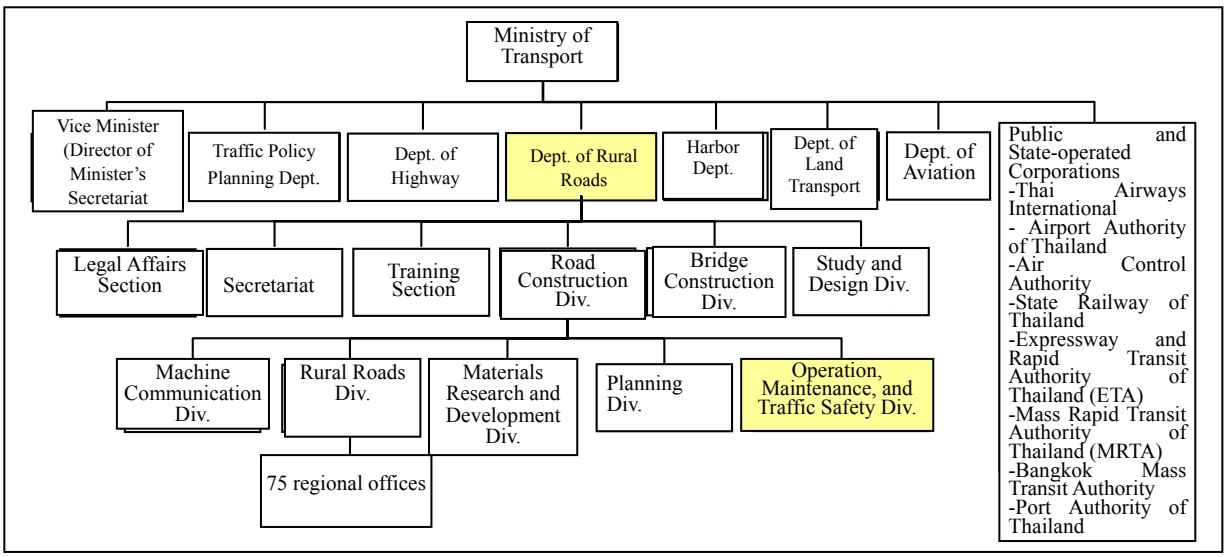
Overall, 97% of the ordinary households and passenger transport services responded that they are satisfied with the project. When the interview subjects were questioned about problems directly related to the project, the majority (63%) responded that there were none. A minority pointed out problems including an increase in traffic accidents (9%) and an increase in traffic congestion and car races on the roads (9%). As countermeasures, there were a relatively large number of suggestions to increase the number of traffic signals and road signs and to strengthen police enforcement of regulations.

2.5 Sustainability

2.5.1 Executing Agency

The operation and maintenance of this project is handled by the Department of Rural Roads (DOR) in the Ministry of Transport. The DOR was launched in October 2002, when the construction tasks and operation and maintenance tasks for rural roads, which had been under the jurisdiction of the Public Works Department (PWD) in the Ministry of the Interior, were moved to the Ministry of Transport during the reorganization of Thailand's central government in 2002. As of September 2006, the DOR had 1,887 employees. Figure 5 shows the organization of the DOR and the Ministry of Transport.

Figure 5: Organization of Ministry of Transport and the Department of Rural Roads



source: Department of Rural Roads, Ministry of Transport, Thailand

2.5.1.1 Technical capacity

The DOR has carried out numerous road and bridge construction projects as well as operation and maintenance of roads and bridges heretofore. The DOR's Training Section has established various training courses on road maintenance, studies and design, roads and bridges, traffic safety, and road inspection. Technical training for the staff is periodically implemented, and there are no problems in technical capacity.

2.5.1.2. Financial status

The executing agency claims that there is a need for an increase in the budget for development of the road network, operation and maintenance, and capacity development such as technical training. However, this project's facilities are given relatively high priority in the allocation of operation and maintenance budgets, despite limited road finances, in part because the project's facilities are a major part of the Bangkok metropolitan road network. Currently, budget shortfalls are not exerting a large adverse impact on operation and maintenance of the project's facilities, and overall there seems to be no problem.

2.5.1.3 Operation and maintenance system

The direct responsibility for operation and maintenance of the project's facilities lies with the Bangkok Metropolitan Roads/Bridges Operation and Maintenance Group in the Operation, Maintenance, and Road Safety Division of the DOR. This group conducts the operation and maintenance 53,908 km of ordinary roads in the Bangkok metropolitan area and its environs as well as 8 bridges spanning the Chao Phraya River.

Table 17: DOR's Annual Expenditure Plan
(unit: million baths)

	2005	2006
1. Development of road network	11,362.823	13,609.758
2.Operation and maintenance	4,127.736	5,179.868
3.Capacity development	96.215	96.499
Total	15,586.774	18,886.125

source: Department of Rural Roads, Ministry of Transport, Thailand

2.5.2 Operation and maintenance status

In the operation and maintenance of the project's facilities, daily maintenance, periodic maintenance, and major repairs are implemented in accordance with the Ministry of Transport's operation and maintenance manual. The main part of daily maintenance involves cleaning of roads and roadsides, inspection of electrical equipment, traffic signals, and lights, maintenance of plants and trees, supervision of illegal residents and kiosks on the street, repair of and compensation for damage due to accidents. Periodic maintenance involves touch up and repainting of lane lines every two years as well as leveling (flattening bumps in the road surface) and repaving every four years. Major repairs are conducted as necessary as determined by the condition of road. Periodic maintenance and major repairs are outsourced. Since project completion until the present time, no major repairs have been implemented, and the road is being maintained in good condition.

3. Feedback

3.1 Lessons Learned

N.A.

3.2 Recommendations

-Recommendations for the Department of Rural Roads, Ministry of Transport

It is necessary to conduct periodic traffic volume studies and to organize statistical records for the purpose of operation and maintenance of the roads and bridges of the project and for ongoing project evaluation and also from the perspective of preparing the necessary information for devising road development plans in the future.

Moreover, a high priority issue is countermeasures for traffic accidents, because the number of traffic accidents is increasing annually. Also, in the results of the beneficiary survey, the most frequently cited negative impact on the socioeconomic environment caused by this project was traffic accidents. For these reasons, it is necessary to install traffic signals at intersections where accidents frequently occur, increase and improve road signs, construct underpasses, etc., and strengthen enforcement of road regulations with the assistance of the local police authorities.

Comparison of Original and Actual Scope

Item	Plan	Actual
① Output Phase I (1)Construction of Wat Nakorn-In Bridge －Total length －Number of lanes (2) Construction of East-West Road －Section －Length of road －Number of lanes －Interchanges －Bridge construction	 940m (main bridge portion, 320 m; approach bridge portion, 620m) 6 lanes Tiwanon Road-the Outer Ring Road 12km (including bridges) 10.7km of 4 lanes; 1.3km of 6 lanes 4 interchanges 6 large bridges, 7 small and medium bridges	 As planned As planned
Phase II (3) Construction of North-South Road －Section －Length of road －Number of lanes －Interchanges －Bridge construction	 Rathan Thibet Road to Phet Kasem Highway 18km (including bridges) 10.1km of 4 lanes, 7.9km of 6 lanes 5 interchanges 7 large bridges, 11 small and medium bridges	 As planned
② Project Period Phase I ・Signing of L/A ・Land expropriation ・Consultant selection ・Consulting services ・Contractor selection ・Construction period ・Project completion	 September 1995 April 1995 – December 1996 (21 months) April 1995 – December 1995 (9 months) January 1996 – June 1999 (42 months) January 1996 – December 1996 (12 months) January 1997 – June 1999 (30 months) June 1999	 September 1995 April 1994 – June 2001 (87 months) April 1999 – January 2001 (22 months) October 1999 – May 2003 (44 months) March 1999 – December 2000 (10 months) October 1999 – May 2003 (44 months) December 2003
Phase II ・Signing of L/A ・Land expropriation ・Consultant selection ・Consulting services ・Contractor selection ・Construction period ・Project completion	 September 1996 October 1995 – December 1997 (27 months) April 1996 – June 1997 (15 months) January 1997 – December 1999 (36 months) October 1996 – December 1997 (15 months) October 1997 – December 1999 (27 months) December 1999	 September 1996 April 1997 – June 2001 (51 months) August 2000 – January 2001 (6 months) February 2001 – December 2003 (35 months) February 2001 – December 2003 (35 months) December 2000 – December 2003 (37 months) December 2003

Item	Plan	Actual
③ Project Cost		
Phase I		
Foreign Currency	7,226 million yen	4,516 million yen
Local Currency	13,332 million yen (3,683 million baths)	11,278 million yen (3,470 million baths)
Total	20,558 million yen	15,794 million yen
ODA Loan Portion	7,226 million yen	4,628 million yen
Exchange Rate	1 baht = 3.62 yen (as of May 1995)	1 baht = 3.25 yen (average during 1995 to 2003)
Phase II		
Foreign Currency	12,495 million yen	7,242 million yen
Local Currency	21,143 million yen (5,034 million baths)	16,002 million yen (5,033 million baths)
Total	33,638 million yen	23,244 million yen
ODA Loan Portion	10,000 million yen	6,474 million yen
Exchange Rate	1 baht = 4.20 yen (as of April 1996)	1 baht = 3.18 yen (average during 1996 – 2003)