

4.4 Road and Traffic Conditions Crossing the Mekong River Bridge

4.4.1 Current Road and Traffic Conditions Crossing the Mekong River Bridge Ferry Operation on the Mekong River

(1) Current Conditions of Ferry Services

There are not any bridges crossing the Mekong River in the target area. four ferry ports are located near the Mekong River bridge area, which are shown on the figure below and small ferry services are in operation. The OD-1 port has few users and it was closed on May, 2024.



Figure 4.4-1 Ferry Port

Ferry fares are shown in Table 4.4-1. When crossing to the opposite bank with a bicycle or motorcycle, the fare for the bicycle or motorcycle is added to the fare for the passengers. On the other hand, for tuk-tuks, light vehicle, small trucks, animals, and bullock carts, the fare includes the driver's and passenger's fare.

Table 4.4-1 Ferry Fares

Type	Fares
Person	1,000 KHR/Person
Bicycle	400 KHR/Unit
Motorcycle	1,000 KHR/Unit
Tuk-Tuk	7,000 KHR/ Unit
Light Vehicle	10,000 KHR/ Unit
Small Truck	15,000 KHR/ Unit
Animal	5,000KHR/Animal
Bullock Cart	6,000KHR/Unit

1) Ferry Service Condition at OD-1

One ferry operates, making one round trip to the other side of the river in about 2 hours. The ferry has few users and is scheduled to be discontinued in the near future. The ferry is mainly used by fisherpersons sell fish caught on the other side of the river.



OD-1 Ferry port (NR1 side)



Fisherpersons sold fish and returning to the opposite shore



Ferry

Figure 4.4-2 The Mekong River Crossing at OD-1

2) Ferry Service Condition at OD-2

Two ferries operate alternately with the opposite shore, making two round trips in about one hour. The trip to the other shore takes about 20 minutes.



OD-2 Ferry port (NR1 side)



Inside the ferry



Ferry

Figure 4.4-3 The Mekong River Crossing at OD-2

3) Ferry Service Condition at OD-3

OD-3 has more passengers than the other ferry. Two ferries operate alternately with the other side of the river, and the trip to the other side of the river takes about 10 minutes.



OD-3 Ferry port (NR1 side)



Inside the ferry

Figure 4.4-4 The Mekong River Crossing at OD-3

4) Ferry Service Condition at OD-4

It takes about 20 minutes to reach the other side of the river. Vegetables and other goods are transported, and vegetables harvested on the other side of the river are brought in, packed by truck, and transported to Phnom Penh and other cities.



OD-4 Ferry port (NR1 side)



Vegetables from the other side of the river are being sold and loaded onto a truck



Vegetables being transported from the other side of the river



Cattle being transported from the other side of the river

Figure 4.4-5 The Mekong River Crossing at OD-4

5) Traffic Issues

- It takes time to reach the other side of the river, because ferries wait for passengers before departing.
- Greatly affected by ferry breakdowns and weather conditions.
- The capacity of the vessels is limited, and many vehicles and people cannot cross at one time, resulting in congestion and waiting time.
- There is a ferry fee to cross the river.

(2) Ferry OD Survey

Figure 4.4-6 shows ferry usage by vehicle type. Approximately half of the ferry users are motorcycles.

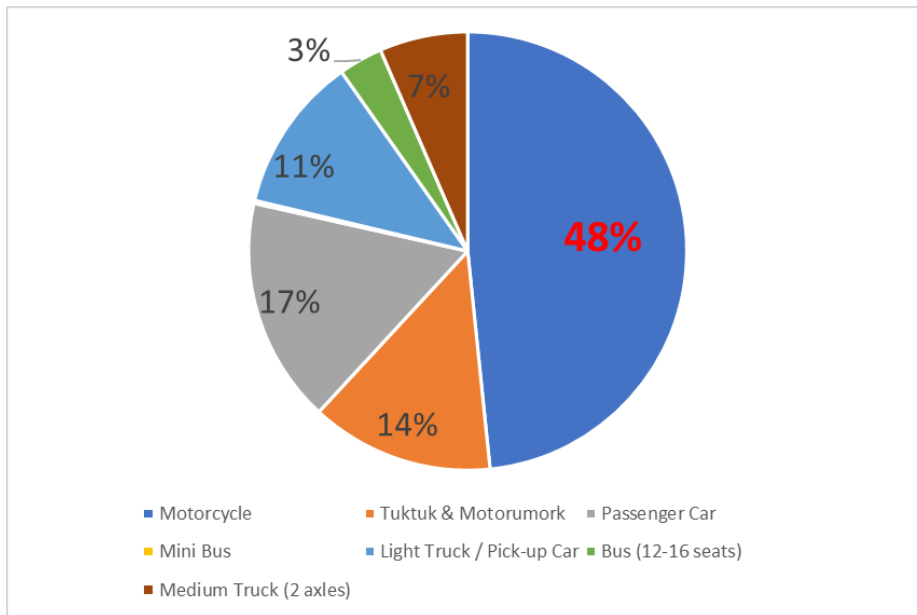


Figure 4.4-6 Ferry Use by Type of Vehicle

Desire line of the ferry OD is shown in Figure 4.4-7. Ferries are used for short trips to the opposite shore.

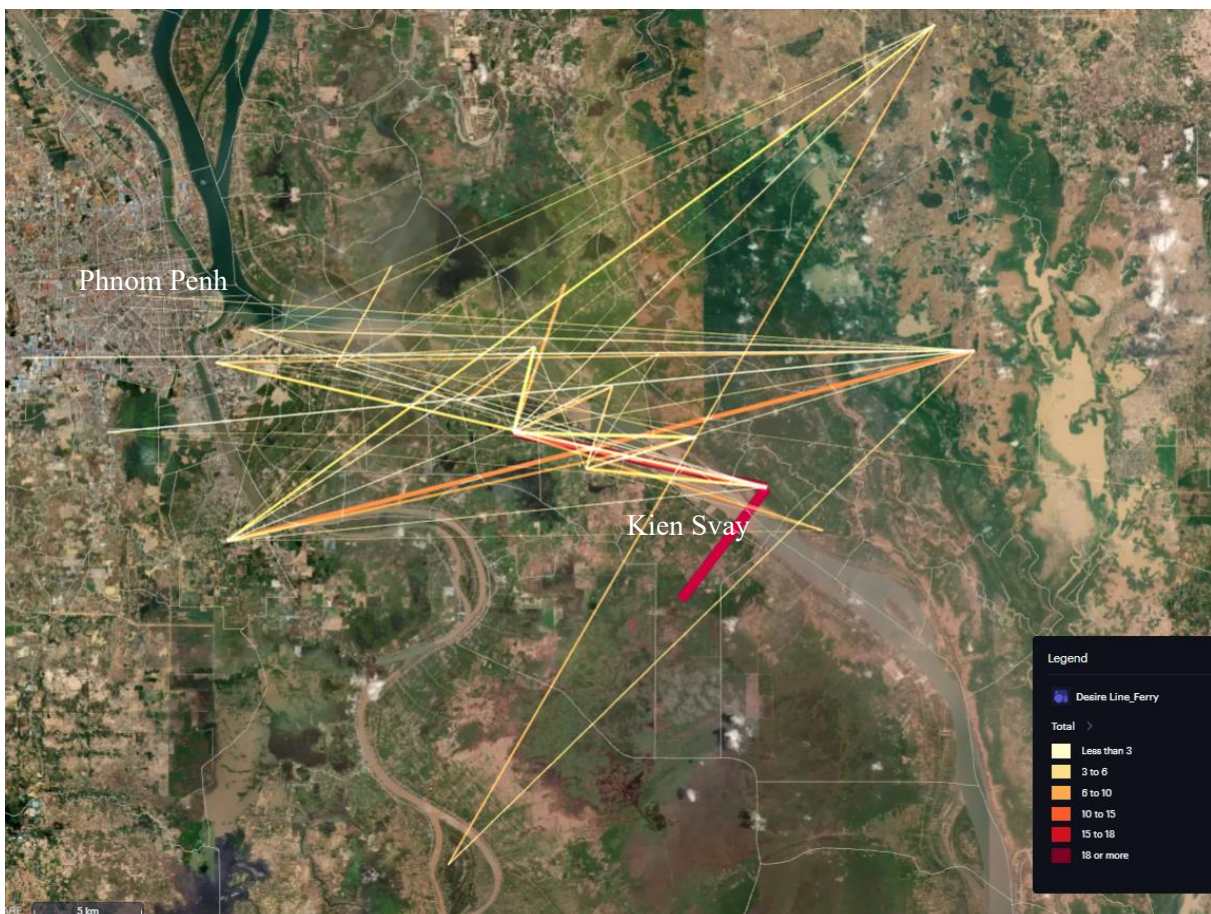


Figure 4.4-7 Desire Line of Ferry OD(PCU)

Figure 4.4-8 shows the purpose of travel by ferry. OD-1 is primarily used to travel to the market to sell fish of buy goods; OD-2 is used to go to work; OD-3 is used to go to work or to visit relatives and family; and OD-4 is mainly used to go to work.

The traffic situation on the Mekong River Crossing is described below in “3.4.2 (4) The Mekong River Bridge”.

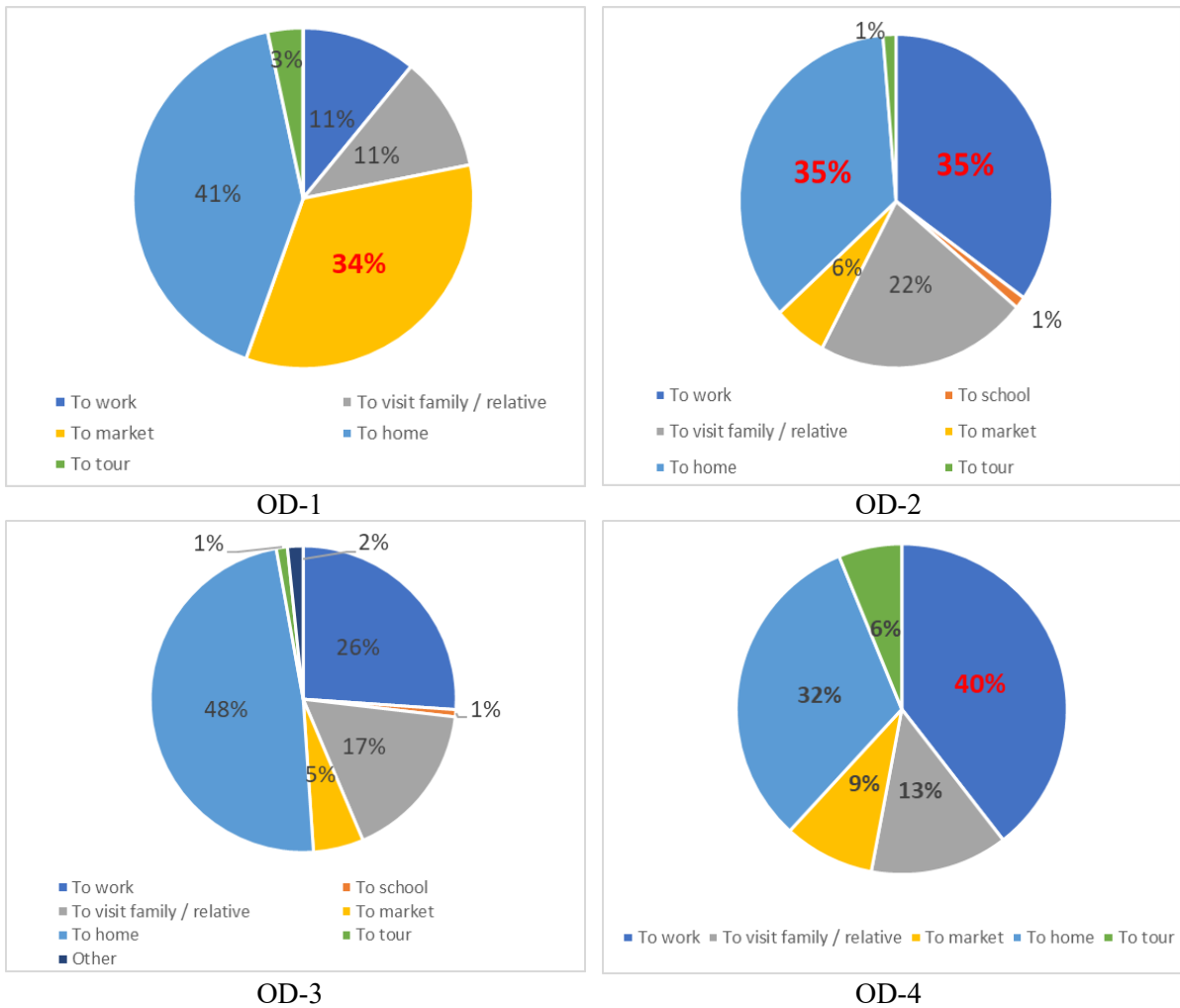


Figure 4.4-8 Purpose of Use for each Ferry

4.4.2 Total Traffic Demand Crossing the Mekong River in Phnom Penh

Currently, the only bridge over the Mekong River in and around Phnom Penh is the Prek Ta Meak Bridge on National Route 8. People use ferries and the Prek Ta Meak bridge to cross the Mekong River.

According to CITL-MP 2023-2033, the PPUTMP, and the draft AKC Master Plan, eight plans for bridges or tunnels across the Mekong River can be identified, including the requested projects in this survey (6 and 8 in Table 4.4-2, below).

Table 4.4-2 Current Status of each Bridge Across the Mekong River and Completion Year

Bridge Name	Condition	Completion Year
1 Prek Ta Meak Bridge on NR8	2010 Opened	-
2 RR3 Bridge north	Planning	Long term (2028-2033)
3 Bridge over the Tycoon Island	Planning	2040
4 RR2 bridge north	Planning	Long term (2028-2033)
5 Cambodia-Korea Friendship Bridge	FS Completed	Short & Medium (2023-2027)
6 Requested Mekong River tunnel	Planning	Long term (2028-2033)
7 Bridge leading to Koh norea island	Planning	2040
8 Requested Mekong river bridge on RR2	Planning	Long term (2028-2033)
9 RR3 bridge south	Planning	Long term (2028-2033)

The total traffic demand across the Mekong River in 2035 is approximately 408,400 PCU/day, which is below the total future bridge and tunnel traffic capacity. The total traffic demand across the Mekong River in 2050 is projected to be about 667,900 PCU/day. This is approximately 1.3 times the traffic capacity of the current plan, indicating that the cross-sectional traffic capacity of the Mekong River Crossing is inadequate.

Table 4.4-3 Future Traffic Volume of Mekong River Bridges and Tunnel around Phom Penh

Bridge Name	Lane	2035		2050	
		Traffic Volume	Road Capacity	Traffic Volume	Road Capacity
1 Prek Ta Meak Bridge on NR8 (Existing)	2	29,100	21,000	38,100	21,000
2 RR3 Bridge north	4	66,800	48,000	81,900	48,000
3 Bridge over the Tycoon Island	4	---	---	71,800	48,000
4 RR2 bridge north	6	83,400	81,000	120,800	81,000
5 Cambodia-Korea Friendship Bridge	4	40,200	48,000	67,900	48,000
6 Requested Mekong River tunnel	6	31,100	81,000	44,300	81,000
7 Bridge leading to Koh Norea island	4	---	---	37,500	48,000
8 Requested Mekong river bridge on RR2	6	100,400	81,000	113,500	81,000
9 RR3 bridge south	4	57,400	48,000	92,000	48,000
Total	40	408,400	408,000	667,800	504,000
		V/C = 1.00		V/C = 1.32	

Current plans call for a 32-lane bridge or tunnel over the Mekong River, which would provide sufficient roadway traffic capacity for traffic demand in 2035.

The results of the future traffic assignment with all requested projects in 2035 also show that the VCR of all bridges and tunnels crossing the Mekong River is below 1.25, except for bridges ① and ②, and there is little risk of chronic traffic congestion during the crossing of the Mekong.

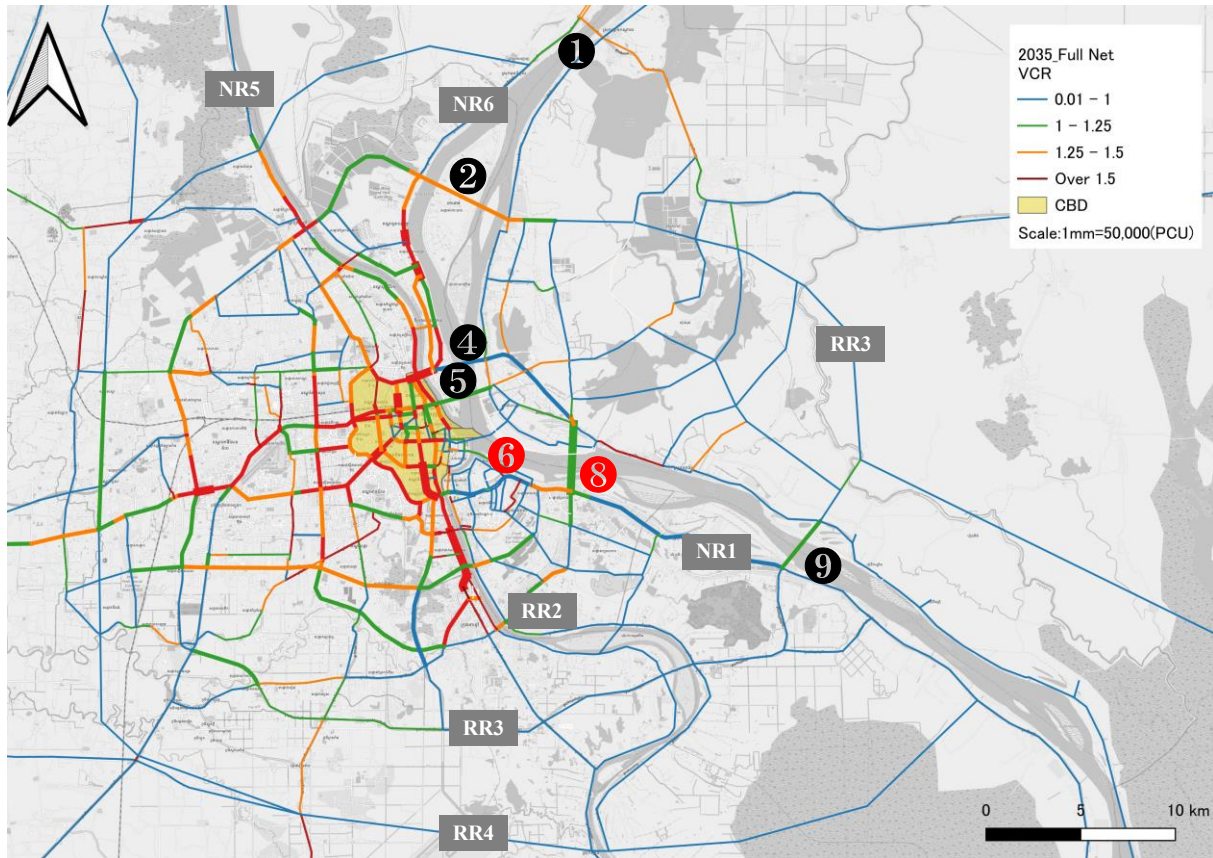


Figure 4.4-9 Re-Post Future Traffic Volume in 2035 with All Requested Projects

On the other hand, there is a traffic demand for 56 lanes of traffic crossing the Mekong River in 2050, compared to 40 lanes traffic capacities of planned bridges or tunnels.

Therefore, with the exception of the ⑥ and ⑦, the VCR exceed 1.25. The bridges are used by traffic bypassing the Phnom Penh city center, in addition to traffic crossing to the opposite side of the Mekong River. The bridge ⑥ planned for the city center. The bridge ⑦ will not directly connected to a ring road such as RR2 on the AKC side. It is considered they are less congested than the other bridge plans because they have less bypass function.

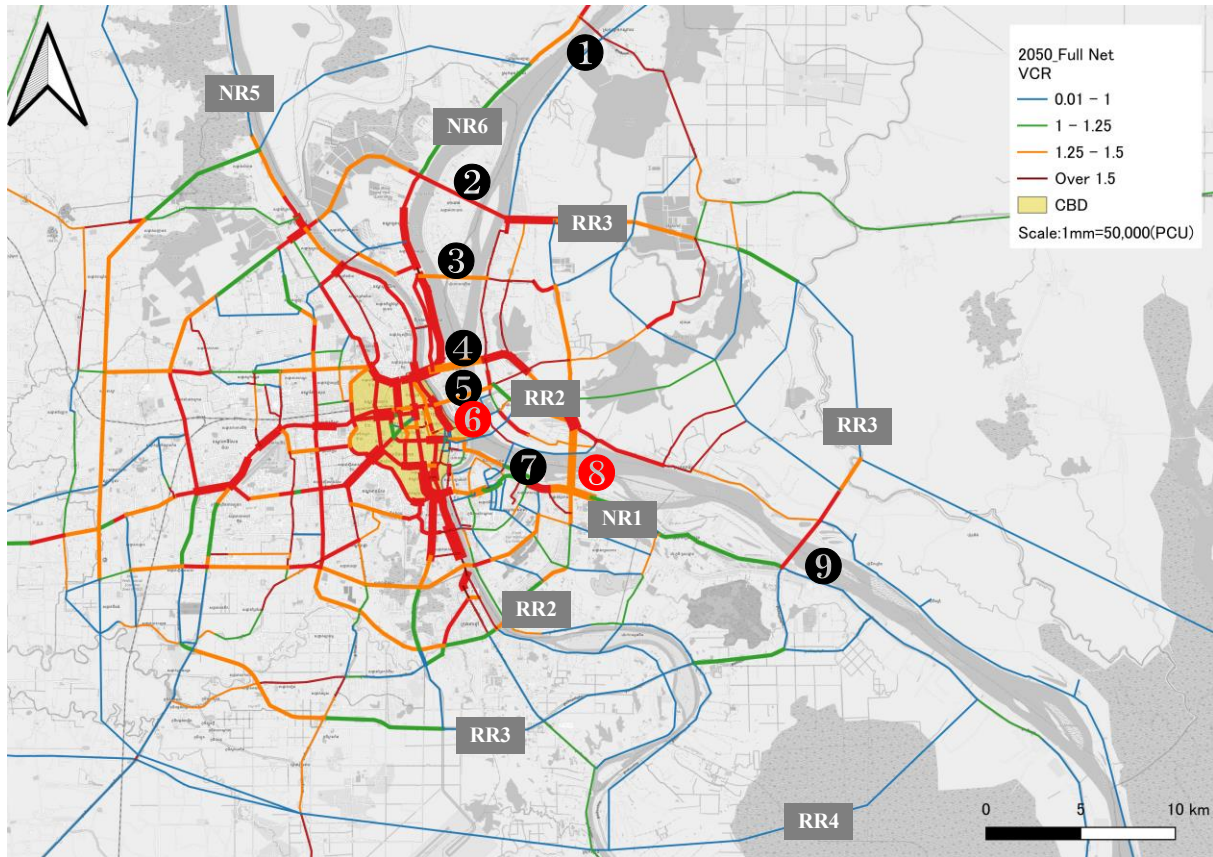


Figure 4.4-10 Re-Post Future Traffic Volume in 2050 with All Requested Projects

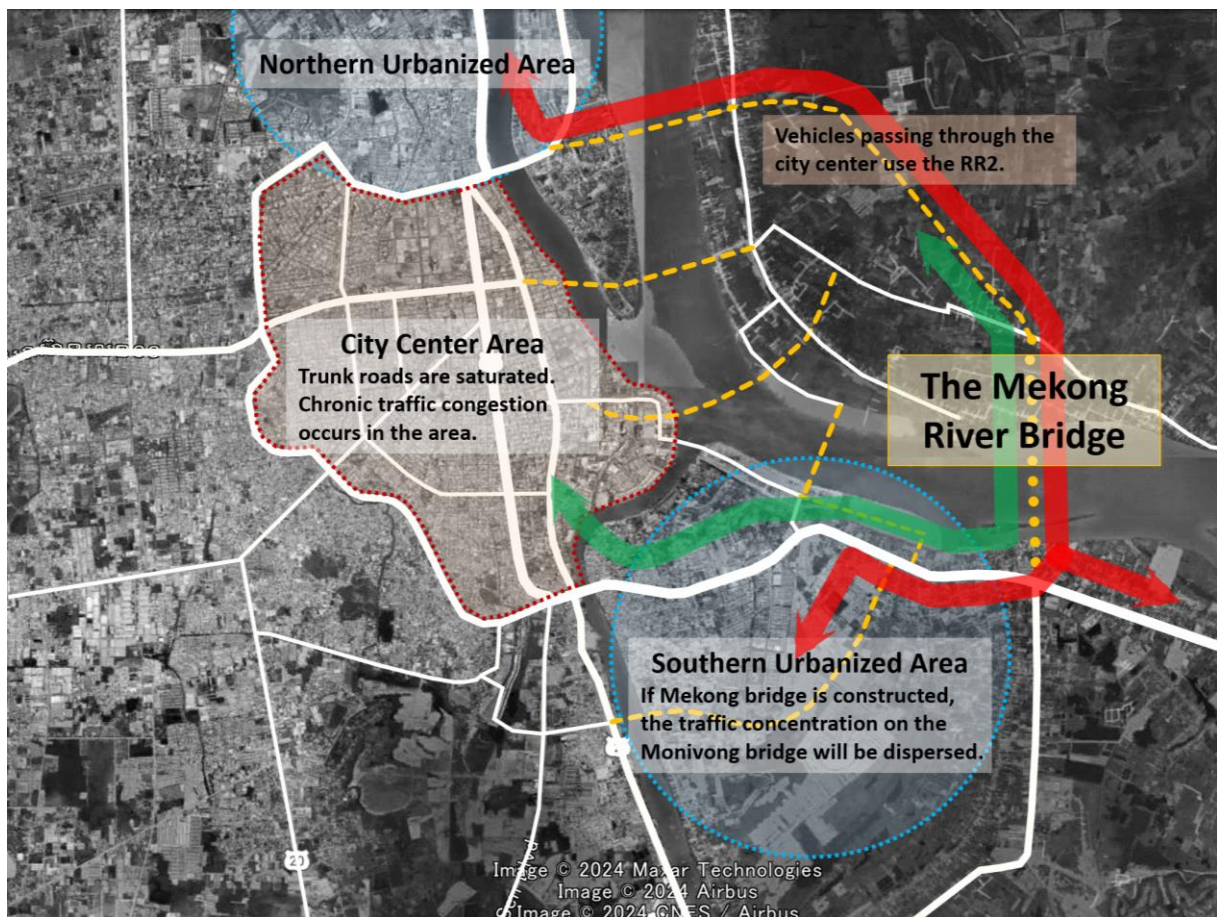
4.4.3 Future Traffic Conditions of the Requested Project

(1) The Mekong River Bridge

The bridge over the Mekong River will be used by "traffic originating and terminating in the southern and northern parts of Phnom Penh and bypassing the city center (red arrows in the figure below)" and "traffic originating or terminating in the areas on the other side of the Mekong River (green arrows in the figure below)".

Traffic originating and terminating in southern and northern Phnom Penh and bypassing the city center" refers to traffic using RR2 on the opposite bank of the Mekong River as a bypass to avoid traffic congestion in the Phnom Penh center city. This type of traffic accounts for about half of the future traffic volume on the Mekong River Bridge of 100,400 PCU/day in 2035. The Mekong River Bridge will reduce the amount of traffic entering the city center, which will also contribute to mitigate traffic congestion on the north-south radial roads (Monivong Street and Norodom Street) leading to the city center.

Traffic originating or terminating in the areas on the other side of the Mekong River" has so far have to use ferries or the Prek Ta Meak Bridge in northern Phnom Penh (National Route 8, located about 30 km north of the Phnom Penh city center). The Mekong River Bridge will improve access to the areas on the other side of the Mekong River and contribute to the promotion of urban development in the areas on the other side of the river.



*The yellow dotted line indicates the Cambodia-Korea Friendship Bridge and RR2 to be developed in the future.

Figure 4.4-11 Conceptual Map of 2 Major Traffic Flow Crossing the Mekong River Bridge

The "traffic with destinations and origins in the urban areas north and south of Phnom Penh" will use Ring Road 2 in AKC as a bypass, avoiding congestion in Phnom Penh's city center. The Mekong River Bridge will reduce the amount of traffic flow into the city center, which will contribute to easing

congestion on the north-south radial roads (Monivong Road and Norodom Road) leading to the city center. This traffic volume accounts for about half of the estimated 2035 traffic volume of 100,400 PCU /day.

The "traffic with destinations and origins in AKC" is limited to using ferries or bypassing the Prek Ta Meak Bridge in northern Phnom Penh (NR8, located about 30 km north of central Phnom Penh). The Mekong River Bridge will improve access to the AKC and help promote its urban development.

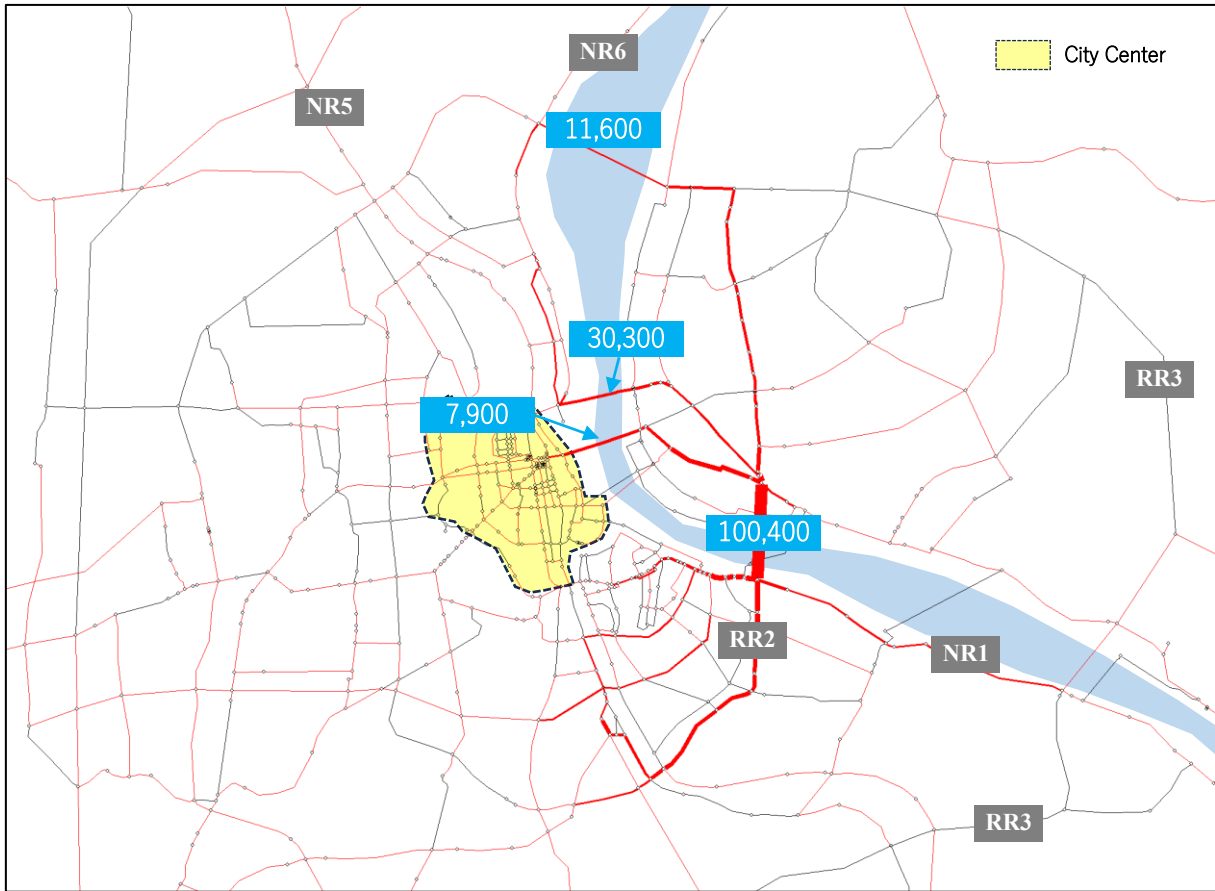


Figure 4.4-12 Traffic Flow Crossing the Mekong River Bridge in 2035 (PCU/day)

Traffic using NR5 from NR1 through Phnom Penh was observed at approximately 2,000 PCU /day. Vehicles passing through Phnom Penh and using the Southern Economic Corridor (Yellow arrow on the right figure) use RR3 instead of the Mekong River Bridge. The Mekong River Bridge will contribute to the smooth flow of logistics traffic to and from Phnom Penh (Red arrow on the right figure), and RR3 will strengthen the connectivity between NR1 and NR5.

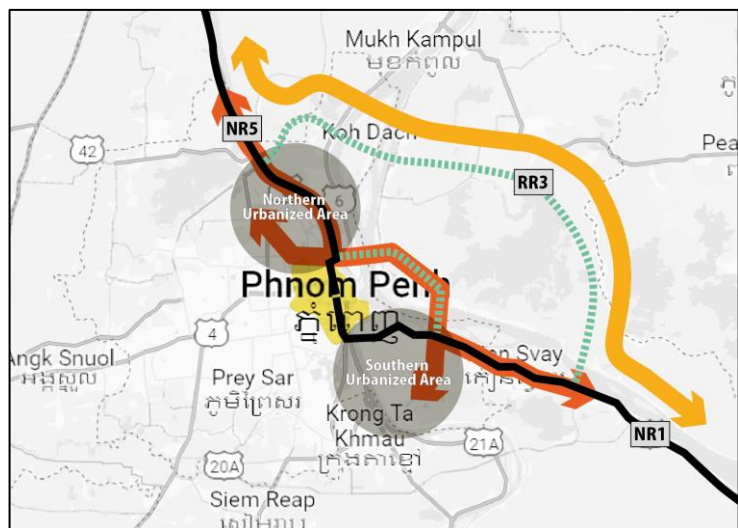


Figure 4.4-13 Major Traffic Flow of RR2 and RR3

Future traffic volumes in 2050 without the Mekong River Bridges are shown below. The Mekong River Bridges on RR3 have a VCR of over 2.0 with 112,500 PCU/day of traffic concentrated on them, creating a bottleneck. The cross section of Phnom Penh city center has a total traffic volume of approximately 422,000 PCU/day, and the VCR exceeds 1.5 on most of the roads.

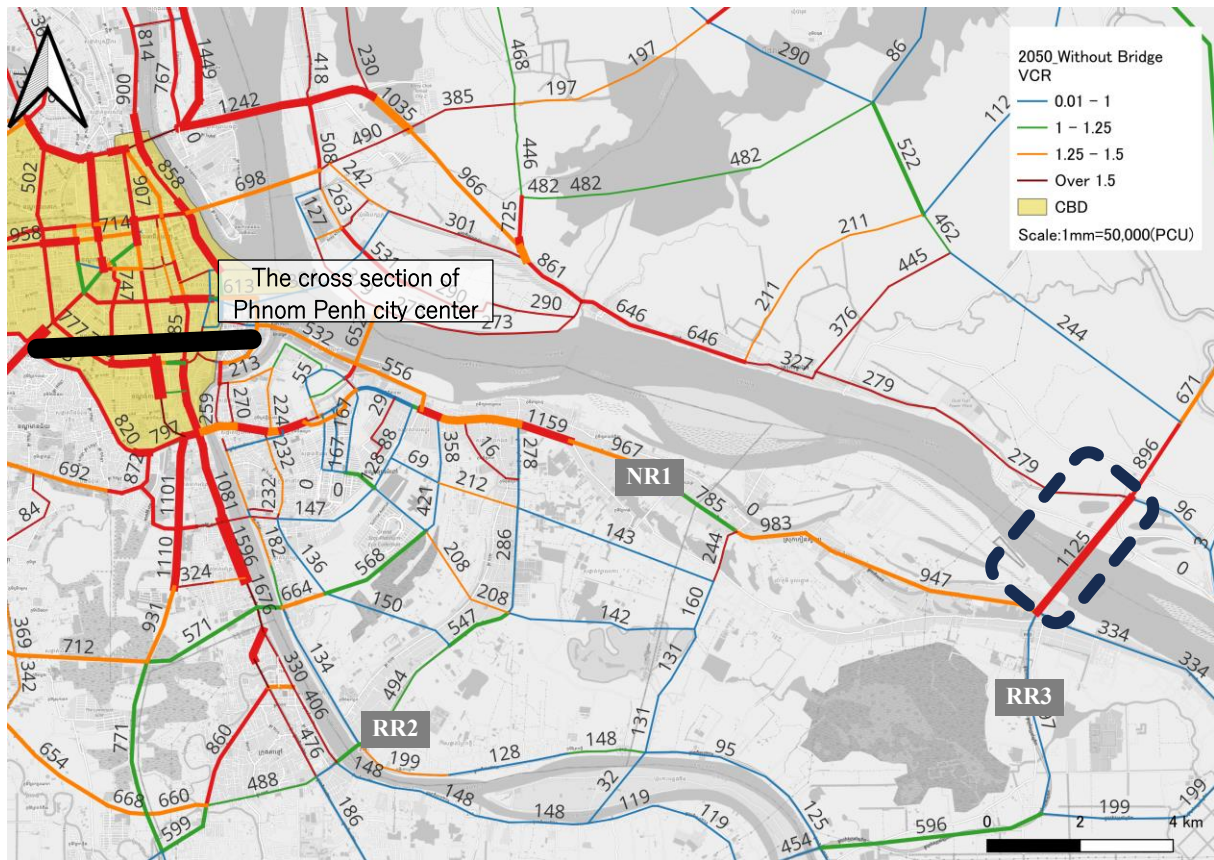


Figure 4.4-14 Traffic Volume in 2050 without the Mekong River Bridge (100PCU/day)

Future traffic volume in 2050 with all requested projects including the Mekong River Bridge is shown below: Traffic volume on the Mekong River Bridge in RR3 will be reduced by 20,000 PCU/day and traffic congestion will be mitigated, but the VCR is still above 1.5. In the Phnom Penh's city center section, the total cross-sectional traffic volume has decreased by about 35,000 PCU/day, which has reduced the flow of traffic into the city center. The bridge construction will not only disperse the traffic on the Mekong River bridges, but also reduce the traffic in the center city. Thus, the necessity for the Mekong River Bridge is high.

The traffic volume of the Mekong River Bridge for the requested project was 113,500 PCU/day, exceeding the traffic capacity of the six-lane road by 81,000 PCU/day. Measures to control traffic volume, such as by encouraging to shift from automobiles to public transportation, need to be implemented in collaboration with road planning.

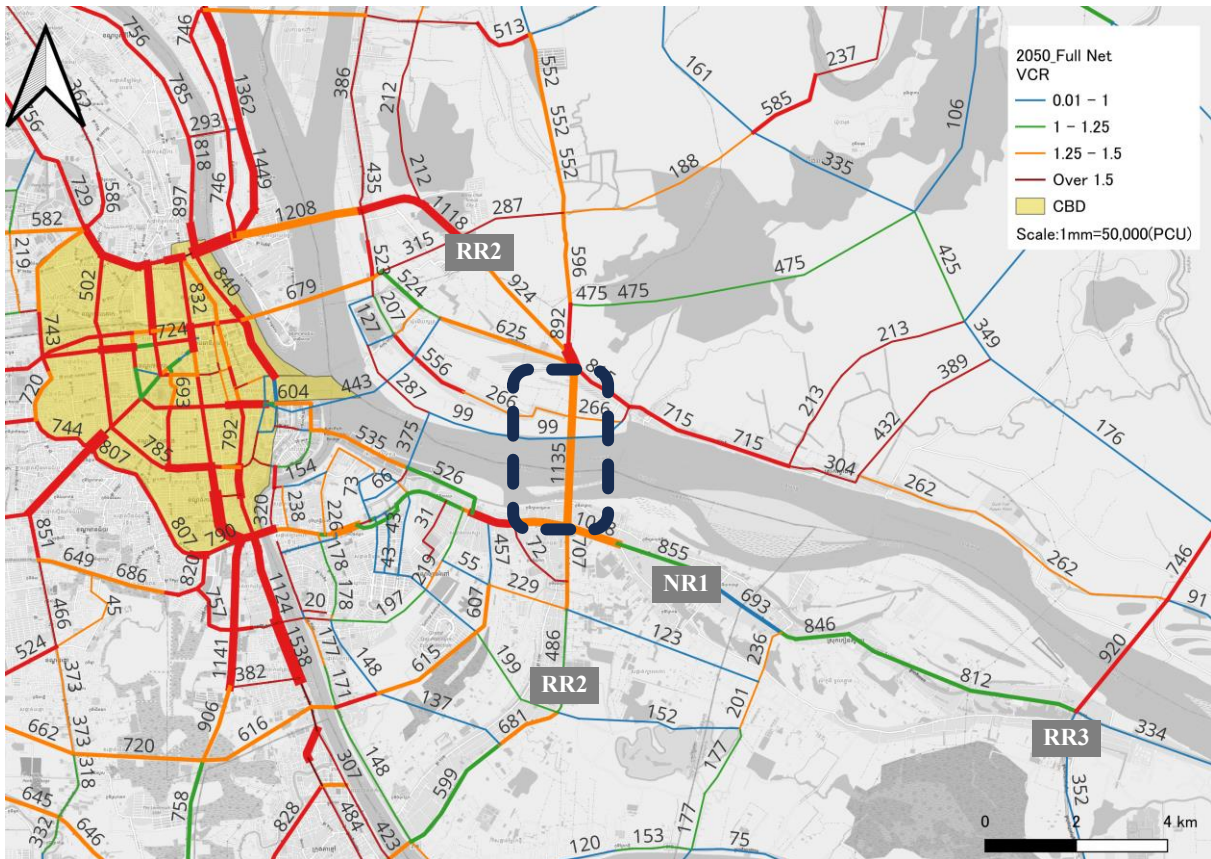


Figure 4.4-15 Traffic Volume in 2050 with All Requested Projects in the Mekong River Bridge (100PCU/day)

(2) The Mekong River Tunnel

Future traffic volumes in 2050 without the Mekong River Tunnel are shown below. Traffic is concentrated on the Korean Friendship Bridge next to the tunnel and on the Mekong River Bridge north of RR2. They have the VCR above 1.5 and are bottlenecks.

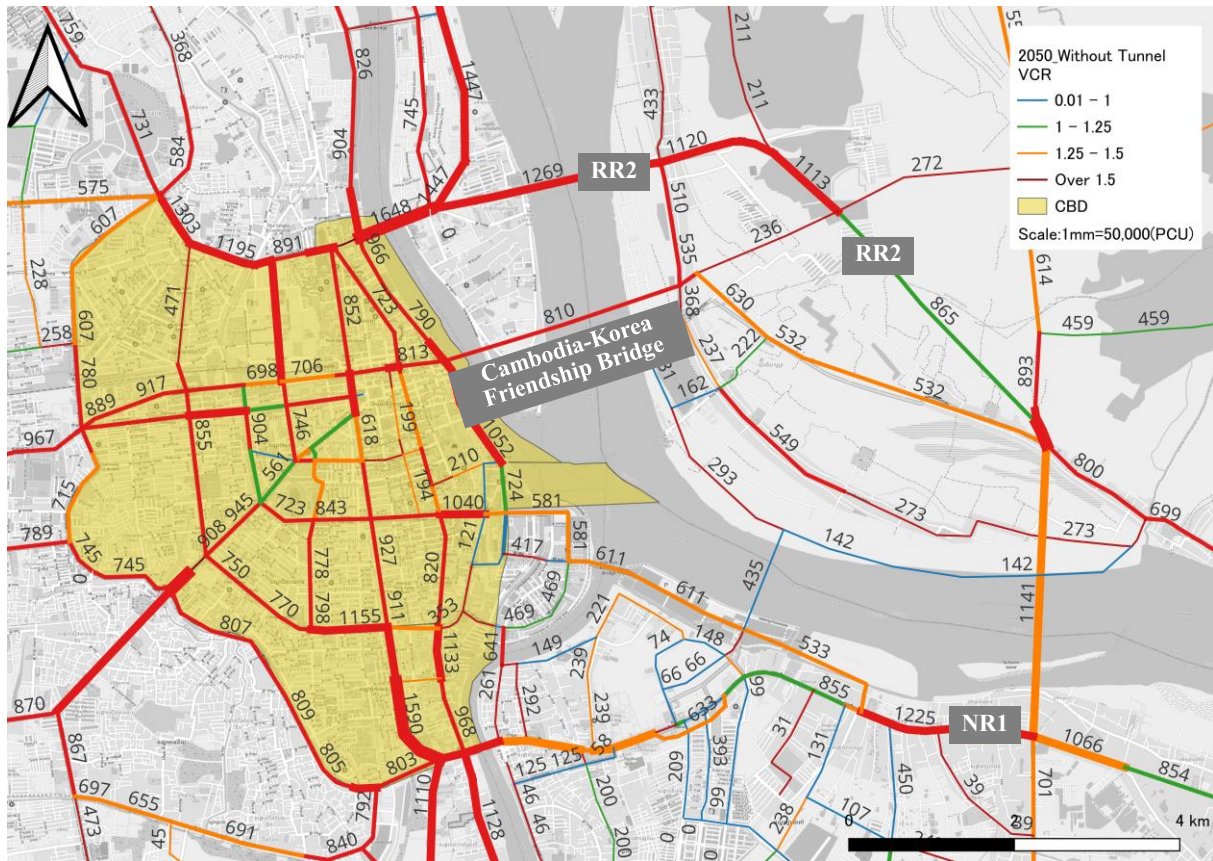


Figure 4.4-16 Traffic Volume in 2050 without the Mekong River Tunnel (100PCU/day)

The future traffic volume in 2050, including all requested projects such as the Mekong River Tunnel, is shown below. Although the traffic volume on the Korean Friendship Bridge and the RR2 North Mekong River Bridge will be reduced, their VCR remains above 1.25. Therefore, there is a necessity for the construction of the tunnel to alleviate traffic congestion at the Mekong River Crossing.

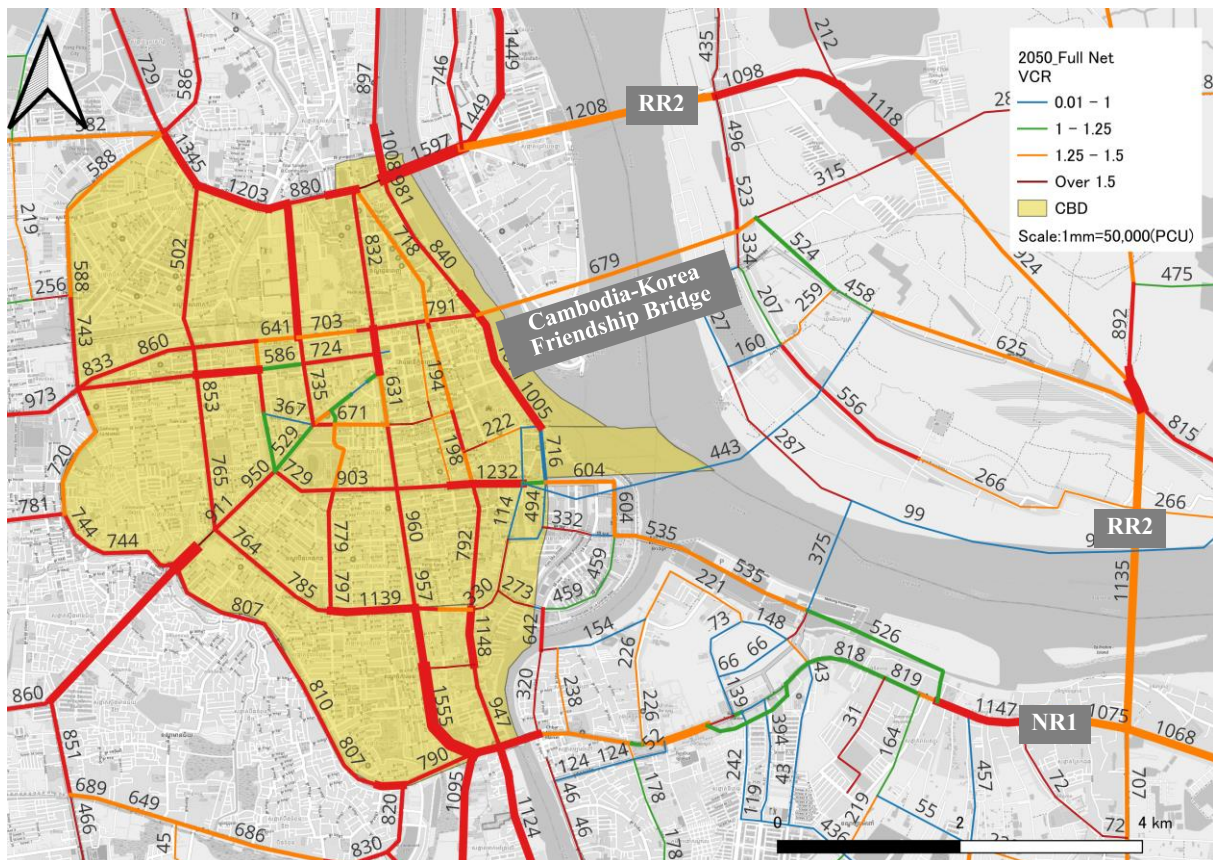


Figure 4.4-17 Traffic Volume in 2050 with All Requested Projects in the Mekong River Tunnel (100PCU/day)

4.4.4 Issues on the Relevant Road Network of Requested Project

The Korean Friendship Bridge project is currently underway with the target of being in operation in 2028. The operational year for the bridge on the west side of RR2 has not been determined. Therefore, the Korean Friendship Bridge will replace the function of RR2 until the western RR2 bridge is constructed. If the bridge for the requested project is constructed, the only road between the two bridges is the existing road, which is likely to become a bottleneck due to the low capacity of the road. In order to construct the Mekong River Bridge and realize its function as a bypass of the central city area of Phnom Penh (Figure 4.4-18) as soon as possible, it is necessary to widen the existing road connecting the bridge under study in this survey and the Korean Friendship Bridge.

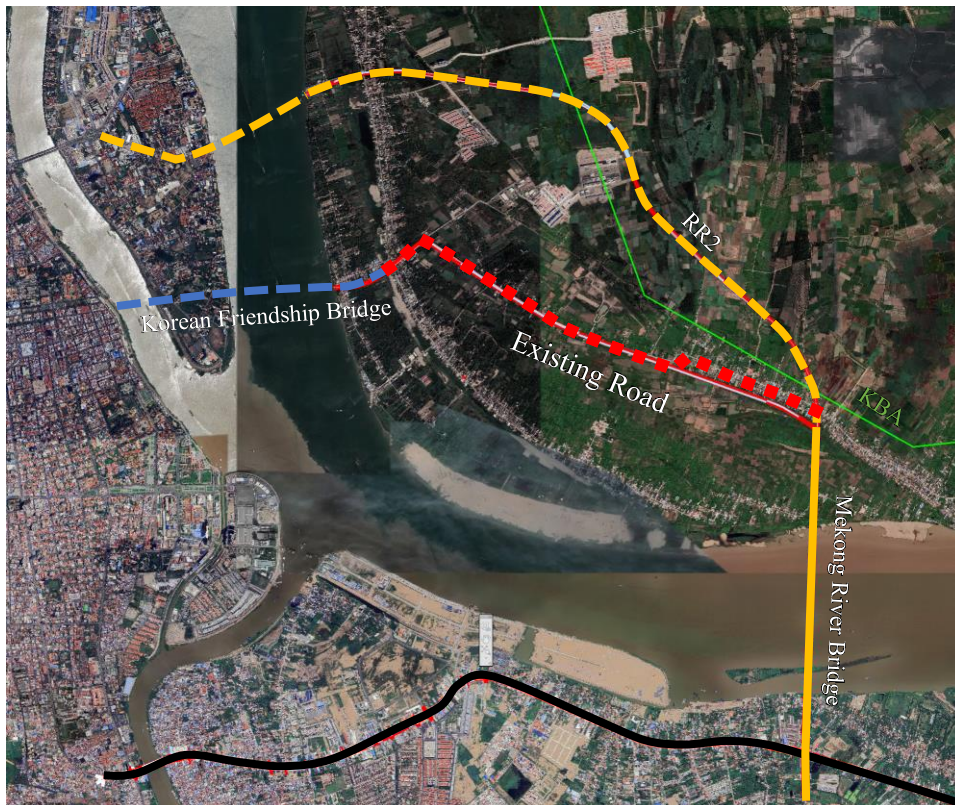


Figure 4.4-18 The Location of the Existing Road Anticipated to be a Bottleneck

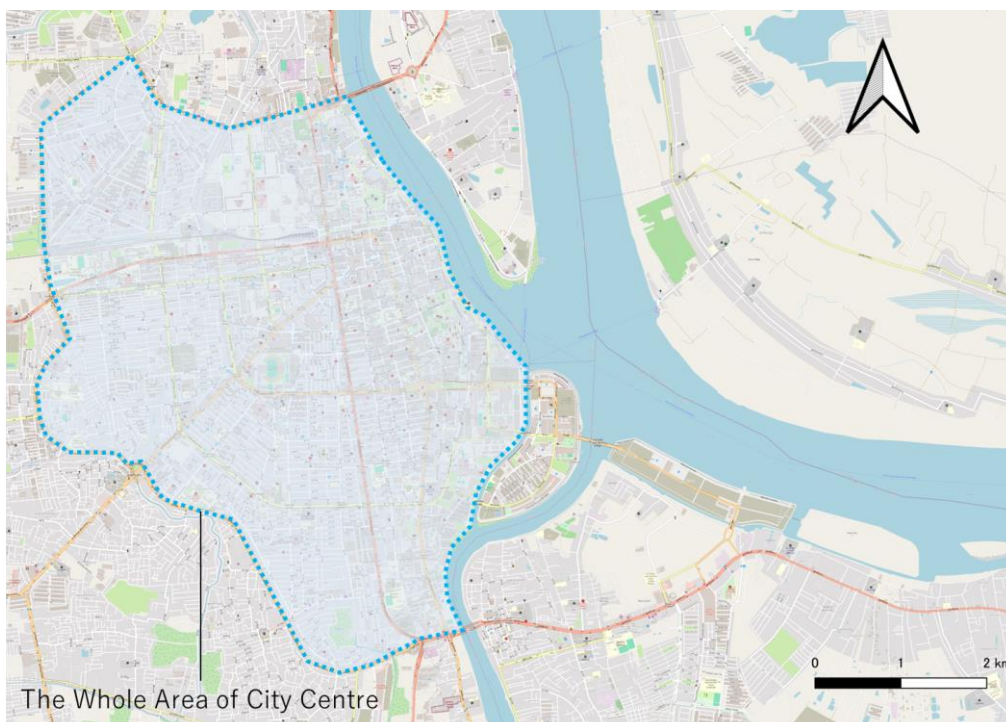


Figure 4.4-19 The Area of City Centre in Phnom Penh

(1) Road Conditions along the Mekong River Bridge Approach Road

Roadside conditions along the Mekong River Bridge approach road section are shown below.



① Around Beginning Point
Location of the connection between the Korea Friendship Bridge and the existing road. DBST 2-lane road with unpaved shoulder.

② Around Widening Sections
Road conditions on the existing road widening section. There are a few houses and shops along the road.







<p>③ Around Bypass Sections There are fields, rice paddies, and other cultivated lands, and there are no paved roads.</p>	<p>④ Around Residential Area There are many houses located along the existing road on the north side of the bypass section. The existing road is concrete paved with houses on stilts and was observed to be flooded.</p>
	
<p>⑤ Around Primary School There is a primary school along the existing road to the north of the bypass section.</p>	<p>⑥ Akreiy Ksatr Side Abutment Point It was identified that a landfill is being built around the proposed location of the bridge abutment on Akreiy Ksatr City side. The site was filled with sand and the developer was identified as a private company.</p>
	
<p>⑦ NR1 Side Abutment Point Fishing boats and ferry operations were observed on the riverbank around the proposed location of the bridge abutment on NR1 side.</p>	<p>⑧ Around NR1 Side Existing Road Many houses and shops along the existing road on NR1 side of the Mekong River Bridge.</p>

Figure 4.4-20 Roadside conditions along the Mekong River Bridge

(2) Existing Road Width along the Mekong River Bridge Approach Road

The existing road width in the widening section is two lanes and shoulders. The existing road width in the bypass section is a one-lane road.

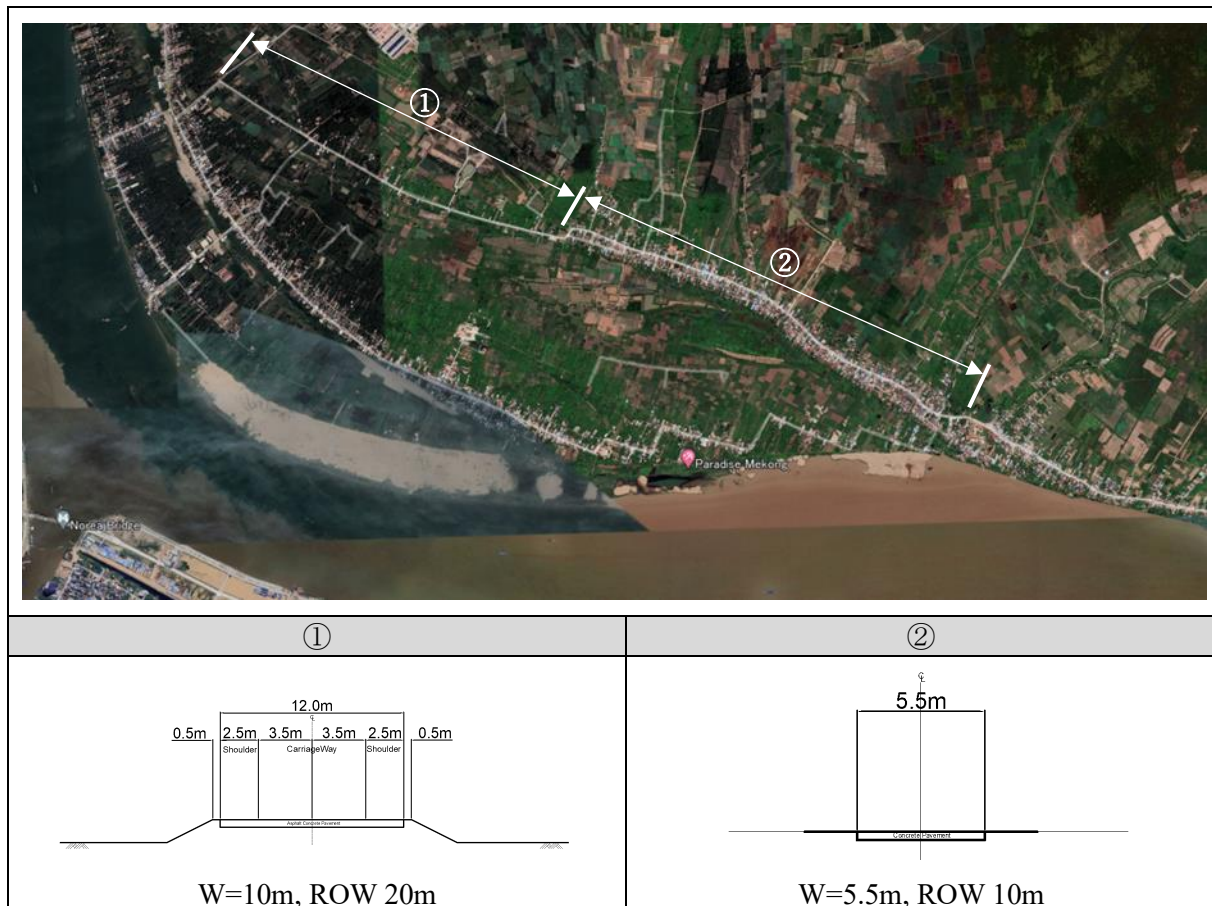


Figure 4.4-21 Existing Road Width of the Akreiy Ksatr Side

(3) Existing Road Structure along the Mekong River Bridge Approach Road

No road structures such as bridges or box culvert were found in this section.

(4) Pavement condition along the Mekong River Bridge Approach Road

The pavement condition of this section was DBST pavement on the Widening Section and Concrete pavement on the existing road near the Bypass section. The pavement condition of both section is classified as normal to good.

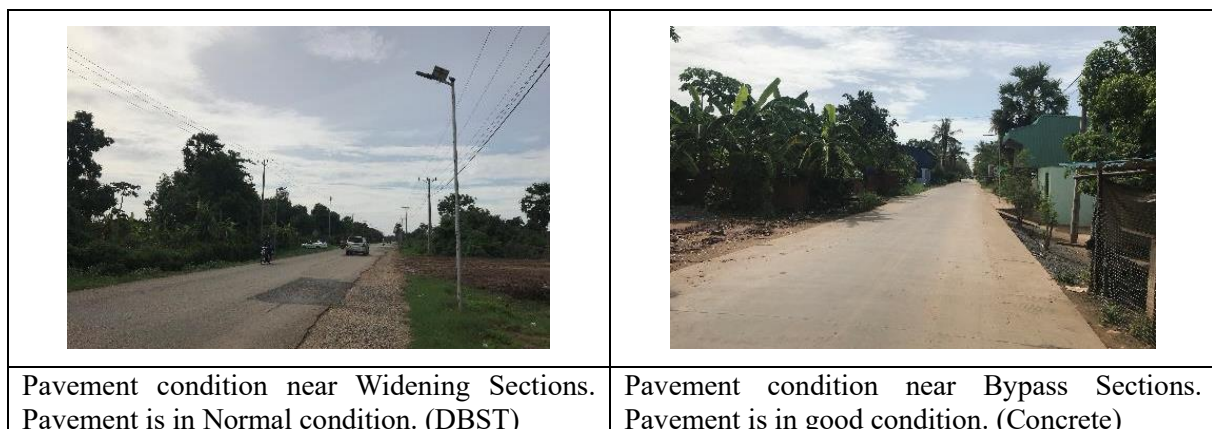


Figure 4.4-22 Pavement Condition (Akreiy Ksatr Side)

4.4.5 Tunnel Section

(1) Roadside Condition

Roadside conditions along tunnel section are shown below.



① Around the riverbanks on PP side
The revetment of Diamond Island has a road that circles the island. The revetment is about 10 m above the surface of the Mekong River.

② Diamond Island
Diamond Island, the pit mouth of the proposed tunnel route, is lined with a number of high-rise buildings, including Naga World.

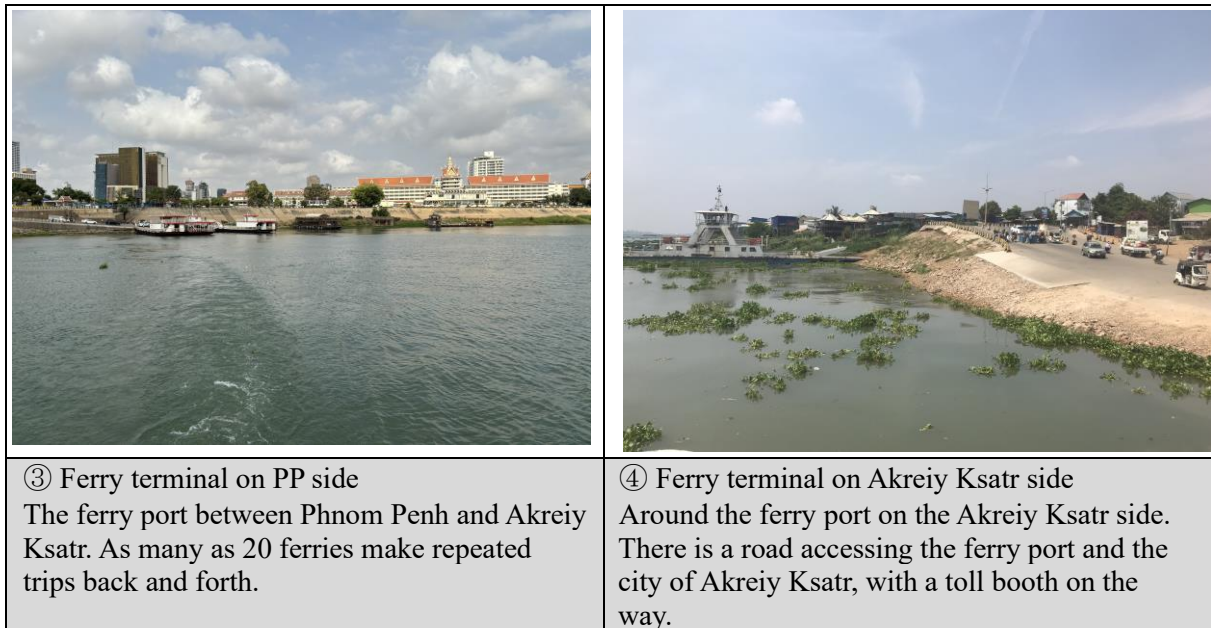


Figure 4.4-23 Road Condition

(2) Existing Road Width

This section consists of two-lane carriage way on one side in Phnom Penh side and two-lane carriage way in Akreiy Ksatr side.

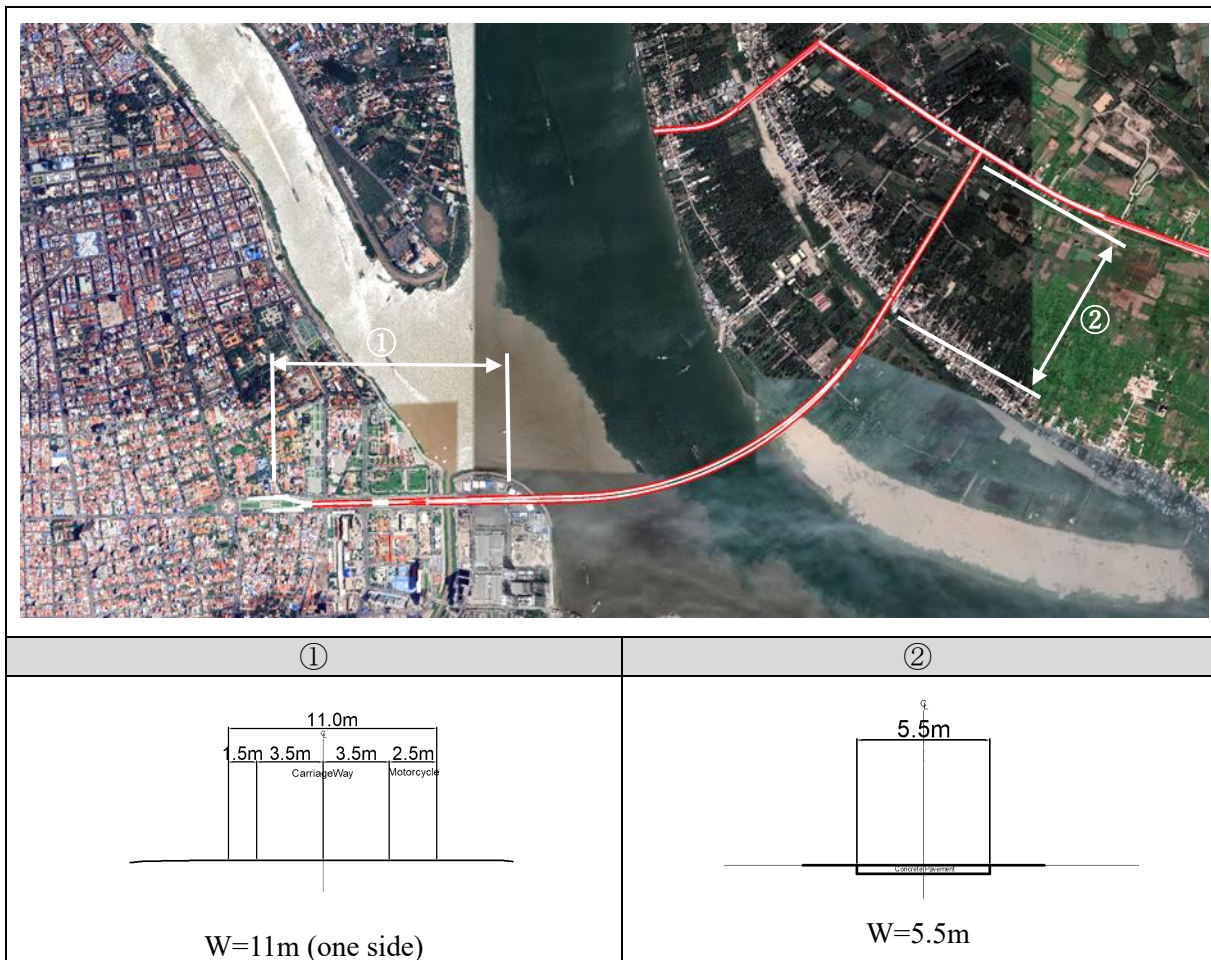


Figure 4.4-24 Existing Road Width

(3) Pavement condition

The pavement condition of this section was Asphalt concrete pavement in the Diamond Island and Concrete pavement in Akreiy Ksatr. The pavement condition of both section is classified as normal.



 A photograph showing a wide asphalt road with a modern building on the left and a street lamp on the right. The sky is overcast.	 A photograph of a concrete road lined with trees and utility poles. A car is visible in the distance under a clear sky.
<p>Pavement condition near Tunnel Sections. Pavement is in Normal condition. (AC)</p>	<p>Pavement condition in Akreiy Ksatr City side. Pavement is in Normal condition. (Concrete)</p>

Figure 4.4-25 Pavement Condition

CHAPTER 5 VALIDATION OF THE REQUESTED PROJECT

5.1 Selection of the best proposal for each requested project

(1) The scope of the requested project

In order to examine the validity, it is necessary to determine the optimal road structure in the target area, such as road alignment, number of lanes, and whether the road is to be widened or bypassed. The sections are classified follows and illustrated in the figure below:

1. Section 0km to 4km
2. Section 4km to 20km
3. Section 20km to 54km
4. The Mekong River Bridge
5. The Mekong River Tunnel

Alternatives for each section will be considered, and the best option for each also will be selected. Note that this section number starts counting from the Monivong Intersection as zero and is different from the kilometer marker indications on National Road 1.

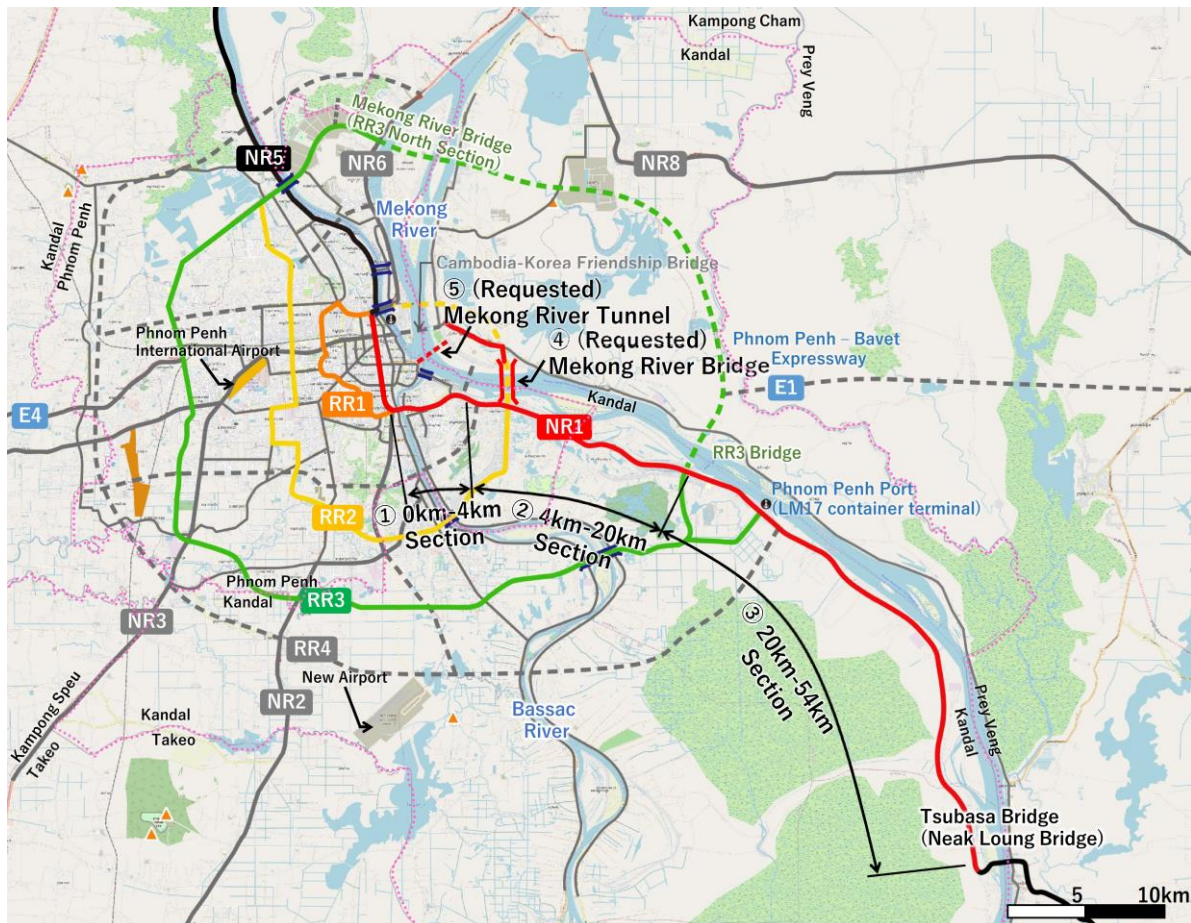


Figure 5.1-1 Requested Projects along the NR1

(2) Design criteria

In principle, the Cambodian design standards will be adopted for the structural reference values of the road to be used in the design. However, since NR1 is designated as part of Asian Highway, it is necessary to satisfy the Asian Highway design criteria values. In addition, since some items are not specified in

the Cambodian standards, the values used in the previous NR1 rehabilitation (2014) were also referred to determine the adopted values for this survey.

In addition, utilizing lessons learned from past infrastructure projects, such as National Road No.5 Improvement Project and Project for Improvement of Road Traffic Safety on Trunk Roads, the design will carefully consider traffic safety. This includes adequately planning for intersection layouts and pedestrian pathways to ensure a safe and efficient environment for all road users.

Table 5.1-1 Design Criteria of NR1

Items	Asian Highway (AH)		Cambodian design standards		NR1 rehabilitation (2014)			Adoption value
	Class I	Class II	Rural (R5)	Urban (U5)				
Design Speed(km/h)	100	80	100	80	80	60	40	80
Min Curve Radius(m)	350	210	495	300	280	150	60	300
Maximum grades (%)	4.0	4.0	3~5	4~6	4.0	5.0	7.0	4.0
Critical plane curve radius (m)	1500	900	-	-	900	500	250	900
Minimum length of spiral (m)	85	70	-	-	70	50	35	70
Lane width (m)	3.5	3.5	3.5	3.5	3.5			3.5
Shoulder width (m)	3.0	2.5	3.0	3.0	1.0			3.0
Median width (m)	3.0	-	4.0	3.0	2.0			3.0
Cross slope (%)	2.0	2.0	2.5~3.0		3.0			3.0
Maximum slope (%)	10.0	10.0	6.0~7.0		4.0			4.0

In case a continuous viaduct is planned for this section, it is necessary to install an entrance/exit by ramp. In this case, the geometric structure of the ramp was determined as shown in the table below.

Table 5.1-2 Design Criteria of Ramp

Items	A Standard
Design Speed(km/h)	40
Min Curve Radius(m)	50
Maximum grades (%)	6.0
Critical plane curve radius (m)	140
Minimum length of spiral (m)	35
Lane width (m)	3.5
Left shoulder width (m)	2.5
Right shoulder width (m)	1.0
Maximum slope (%)	11.0
Deceleration length (m)	80.0
Acceleration length (m)	160.0
Taper length (m)	50.0
Outflow: direct Inflow: parallel	

Table 5.1-3 Design Criteria of RR2

Items	Cambodian design standards		Adoption value
	Rural (R5)	Urban (U5)	
Design Speed(km/h)	100	80	80
Min Curve Radius(m)	495	300	300
Maximum grades (%)	3~5	4~6	4.0
Critical plane curve radius (m)	-	-	900
Minimum length of spiral (m)	-	-	70
Lane width (m)	3.5	3.5	3.5
Shoulder width (m)	3.0	3.0	3.0
Median width (m)	4.0	3.0	3.0
Cross slope (%)	2.5~3.0		3.0
Maximum slope (%)	6.0~7.0		4.0

(3) Policy on planning alternatives

Based on the forecasted traffic demands for 2050, the section from the Bassac River crossing to just before the Tsubasa Bridge on National Road No. 1 (analyzed in three segments: 0km-4km, 4km-20km, and 20km-54km) will require traffic capacity enhancement measures. Two options have been identified: full road widening or construction of bypasses for entire sections.

During this study, MPWT indicated that the Right of Way (ROW) has been secured to allow for widening along National Road No. 1. Given the high volume of earthwork and estimated costs required for constructing new embankments for bypasses, the basic policy is to pursue road widening across all sections. For areas where widening poses challenges, short bypasses will be considered as alternative solutions.

5.1.1 The 0km-4km Section of National Road 1

(1) Target Section and Current Situation

1) Location and surrounding facilities

The target section of NR1 is shown below.

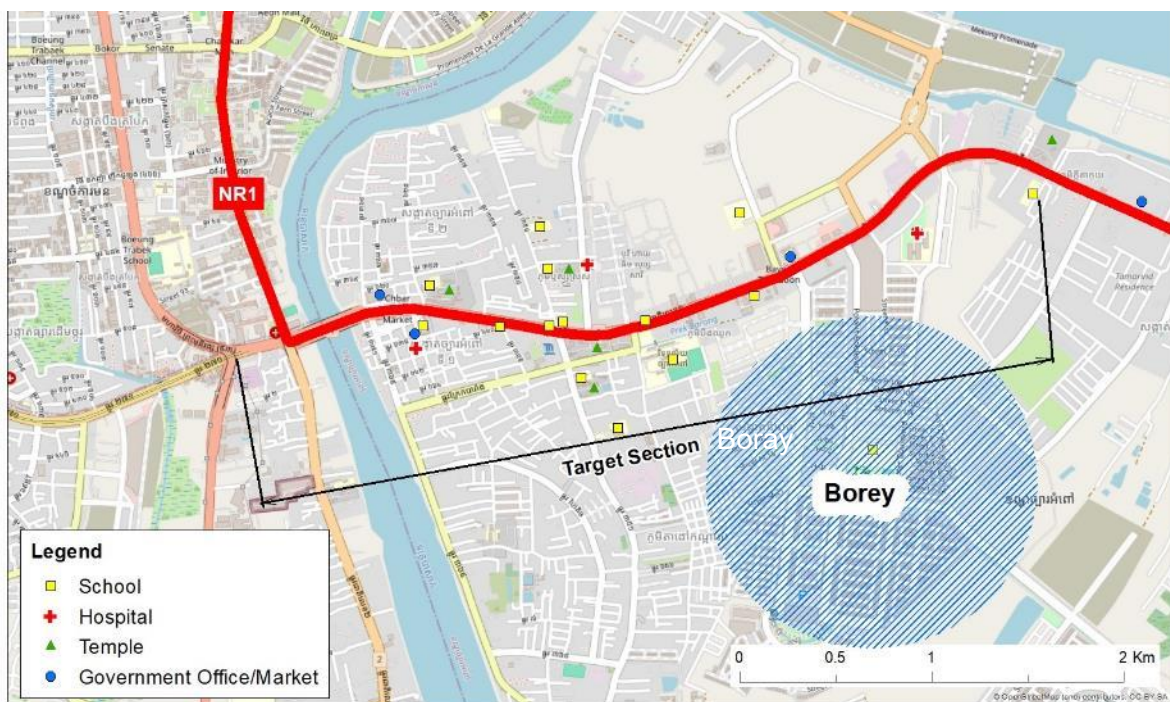


Figure 5.1-2 Facilities along the 0km-4km Section of NR1

2) Existing Cross Section

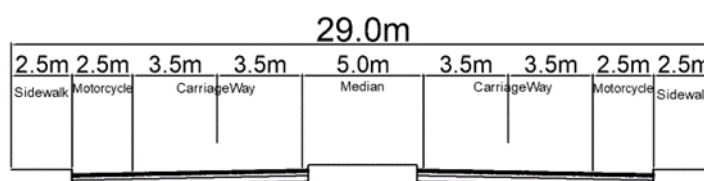


Figure 5.1-3 Existing Cross Section

(2) Implementation Alternatives

From the Monivong intersection (No.0+00) to near KP10 (No.4+630) has been upgraded with four lanes by JICA grand aide in 2014. The road width of this section ranges from 25m to 39m within the 40m ROW.

However, traffic volume is expected to increase significantly in the future, and road capacity is likely to be insufficient. Moreover, since the roadside is densely populated with commercial facilities, it will be difficult to widen the road. Given the circumstances described, the construction of a viaduct was proposed as a solution. As an alternative, a plan for partial grade separation, which involved implementing a flyover at the particularly congested section and 6-lane implementation on the other sections, as shown in the right figure, was developed for comparison with a full-length viaduct.

The continuous viaduct from the Monivong intersection to near KP10, including the locations of the ramp installations, was also considered. Both alternatives require more width at the beginnings and ends of the bridges, as well as at the locations of the ramps.

The future traffic demand forecasts for this section indicate that the current traffic capacity will be insufficient. Simply improving the existing intersections will not resolve the capacity issues of the roadway segments. Consequently, two alternatives for increasing the single-roadway traffic capacity—a continuous viaduct and partial grade-separated structures—was compared in this section.

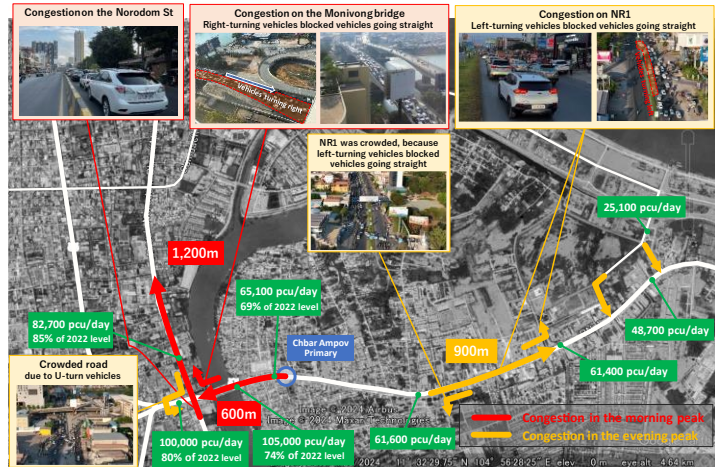
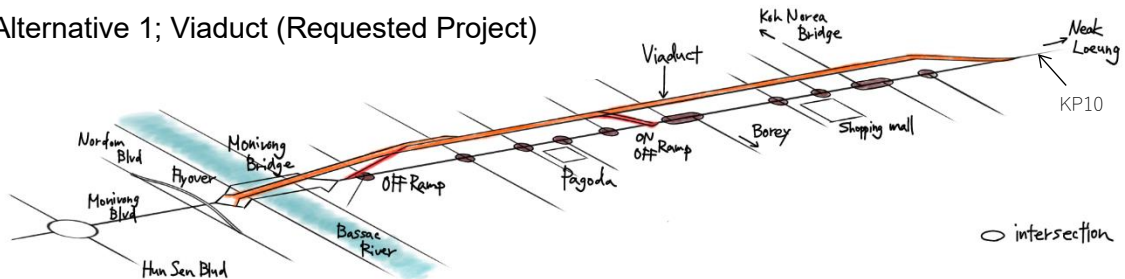


Figure 5.1-4 Current Traffic Situation

Alternative 1; Viaduct (Requested Project)



Alternative 2; Partial Flyover

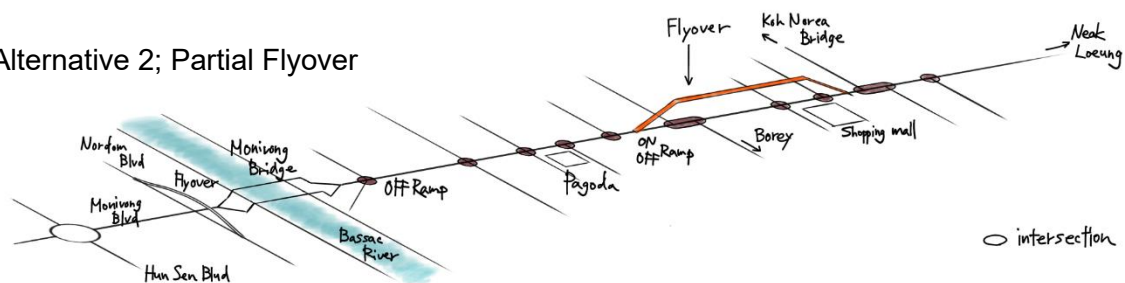


Figure 5.1-5 Sketch of Alternatives

1) Drawings of Plans

Alternative 1; Viaduct (Requested Project)

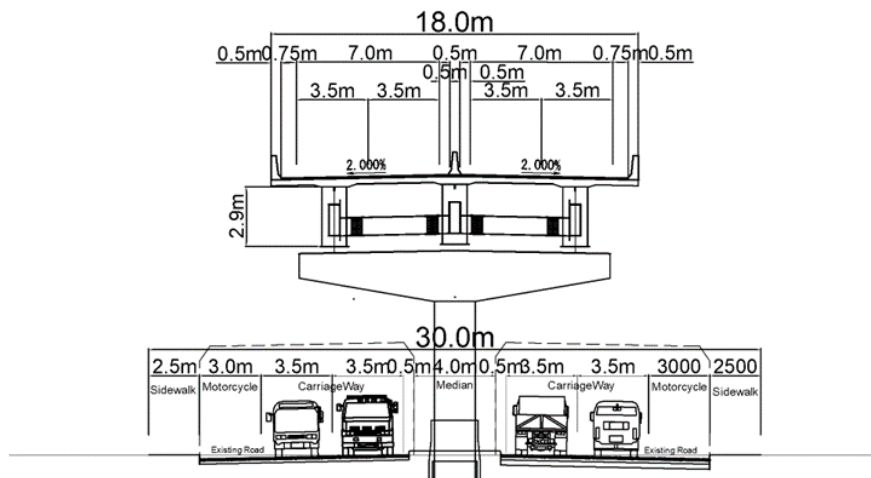


Alternative 2; Partial Flyover



Figure 5.1-6 Plan of Alternatives on the 0km-4km Section

Alternative 1; Continuous Viaduct



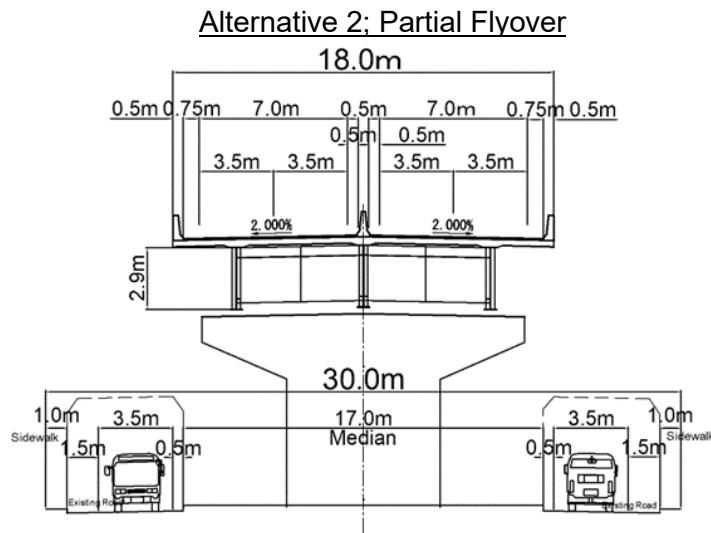


Figure 5.1-7 Typical cross-sections

2) Study on Beginning Location of the Viaduct

The starting point of the continuous viaduct has been considered. Currently, a three-level interchange is being constructed approximately 200 meters west of the Monivong flyover at the Morodok intersection. The possibility of overpassing the Monivong flyover and connecting the continuous viaduct to the second level of the under-construction flyover (Alternative 1) was explored. However, this approach has been deemed structurally challenging due to a longitudinal gradient exceeding 6%. Consequently, it has been determined that the viaduct must land at ground level on the east side of the Monivong flyover (Alternative 2).

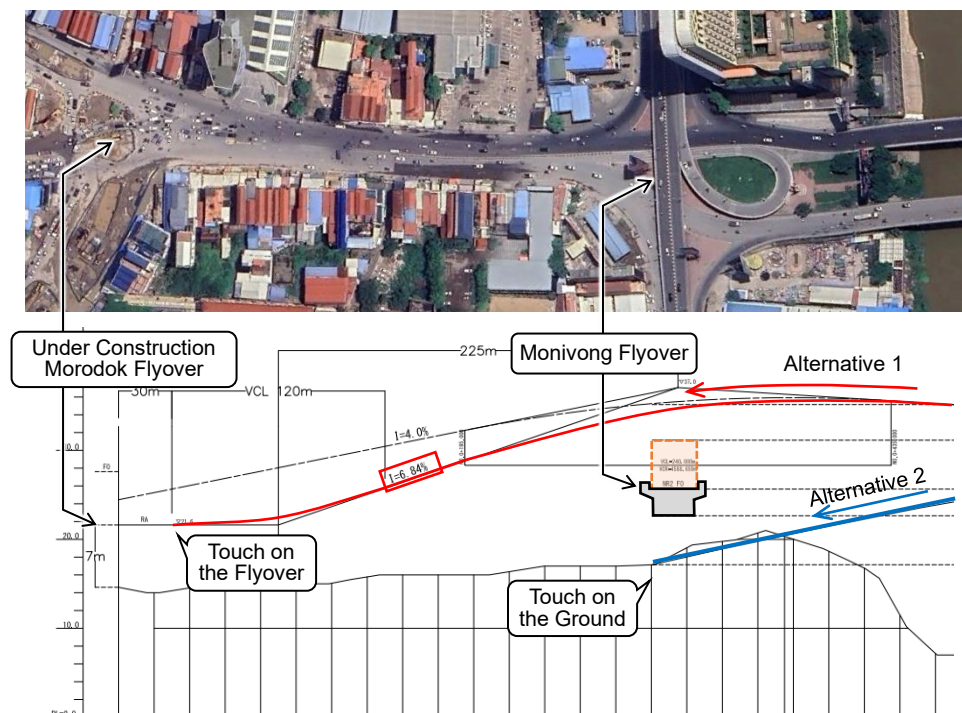


Figure 5.1-8 Profile of the beginning point of the viaduct

The viaduct's designated landing point is complicated by the existing Monivong flyover's loop ramp, which requires consideration of how to handle the ramp. Two alternatives were considered: Alternative 1 involves removing the loop ramp to facilitate smoother traffic at the viaduct's landing, and Alternative

2, which retains the loop ramp despite resulting in a more challenging alignment and reduced driving speeds. Consultations with MPWT revealed opposition from the Cambodian side to the removal of existing structures, leading to the adoption of Alternative 2.

In Alternative 2, the structures meet the as ramp standards. However, there is a need for the installation of adequate signage for speed reduction. After thorough discussions with the Cambodian side and under the condition that necessary safety measures are implemented, Alternative 2 was selected.

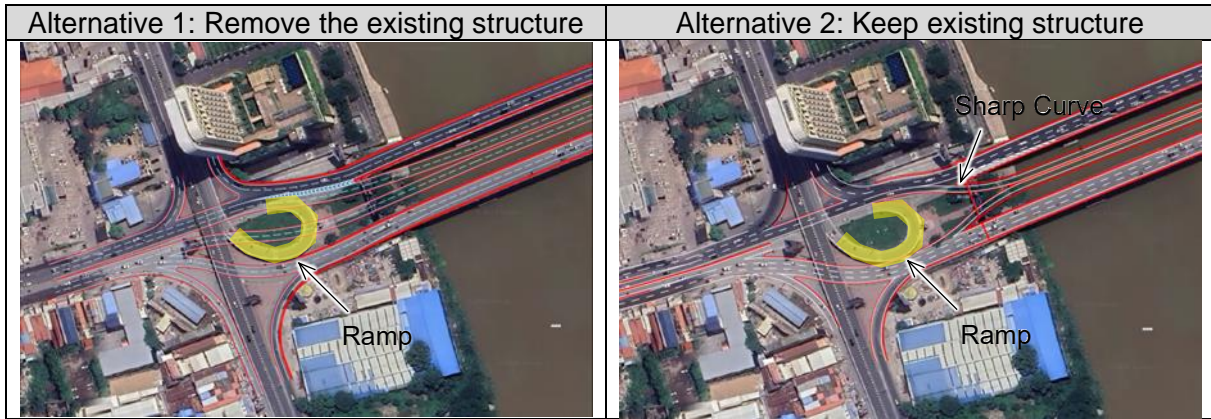


Figure 5.1-9 Connection of the Viaduct and Monivong Intersection

(3) Consider of Intersection for Koh Norea connecting road

It crosses the Koh Norea connecting road near No.4+000. The Koh Norea connecting road is a two-lane road under construction and there is a signalized intersection with NR1. With the Norea City development within Koh Norea, a four-lane road will be extended from the Koh Norea Bridge to the east end of Koh Norea, where it will intersect NR1 near No. 4+700. After the extension, access from the Cornorea Bridge to NR1 is expected to be primarily at the east intersection. The west intersection was determined to be possible with at-grade intersections based on intersection analysis with estimated traffic volumes. The eastern intersection is shown in Section 5.1.2.

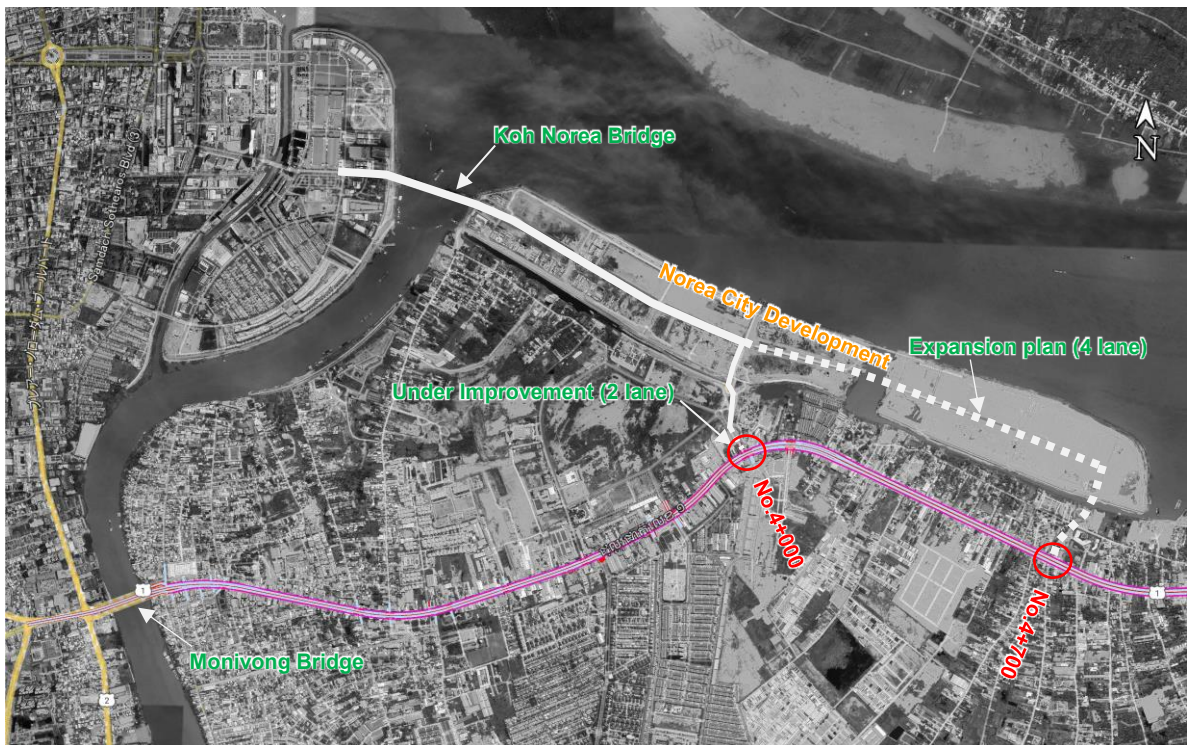


Figure 5.1-10 Location of Koh Norea connecting road

(4) Cost Estimation and Evaluation

Preliminary design for the road bridge was conducted, and an estimated project cost was calculated. Due to the current congestion around the Monivong Flyover, it is believed that the viaduct will not significantly alleviate traffic congestion, thus the high project costs may not provide proportional benefits. While effectiveness is expected after the diversion of traffic through future routes such as RR2 and RR3, at the present time, partial flyovers as a countermeasure for spot congestion are considered more efficient than continuous viaducts.

Table 5.1-4 Cost estimation and evaluation; No.0+000~No.4+630

	Alternative 1	Alternative 2
Structural Feature	Continuous Viaduct	Partial Flyover
Bridge Length	L=4.6 km	L=1.1 km
Traffic Congestion	On NR1 0-4km: Reduce At Monivong Intersection: Same	On NR1 0-4km: Partially reduce At Monivong Intersection: Same
Construction Cost (Direct Cost)	48.8 billion JPY 314.7 million USD	11.5 billion JPY 74.4 million USD
Number of Affected Structures	111	0
Evaluation	Fair	Good

Note) The cost doesn't include indirect cost, additional cost and so on. Loan amount will be recalculated.

5.1.2 The 4km-20km Section of National Road 1

(1) Target Section and Current Situation

1) Location and surrounding facilities



Figure 5.1-11 Facilities along the 4km-20km Section of NR1

2) Existing Cross Section

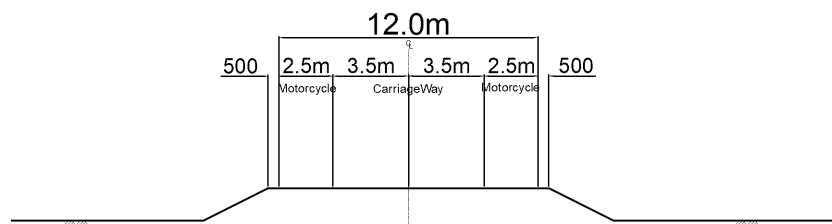


Figure 5.1-12 Existing Cross Section

(2) Alternatives

The section from No.4+630, the end of the viaduct section, to the intersection with RR3 (No.19+800), L=15.17km, needs to be widened from the current 2-lane road to a 6-lane road as the traffic volume is expected to increase in the future. In addition, since the intersection branching to the Koh Norea Bridge is included in this section and the intersection is under capacity, the construction of a flyover to the relevant intersection will be considered. Most of the section has been set back to allow for future widening, but in the vicinity of Kokir Market, stores are operating on the street and may take time to coordinate with the residents for widening. Therefore, a short bypass instead widening at the Kokir Market was considered as an alternative.

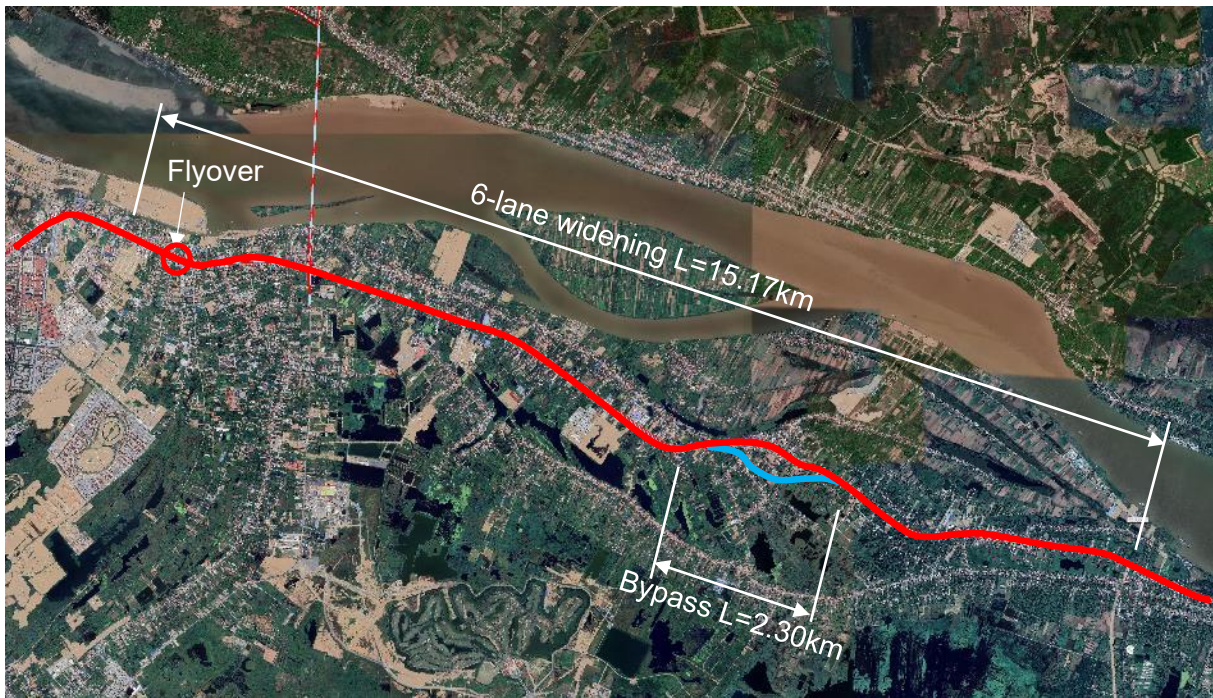
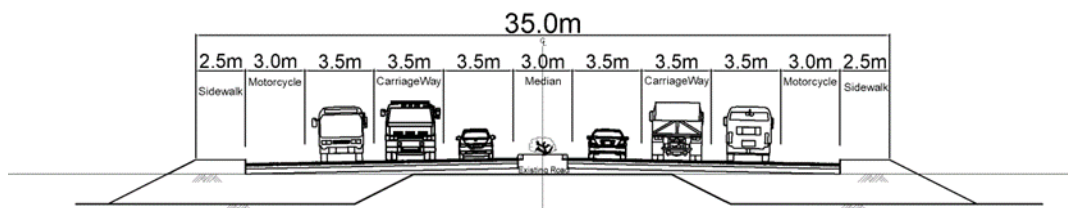
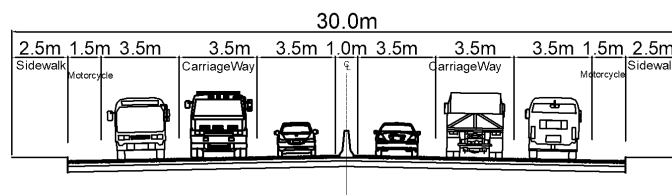


Figure 5.1-13 Six-lane Widening Section and Alternative Bypass

Typical Cross Section for Widening



Typical Cross Section for Widening (Kokir Market)



Typical Cross Section for Bypass

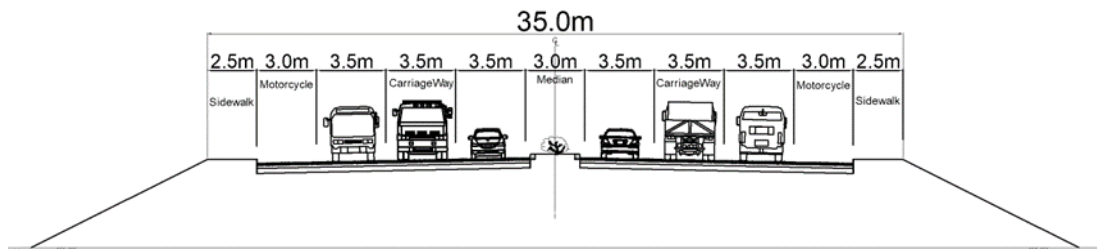


Figure 5.1-14 Typical Cross-sections

Koh-Norea Intersection

The intersection branching off to the Koh Norea Bridge is estimated to have high traffic volumes in the future and thus requires a multi-level intersection. The shape of the multi-level intersection was planned to be a

diamond shape, which would require the least amount of road land, with a flyover straight ahead on NR1.

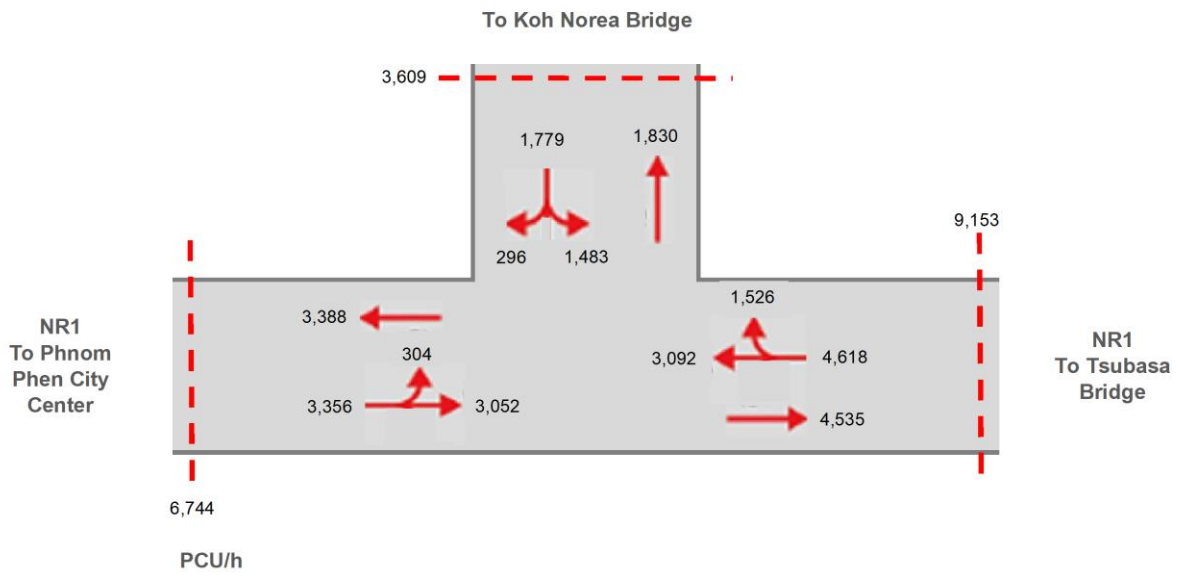


Figure 5.1-15 Traffic Volume in 2050



Figure 5.1-16 Plan of Intersection

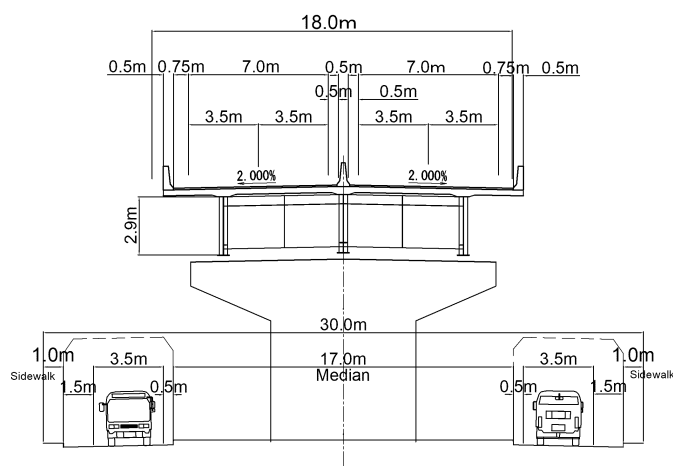


Figure 5.1-17 Typical cross-section

(3) Cost estimation and evaluation

The survey results have confirmed that a six-lane expansion is feasible near the market area by reducing medians. On the other hands, the cost of embankment construction makes the alternative 2, bypass plan, more expensive than widening the existing road, since it requires more soil. Additionally, there has been a report from MPWT that compensation for a 40-meter width along the entire NR1 has been completed, confirming the preference for utilizing existing land over acquiring new land for a bypass. Thus, widening NR1 to six lanes has been selected as the optimal solution, rather than constructing a bypass.

Table 5.1-5 Cost estimation and evaluation; No.4+630~No.19+800

	Alternative 1	Alternative 2
Structural Feature	Six-lane widening	Bypass (Kokir Market)
Length	L=15.17 km (Flyover L=1.08km)	L=15.19 km
Construction Cost (Direct Cost)	15.1 billion JPY 97.4 million USD	9.1 billion JPY 58.6 million USD
Number of Affected Structures	In ROW 933	In ROW 767
	New Acquisition 0	New Acquisition 67
Evaluation	Good	Fair

Note) The cost doesn't include indirect cost, additional cost and so on. Loan amount will be recalculated.

5.1.3 The 20km-54km Section of National Road 1

(1) Target Section and Current Situation

1) Location and surrounding facilities

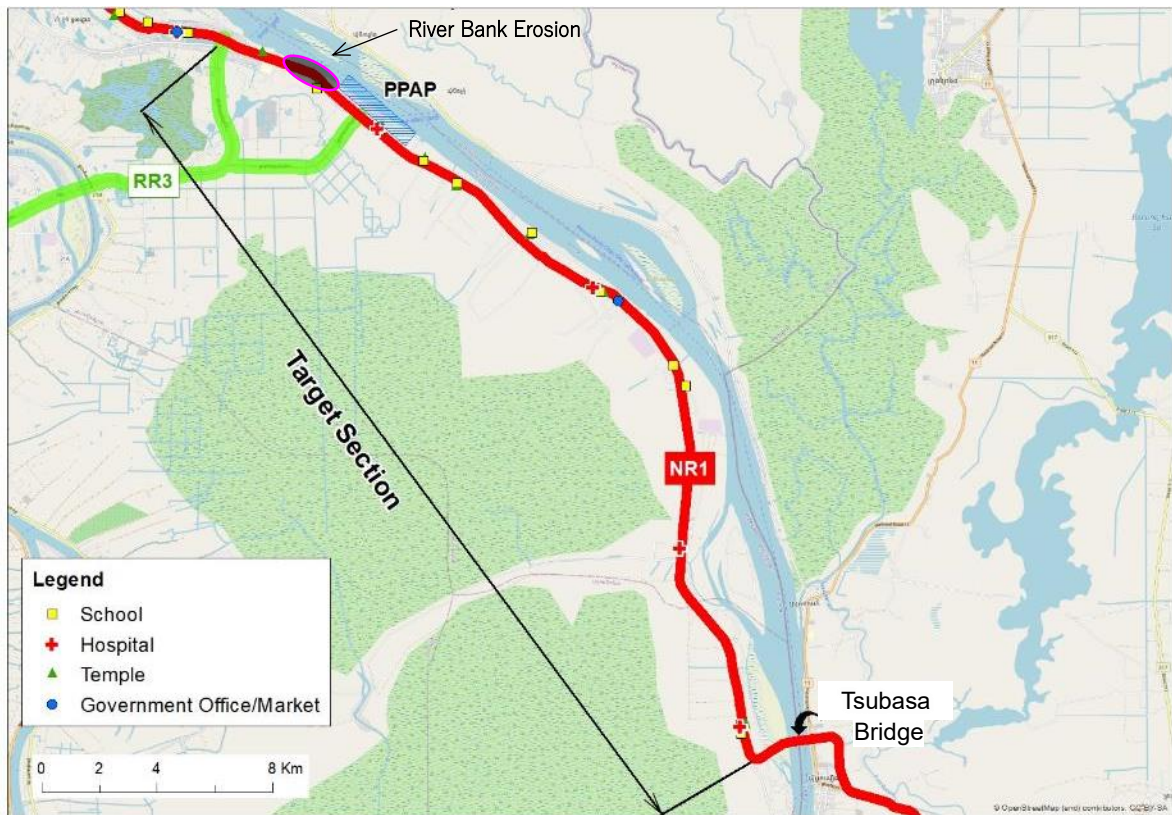


Figure 5.1-18 Facilities along the 20km-54km Section of NR1

2) Existing Cross Section

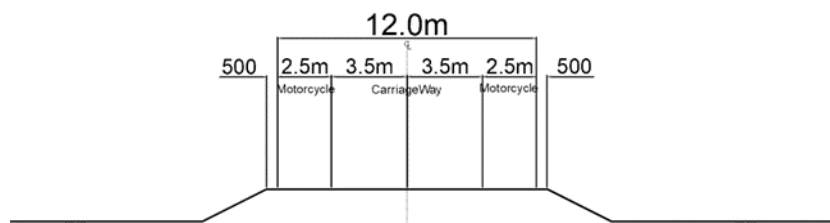


Figure 5.1-19 Existing Cross Section

(2) Alternatives

The section from the intersection with RR3 (No.19+800) to No.53+566 before Tsubasa Bridge, L=33.77km, needs to be widened from the current 2 lanes to 4 lanes in consideration of future traffic volume.

- Section No.22+700 to No.23+600

The bank of the Mekong River is eroding and approaching NR1. In this section, simple measures were installed to try to stop the bank erosion. It was informed that the erosion had stopped after the sand removal from the Mekong River was restricted. However, since the separation between NR1 and the revetment is narrow and several restaurants and other businesses are observed between the road and the revetment, a short bypass that bypasses the road to the inland side was considered as an alternative.

- Section No.42+850, No.43+450, and No.46+400

There are bridges constructed with JICA assistance near No.42+850 and No.43+450, and an existing box culvert and roadside market near No.46+400, a short bypass that bypasses these bridges was considered as an alternative.

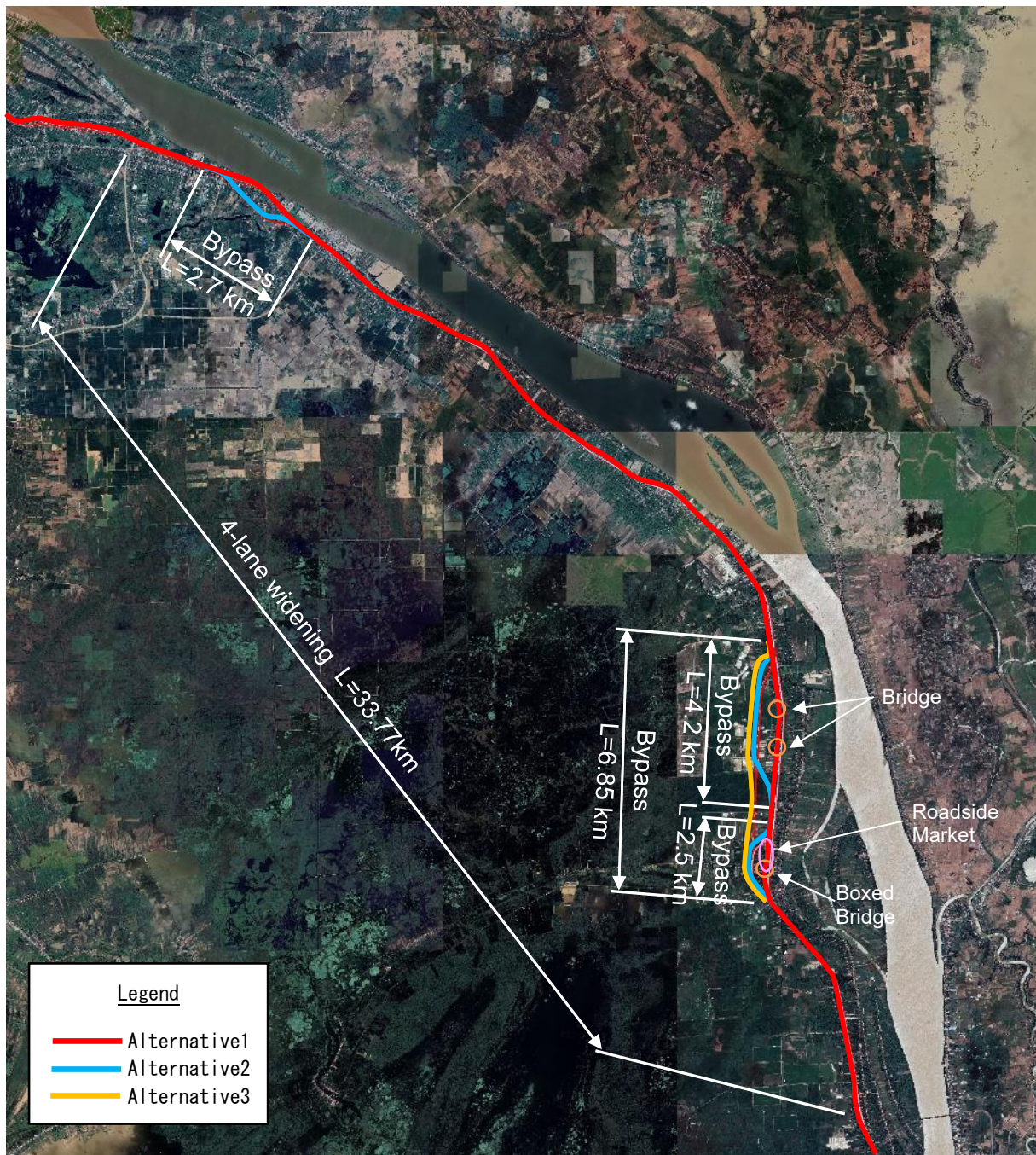
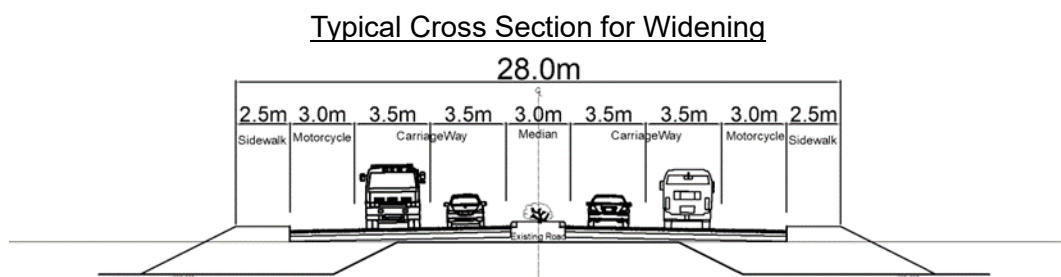


Figure 5.1-20 4-lane widening section and alternative bypass



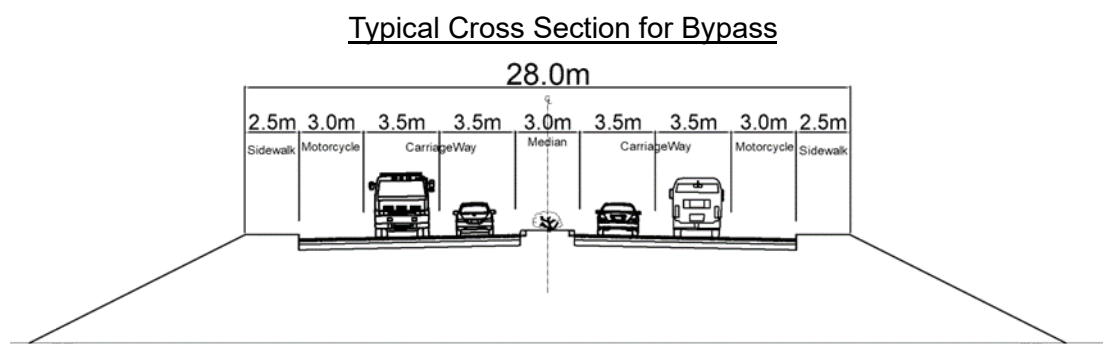


Figure 5.1-21 Typical cross-sections

(3) Cost estimation and evaluation

Based on the survey results, the sections from No.22+700 to No.23+600 along the riverbank are experiencing erosion, and MPWT plans to implement separate erosion control measures in the future. Due to the need for new land acquisition and the greater amount of embankment required for a bypass compared to widening the existing road, a policy prioritizing the widening of the existing road has been confirmed.

For the short bypass options considered near No.42+850, No.43+450, and No.46+400, similar to earlier sections, a bypass would require 5-6 meters of new embankment, which is more than the widening option where embankment has already been placed, leading to higher construction costs. Additionally, it has been reported by MPWT that compensation for a 40-meter width along the entire NR1 has been completed, and there is a preference to utilize existing land rather than acquiring new land for a bypass. Hence, a widening plan using existing land is favored, and a four-lane expansion for the entire section is recommended.

Furthermore, regarding the maintenance of this section, it will be necessary to reconfirm and agree with MPWT on measures to address riverbank erosion in the preparatory survey.

Table 5.1-6 Cost estimation and evaluation; No.19+800~No.53+566

	Alternative 1	Alternative 2	Alternative 3
Structural Feature	4-lane widening	Bypass (3BP)	Bypass (2BP)
Length	L=33.77 km	L=34.33 km	L=34.01 km
Construction Cost (Direct Cost)	12.9 billion JPY 82.9 million USD	15.4 billion JPY 99.6 million USD	14.9 billion JPY 96.1 million USD
Number of Affected Structures	In ROW 1052	In ROW 910	In ROW 910
	New Acquisition 0	New Acquisition 65	New Acquisition 53
Evaluation	Good	Fair	Fair

Note) The cost doesn't include indirect cost, additional cost and so on. Loan amount will be recalculated.

5.1.4 Mekong River Bridge

(1) Target Section and Current Situation

1) Location and surrounding facilities

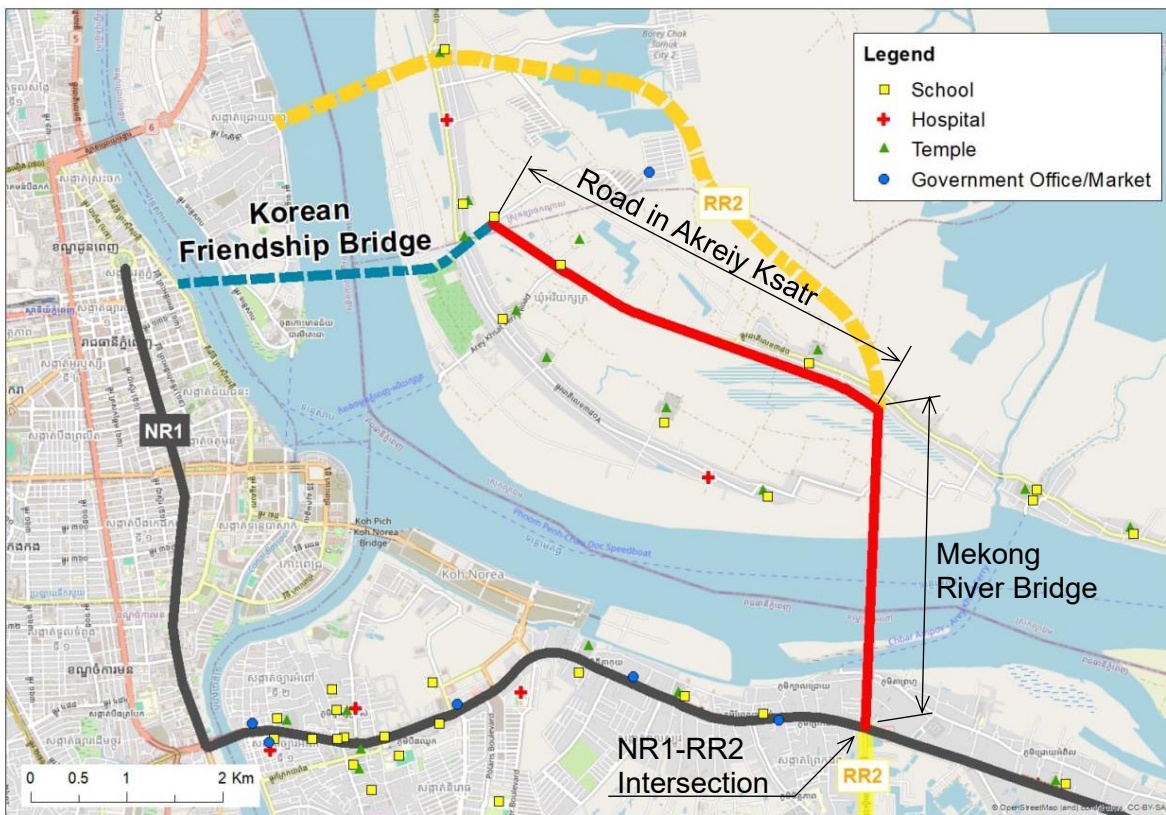


Figure 5.1-22 Facilities around the Mekong River Bridge

2) Components

In the development of the Mekong River Bridge, the analysis extends beyond just the bridge itself to ensure that vehicles can smoothly access and exit the bridge. This necessitates a comprehensive examination of the surrounding infrastructure. Specifically, this includes the roads on the Akreiy Ksatr City side that are connected by the bridge, and on the Phnom Penh side, the intersections with NR1.

Therefore, the evaluation of the Mekong River Bridge project is structured around three critical components: 1) the Mekong River Bridge itself, 2) the Access Road in Akreiy Ksatr City, and 3) the intersection with NR1-RR2.

(2) Study on each Component

1) The Mekong River Bridge

Conditions

In the design on Mekong River Bridge, one main navigational channel for 3,000DWT vessels and two sub navigational channels for local coasters are considered in the planning, to take into account the navigational situation such as frequent vessel traffic at the site.

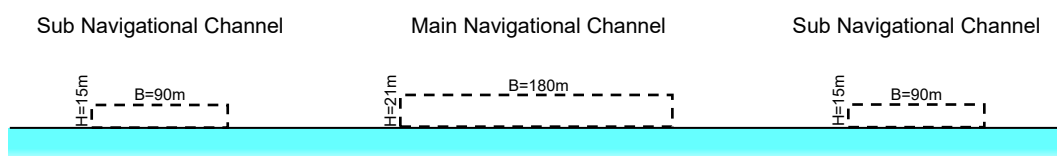


Figure 5.1-23 Navigational Clearance for the Mekong River Bridge

The conditions for the project are based on the figures specified in the Cambodia Waterway Development Master Plan, and similar conditions have been applied to the planned Korean Friendship Bridge upstream. The use of these figures has been confirmed by MPWT.

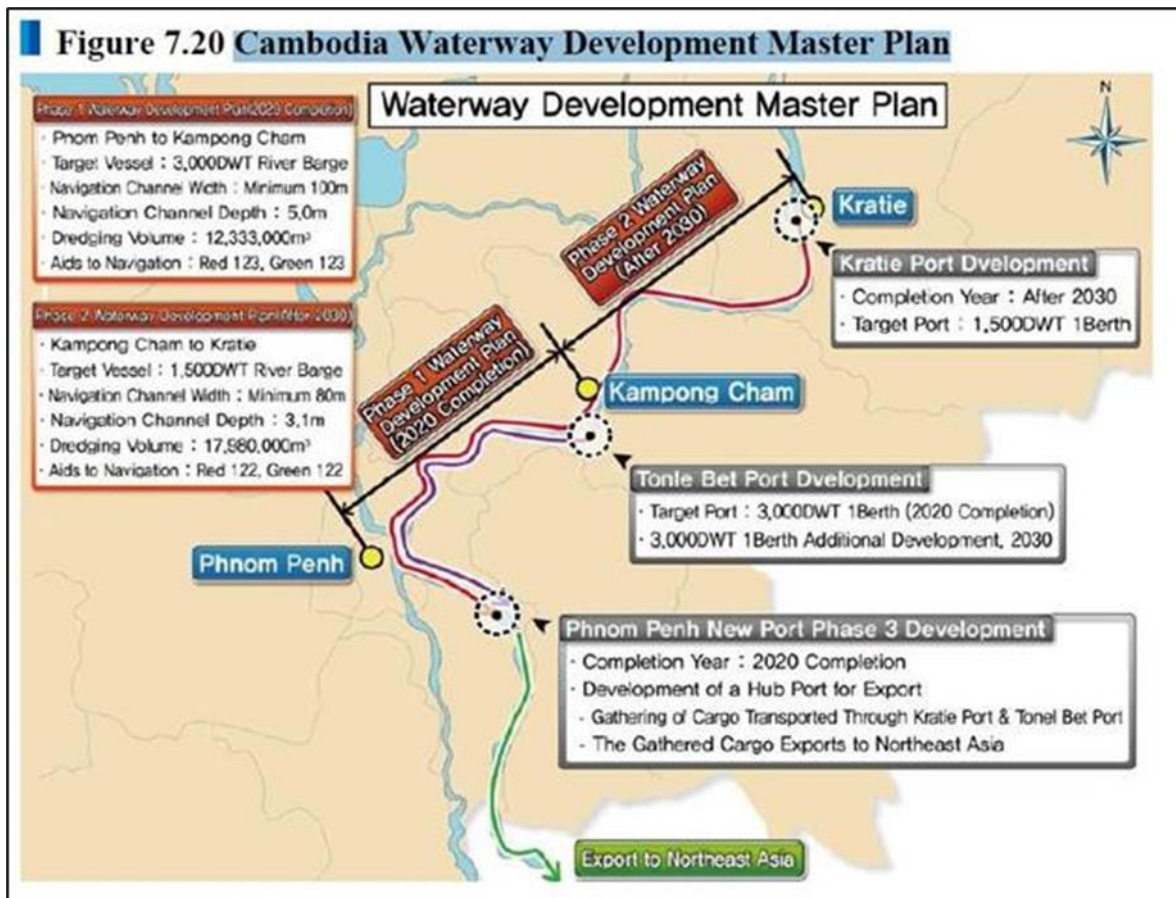


Figure 5.1-24 Cambodia Waterway Development Master Plan

Typical cross section

Based on the demand forecast results, the projected traffic volume for this bridge by the year 2050 is expected to be 115,000 pcu per day. Consequently, the plan is to design the bridge with six lanes to accommodate this volume.

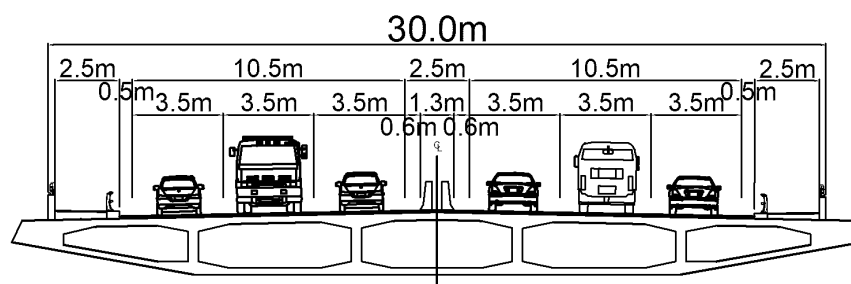


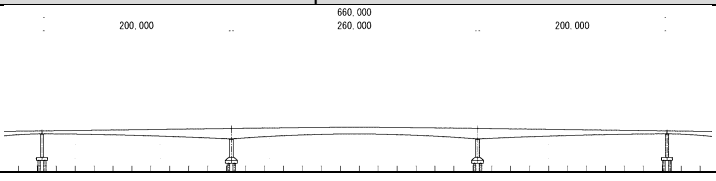
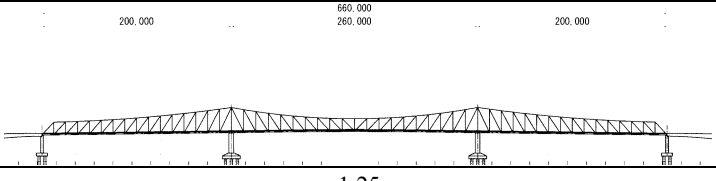
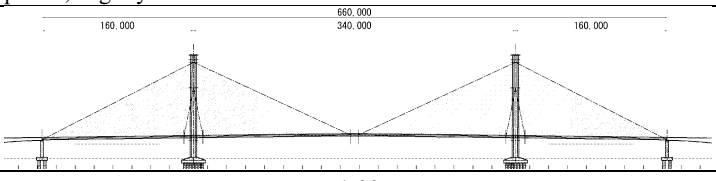
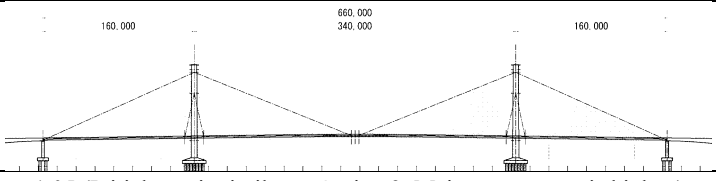
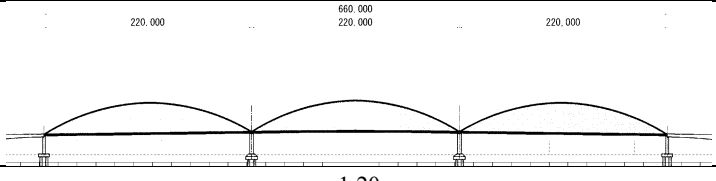
Figure 5.1-25 Typical Cross-sections

Bridge type study

Bridge types applicable to the main bridge of the Mekong River Bridge was compared and studied. The comparison was conducted for the following 5 options; 1: steel box girder bridge (steel deck), 2: steel truss bridge, 3: PC cable stayed bridge, 4: steel cable stayed bridge, 5: steel arch bridge.

PC cable stayed bridge is most recommended as an optimum among the above-mentioned options.

Table 5.1-7 Comparison of Bridge Types for Main Bridge

		Description	Evaluation
1	[Steel box girder bridge (Steel deck)] Profile		
	Cost	1.20	△
	Structure	Longer approach bridge due to higher alignment because of higher girder depth.	×
	Construction	Full-span lifting w/ barge, crane + bents in waterway. Large assembly yard required.	△
	Maintenance	Repainting required for steel elements.	○
	Aesthetics	Simple. Less iconic.	○
2	[Steel truss bridge] Profile		
	Cost	1.25	△
	Structure	Many experiences for same structure type worldwide. No problem for application to similar size.	○
	Construction	Barge + crawler crane, cantilever erection + bents in waterway.	△
	Maintenance	Repainting required for many members.	△
	Aesthetics	Transparent, slightly old-fashioned.	×
3	[PC Cable Stayed Bridge] Profile		
	Cost	1.00	◎
	Structure	Experience of similar size in Tsubasa Bridge. No problem for application.	○
	Construction	Cantilever erection w/o large temporary equipment.	◎
	Maintenance	Less maintenance due to concrete.	◎
	Aesthetics	Iconic.	◎
4	[Steel Cable Stayed Bridge] Profile		
	Cost	1.05 (Initial cost is similar to Option 3. Maintenance cost is higher.)	○
	Structure	Many experiences worldwide. No problem for application to similar size.	○
	Construction	Cantilever erection w/o large temporary equipment.	◎
	Maintenance	Repainting required for girder members.	○
	Aesthetics	Iconic.	◎
5	[Steel Arch Bridge] Profile		
	Cost	1.20	△
	Structure	Many experiences for similar structure worldwide. No problem for application to similar size.	○
	Construction	Lifting / sliding erection from barge w/ bents. Large assembly yard required.	△
	Maintenance	Repainting required.	○
	Aesthetics	Symbolic.	◎

Notes ◎: excellent, ○: good, △: poor, ×: very poor

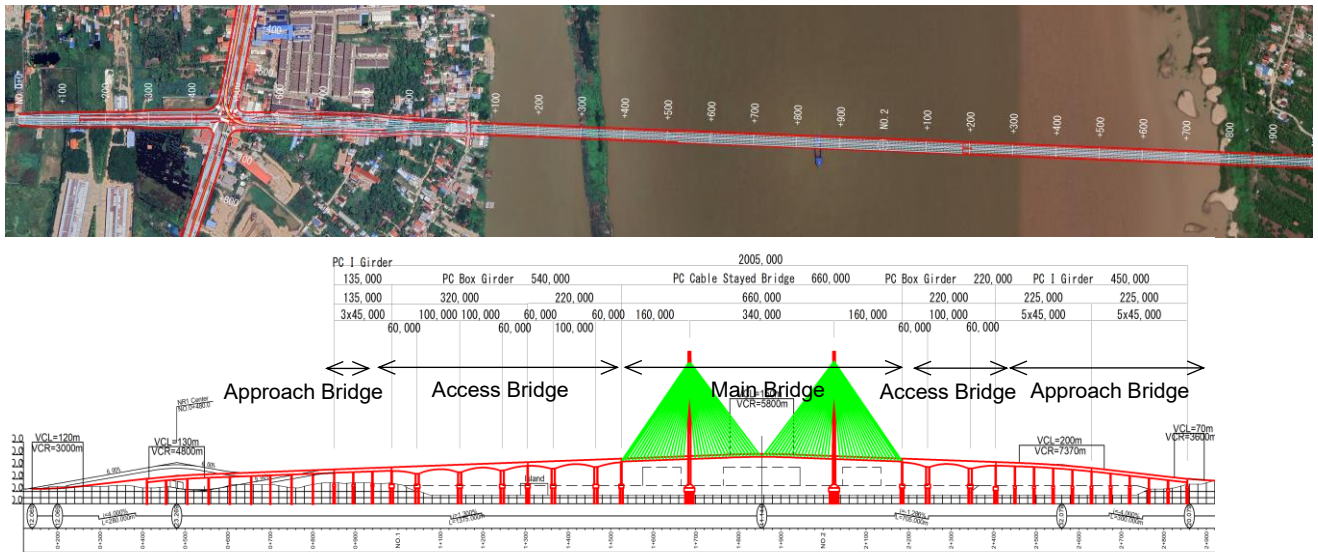


Figure 5.1-26 Plan and Profile of the Mekong River Bridge

For access bridges over the Mekong River connecting from approach bridges on land to Main Bridge, standard span length is determined to be about 100m so as to maintain safe navigability for local small vessels considering the actual situation of frequent vessel traffic at the site. Bridge type for the Access Bridge is hence assumed at the moment as PC box girder bridge (erected by free cantilever method) reasonably applicable to this span length and construction condition.

2) Access Road in Akreiy Ksatr

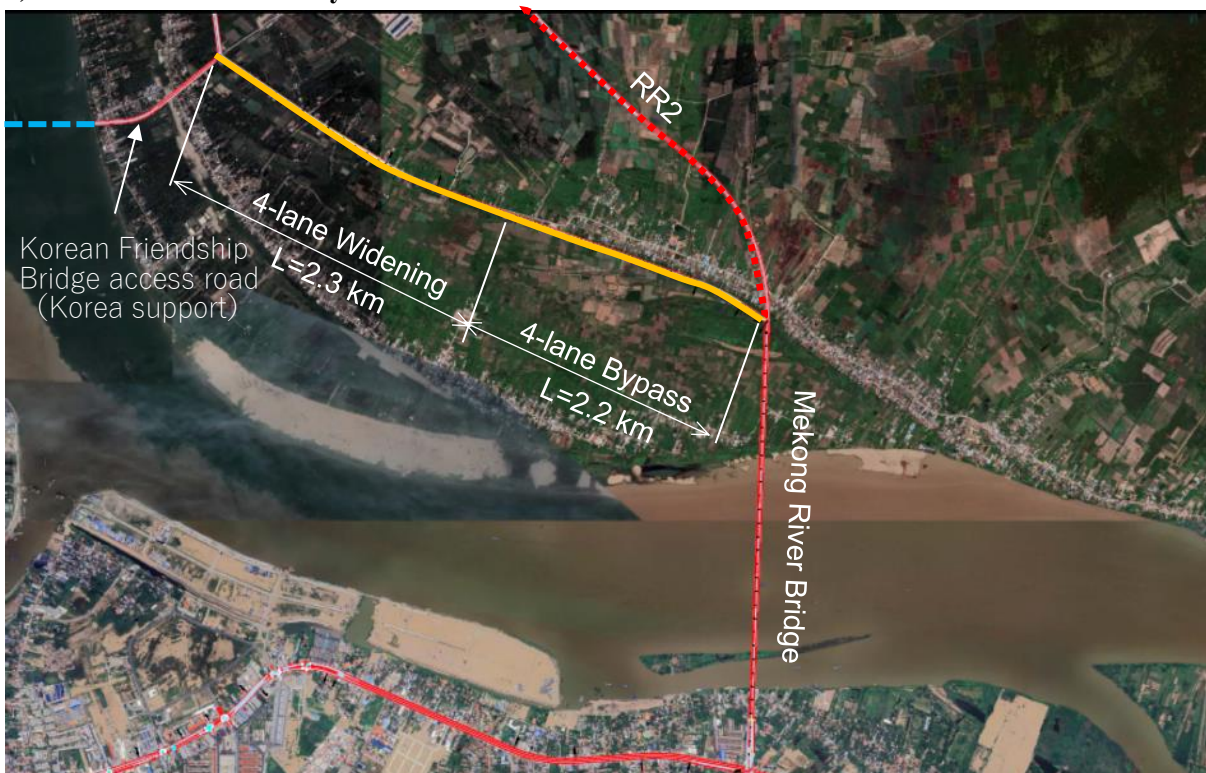


Figure 5.1-27 Road Plan in Akreiy Ksatr City

The current two-lane road in Akreiy Ksatr City requires widening to accommodate the increased traffic demand resulting from the new bridge implementation. Due to many residences facing the road in certain

sections, a bypass is appropriate as shown in the figure above. (May be developed with Korean assistance)

The bridge is planned to be a six-lane structure, and similar traffic capacity would be required if RR2 is extended. However, since this road will function temporarily until the construction of RR2, it will be developed as a four-lane road. Below is the typical cross-section for both widening and bypass section.

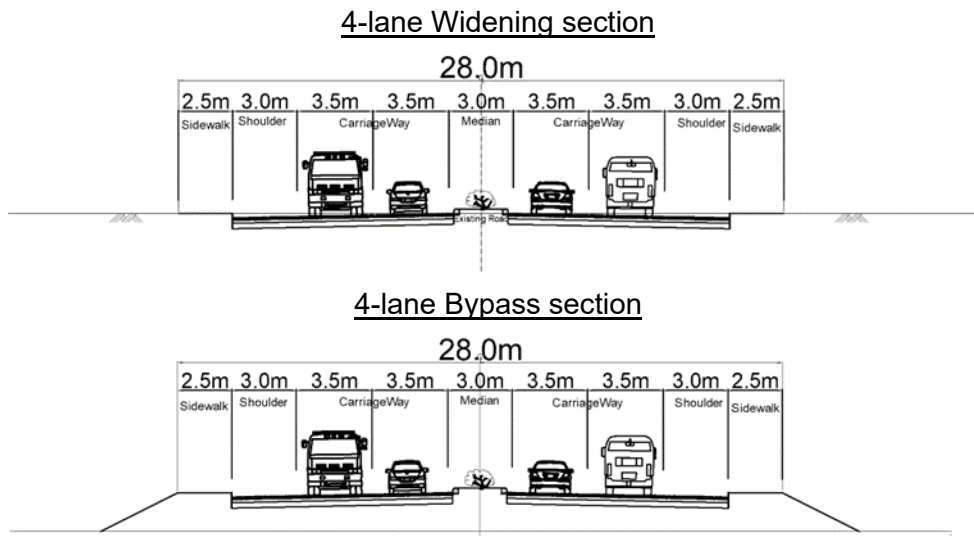


Figure 5.1-28 Typical Cross-sections

3) NR1-RR2 Intersection

Due to the high volume of traffic at the intersection of NR1 and RR2, there is a need to convert it into a grade-separated interchange. Three different designs for the junction have been considered.

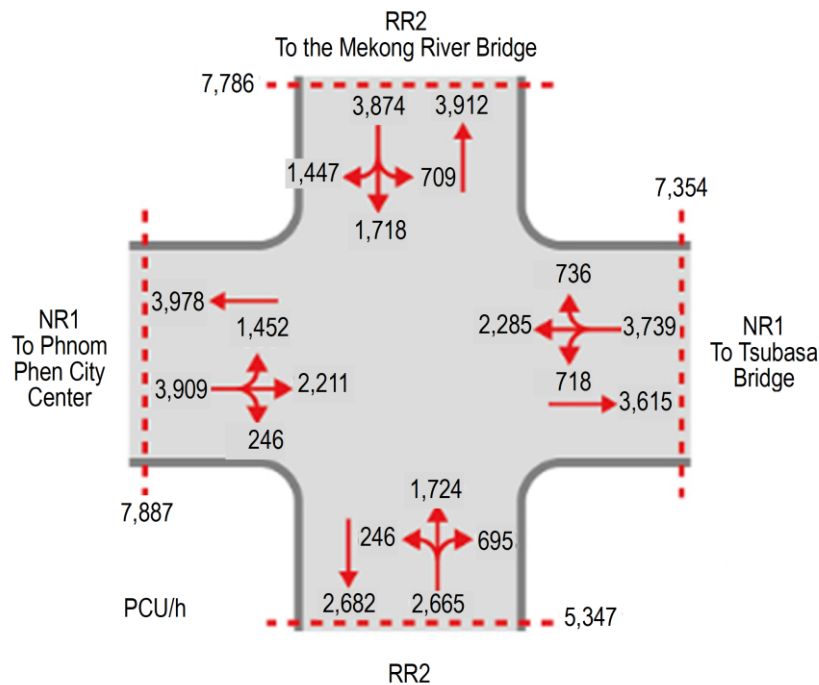


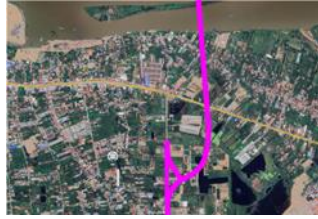


Figure 5.1-29 Traffic Volume at NR1-RR2 Intersection

Table 5.1-8 Alternatives for NR1-RR2 Intersection Shape

Alternatives	Diamond Interchange	Clover Interchange	Y Shape Interchange
Plan			
Remark	<ul style="list-style-type: none"> The impact on land acquisition will be the least among the alternatives. To maintain smooth traffic, a flyover for Left-turn is necessary. 	<ul style="list-style-type: none"> The impact on land acquisition will be larger than others. The capacity of this interchange is relatively lower than other grade-separated interchange and it could cause congestions 	<ul style="list-style-type: none"> The impact on land acquisition will be larger than others. The traffic at the intersection has been effectively dispersed to ensure sufficient traffic management. This adjustment allows for smoother handling of the traffic flow at the crossing point.
Evaluation	Good	Fair	Fair

After evaluating and comparing the features of each design option for the NR1 and RR2 intersection, the diamond interchange was selected. This design was chosen because it has the least impact on surrounding houses and adequately handles traffic without issues, offering a balance between efficiency and minimal disruption. The RR2 road crosses the Mekong River, so it is necessary to raise the road profile past the intersection to the navigation clearance elevation. Due to the short distance from the intersection to the Mekong River, RR2 was planned to be a flyover.

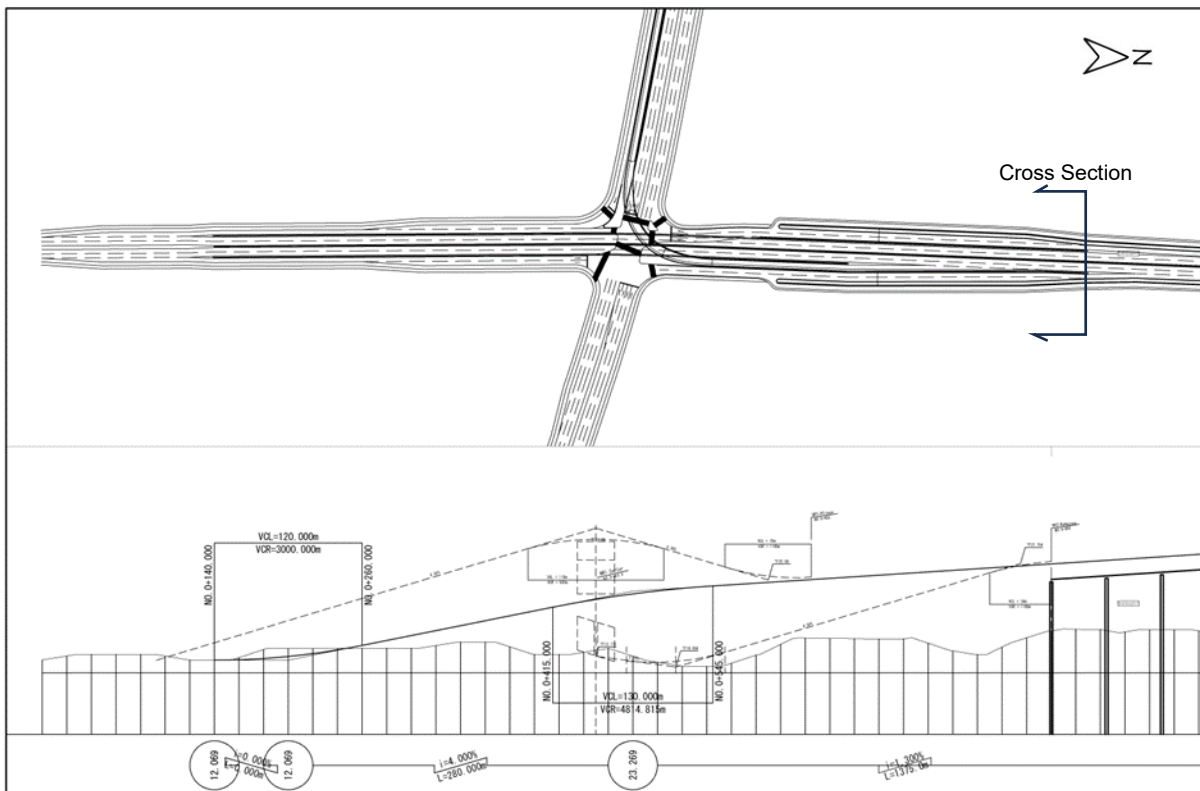


Figure 5.1-30 Intersection Plan and Profile

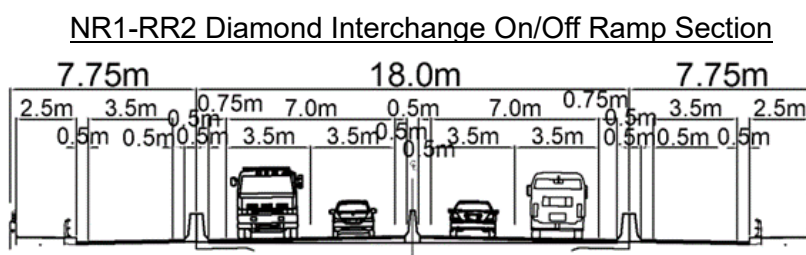


Figure 5.1-31 Typical Cross-Sections

(3) Cost estimation

The results of the cost estimation for each component, as detailed previously, are shown in the table below.

Table 5.1-9 Cost Estimation for the Mekong River Bridge

	The Mekong River Bridge	NR1-RR2 Overpass	Road Construction in Akreiy Ksatr City
Length	L=2.95 km	L=1.70 km	L=4.50 km
Construction Cost (Direct Cost)	47.7 billion JPY 307.9 million USD	9.2 billion JPY 59.5 million USD	1.7 billion JPY 11.1 million USD
Number of Affected Structures	New Acquisition 53		New Acquisition 30

Note) The cost doesn't include indirect cost, additional cost and so on. Loan amount will be recalculated.

5.1.5 Mekong River Tunnel

(1) Target Section and Current Situation

1) Location and surrounding facilities



Figure 5.1-32 Facilities around the Mekong River Tunnel

(2) Alternatives

For constructing a tunnel across a river, the options include a submerged tunnel or a shield tunnel. Here are the key points for each method:

Submerged Tunnel:

- This method allows the tunnel to be shallower, reducing the overall length and consequently the cost. The tunnel sections are prefabricated above ground, ensuring higher construction quality.
- However, it requires excavation of the riverbed, which can impact the environment. Additionally, construction may be affected by weather conditions.

Shield Tunnel:

- This method uses a tunnel boring machine, minimizing the impact on the surroundings. It also allows for simultaneous construction of the tunnel walls while tunnelling, making it suitable for areas with soft ground.
- Shield tunnels are generally deeper than submerged tunnels, which results in extended impact range.

Tunnel Maintenance and Management:

- Underwater tunnels require advanced technology not only for construction but also for operation and maintenance, including structural repairs and leakage control, as well as for traffic control, traffic accidents, and fire response.

Longitudinal Considerations:

- In the area under study, special attention must be given to unexploded ordnance (UXO), as unexploded ordnance from the construction of the Tsubasa Bridge is estimated to be within 20 meters below ground. Therefore, the tunnel depth is set deeper than 20 meters.
- As a result, the structural length of a shield tunnel is 900 meters longer than that of a submerged tunnel.

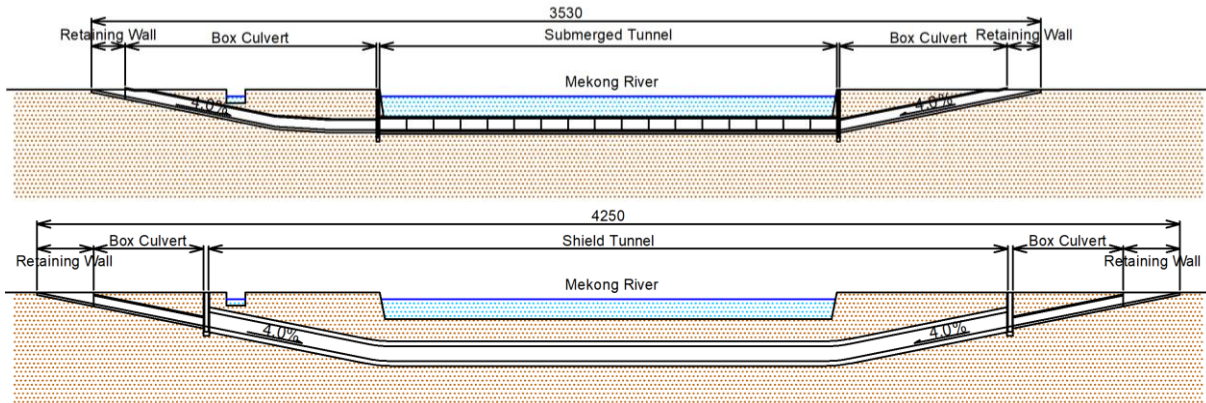
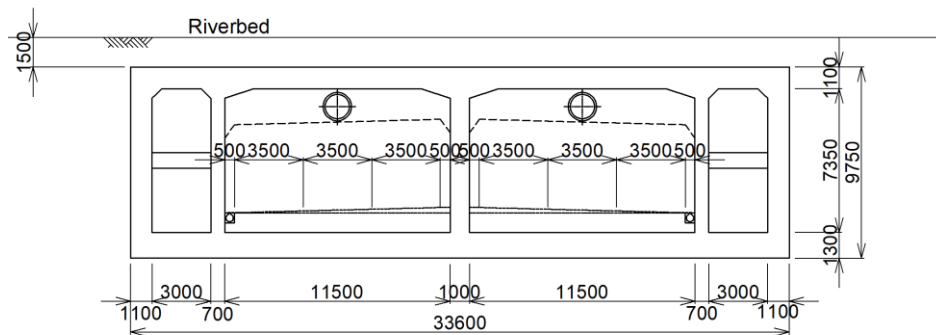


Figure 5.1-33 Profile of Submerged Tunnel and Shield Tunnel

Cross Section:

- In the cross-sectional analysis of the tunnel, the number of lanes is set to six, based on the results of future traffic demand forecasts. For the shield tunnel, it will be configured as two tubes, each containing three lanes.

Typical Cross Section for Submerged Tunnel



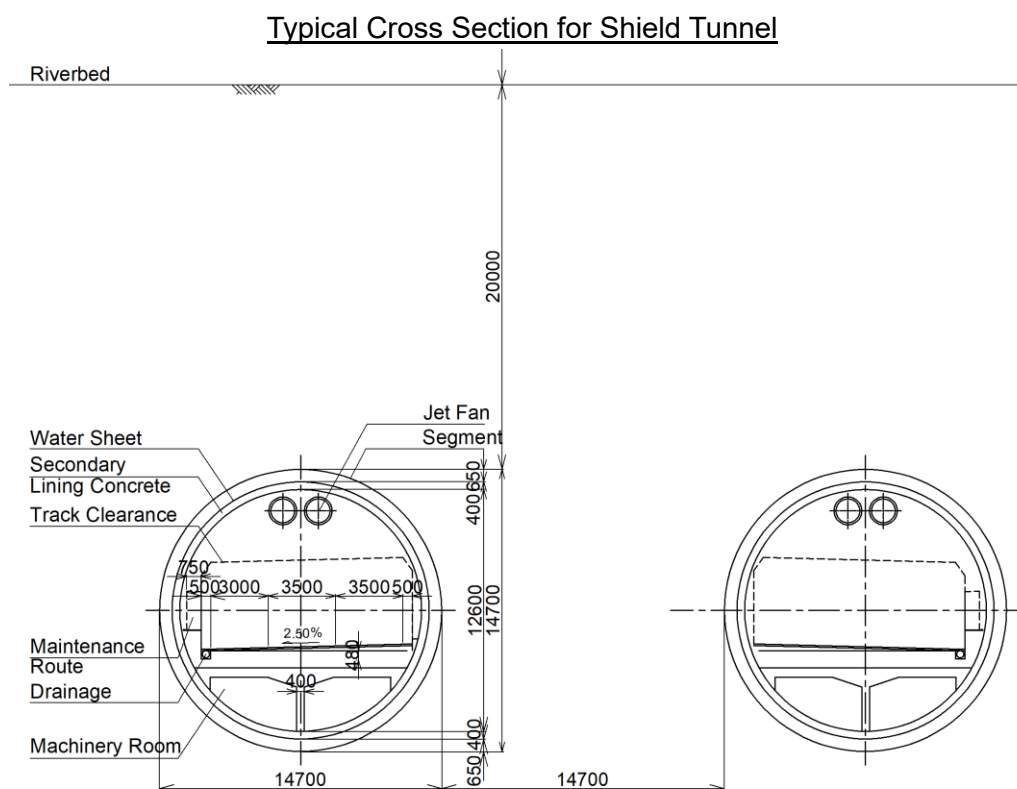


Figure 5.1-34 Typical Cross-sections

(3) Cost estimation and evaluation

While the submerged tunnel method necessitates handling UXO risks, MPWT has indicated that this issue is not a major concern. Given its cost-effectiveness and shorter total length, the submerged tunnel is recommended for this location.

Table 5.1-10 Cost Estimation and Evaluation; The Mekong River Tunnel

	Alternative 1	Alternative 2
Structural Feature	Submerged Tunnel	Shield Tunnel
Length	L= 3.53km	L= 4.25km
Construction Cost (Direct Cost)	136.4 billion JPY 880.0 million USD	160.1 billion JPY 1,033.1 million USD
Number of Affected Structures	New Acquisition 15	New Acquisition 15
Evaluation	Good	Fair

Note) The cost doesn't include indirect cost, additional cost and so on. Loan amount will be recalculated.

Given that the currently considered alignment is near the royal palace, where high constructions are to be avoided, if a bridge were to be constructed as an alternative to a tunnel, the cost would be estimated at 66.1 billion yen (426.1 million USD). This would result in a lower cost compared to constructing a tunnel.

5.2 Validation of Each Best Proposal

To examine the validity of the project, the EIRR is calculated from the results of the demand forecast and project costs. The items to be examined for validity are economic efficiency and environmental and social considerations.

5.2.1 Validity of Requested Projects

(1) Necessity of requested projects

The necessity of each requested project described in Chapters 3 and 4 was reconsidered from the following perspectives.

1. Priority in upper-level plans
2. Contribution to the strengthen connectivity of the Southern Economic Corridor
3. Contribution to mitigate traffic congestion of NR1
4. Contribution to mitigate traffic congestion in Phnom Penh's city center
5. Contribution to the promotion of urban development along NR1
6. Contribution to the promotion of urban development in AKC

1) The 0km-4km Section of NR1

The necessity for this section is shown below.

Table 5.2-1 Necessity of the Requested Project - The 0km-4km Section of NR1 -

Item	Contents
1. Priority in Upper-Level Plan	- Not listed in CITL MP
2. Strengthen the Economic Corridor Connectivity	- The travel speed of NR1 will be increased and the travel time from Tsubasa Bridge to the intersection of NR5 and RR2 will be shortened.
3. Mitigate traffic congestion of NR1	- If a viaduct or flyover is not constructed, chronic traffic congestion will occur. Six-lane widening and flyover construction will contribute to mitigate the chronic traffic congestion on NR1. - Traffic congestion starting from the Monivong Bridge will remain due to the congestion on Norodom street. - If the requested project of this section implement after the congestion on the main radial road to the city center is alleviated, it will contribute significantly to mitigate the traffic congestion on NR1.
4. Mitigate traffic congestion in Phnom Penh's city center	- The requested project implementation in this section will increase traffic to the city center, worsening traffic congestion on radial arterial roads.
5. Promotion of urban development along NR1	- Urbanization develops rapidly along this section. Contribution to promote urban development is significant because the accessibility to the area along this section will be improved by the road improvement.
6. Promotion of urban development in AKC	- It does not contribute to the improvement of accessibility to AKC.

2) The 4km-20km Section of NR1

The necessity for this section is shown below.

Table 5.2-2 Necessity of the Requested Project - The 4km-20km Section of NR1 -

Item	Contents
1. Priority in Upper-Level Plan	- Included in CITL MP's short-term development projects.

Item	Contents
2.Strengthen the Economic Corridor Connectivity	- The travel speed of NR1 will be increased and the travel time from Tsubasa Bridge to the intersection of NR5 and RR2 will be shortened.
3. Mitigate traffic congestion of NR1	- Chronic traffic congestion will occur if the requested project in this section is not implemented. six-lane widening will mitigate chronic traffic congestion in this section. - Note that traffic will concentrate on the section west of RR2. Even with six-lane widening, there is a risk of chronic traffic congestion. - Therefore, measures should be taken to encourage a shift from cars to public transportation. - The widening will ensure pedestrian safety and overtaking safety, and will contribute to improved mobility.
4.Mitigate traffic congestion in Phnom Penh's city center	- The implementation of this requested project will not significantly change the traffic flow to Phnom Penh city center. - The impact of this requested project on traffic congestion in the city center is minimal.
5.Promotion of urban development along NR1	- Urbanization develops rapidly along this section. Contribution to promote urban development is significant because the accessibility to the area along this section will be improved by the road improvement.
6.Promotion of urban development in AKC	- It will not contribute to the improvement of accessibility to AKC.

3) The 20km-54km Section of NR1

The necessity for this section is shown below.

Table 5.2-3 Necessity of the Requested Project - The 20km-54km Section of NR1 -

Item	Contents
1.Priority in Upper-Level Plan	- Included in CITL MP's long-term development projects.
2.Strengthen the Economic Corridor Connectivity	- The travel speed of NR1 will be increased and the travel time from Tsubasa Bridge to the intersection of NR5 and RR2 will be shortened.
3. Mitigate traffic congestion of NR1	- Traffic congestion will occur mainly during peak hours if the requested project on this section is not implemented. Traffic congestion will be alleviated by four-lane widening in this section. - The widening will ensure pedestrian safety and overtaking safety, and will contribute to improved mobility.
4.Mitigate traffic congestion in Phnom Penh's city center	- Located far from Phnom Penh city center, contribution to reducing congestion in the city center is not significant.
5.Promotion of urban development along NR1	- Although urban development is not active along the road due to its distance from Phnom Penh city center, the road improvement will improve accessibility to the areas along the road, which will contribute to the promotion of urban development.
6.Promotion of urban development in AKC	- It will not contribute to the improvement of accessibility to AKC.

4) The Mekong River Bridge

The necessity for this section is shown below.

Table 5.2-4 Necessity of the Requested Project – The Mekong River Bridge -

Item	Contents
1.Priority in Upper-Level Plan	- Included in CITL MP's long-term development projects.
2.Strengthen the Economic Corridor Connectivity	- Does not contribute to the reduction of travel time from Tsubasa Bridge to NR5
3. Mitigate traffic	- The bridge construction will contribute to the mitigation of chronic traffic

Item	Contents
congestion of NR1	congestion at the Monivong Bridge. On the other hand, due to the bridge construction, traffic will be concentrated in the west side of RR2, causing chronic traffic congestion.
4.Mitigate traffic congestion in Phnom Penh's city center	-The Mekong River Bridge will reduce cross-sectional traffic on the south side of Phnom Penh city center and contribute to mitigate traffic congestion in the city center.
5.Promotion of urban development along NR1	- It will not contribute to the promotion of urban development to NR1.
6.Promotion of urban development in AKC	- It will contribute to improve accessibility to and promote urban development of AKC.

5) The Mekong River Tunnel

The necessity for this section is shown below.

Table 5.2-5 Necessity of the Requested Project – The Mekong River Tunnel -

Item	Contents
1.Priority in Upper-Level Plan	- Included in CITL MP's long-term development projects.
2.Strengthen the Economic Corridor Connectivity	- The Mekong River Bridge will allow for a new connection to NR5 through RR2, avoiding chronic traffic congestion in the Phnom Penh's city center. - Because it will connect to NR5 avoiding chronic traffic congestion in the city center, the travel time from Tsubasa Bridge to NR5 will also be reduced.
3. Mitigate traffic congestion of NR1	- It will not contribute to the traffic congestion on NR1.
4.Mitigate traffic congestion in Phnom Penh's city center	-The Mekong River Bridge will reduce cross-sectional traffic on the south side of Phnom Penh city center and contribute to mitigate traffic congestion in the city center.
5.Promotion of urban development along NR1	- It will not contribute to the promotion of urban development to NR1.
6.Promotion of urban development in AKC	- It will contribute to improve accessibility to and promote urban development of AKC.

5.2.2 Economic Analysis

(1) Methodology

1) Economic Benefit

Economic benefits of this project are defined as a Vehicle Operation Cost (VOC) and Travel Time Cost (TTC). These benefits are calculated by subtracting the total costs of VOC and TTC of “With Project Case” from those of “Without Project Case”.

2) Conversion from Market Price to Economic Price

The economic evaluation is done in economic price in order to evaluate a project from the view of national economy. Economic price can be converted from market price, and the economic price means (a) truly used for the project and (b) true price of the resources and outputs. Above mentioned (a) is to subtract taxes, interests, subsidies, etc. because they are transfers of incomes in the view of national economy. Also (b) is to correct distortions of market prices such as a gap between internal prices and world prices of resources and services. Generally, Standard Conversion Factor (SCF) is used to correct those distortions.

3) Discounting

The total costs and benefits of a project can be added up over the long time of project life; however, project investment, which is the main part of a project cost, is done in the early time of the project. Conventionally, resources used up or generated in earlier years value higher than that in later years. Therefore, a discount rate is applied to the resources and benefits in different years to convert them to present values. In this study, the opportunity cost of capital is applied for the discount rate.

4) Opportunity Cost of Capital

Theoretically, the opportunity cost of capital can be understood as “the marginal Economic Internal Rate of Return (EIRR): the lowest EIRR of the projects which are accepted under the budget constraint of a nation.” However, this ratio is difficult to figure out actually, hence International development partners generally use 10-12% as the discount rate.

5) Evaluation Indices

Economical Internal Rate of Return (EIRR), Net Present Value (NPV) and Benefit Cost Ratio (BCR) are applied as evaluation indices and calculated.

(2) Find Standard Conversion Factor (SCF)

SCF is an index that shows the extent to which the prices of domestic goods and services are distorted by non-perfectly competitive market factors such as tariffs, subsidies, and other import volume restrictions, and converts market prices into economic prices. It is used as a coefficient when the five-year average SCF is 0.94.

Table 5.2-6 Standard Conversion Factor

Items	Year				
	2018	2019	2020	2021	2022
(1) Import Value (CIF)	18,813.2	22,241.6	21,066.0	19,520.9	23,179.5
(2) Import Duties	2,347.5	2,890.5	2,195.2	2,125.6	2,543.0
(3) Export Value (FOB)	12,973.3	14,986.1	18,522.2	19,520.9	23,179.5
(4) Export Duties	7.1	6.5	2.8	5.1	5.7
SCF	0.93	0.93	0.95	0.95	0.95
Average					0.94

Unit: Million USD (exclude SCF)

Source: Key Indicators for Asia and the Pacific 2023

(3) Implementation Plan of the Project

The table below shows the implementation schedule for each project.

Table 5.2-7 Implementation Plan

	2025	2026	2027	2028	2029	2030	2031
Feasibility study	■						
Detail design		■					
Bidding			■				
1 Viaduct				■	■	■	■
2 NR1 Widening (6 Lanes)				■	■	■	
3 NR1 Widening (4 Lanes)				■	■	■	
4 The Mekong River Bridge				■	■	■	■
5 The Mekong River Tunnel				■	■	■	■

Note) The period for selecting detail design consultant will be considered

(4) Assumptions for Economic Evaluation

- The benefit calculation period is set at 30 years
- The base year is set as 2024
- Opportunity cost of capital (Discount rate): 10%
- Standard conversion factor (SCF): 0.94
- Residual value¹: Nothing

(5) Definition of “With Project Case” and “Without Project Case”

The definitions of “With Project Case” and “Without Project Case” are as follow of

With Project Case: All candidate projects (1 Viaduct, 2. NR1 Widening (4-20km),
3. NR1 Widening (20-54km), 4. The Mekong River Bridge) are constructed.

Without Project Case: One of candidate projects is not constructed.

¹ Residual value is the value of the existing facilities and equipment (remaining fixed assets) at the end of project life.

(6) Estimation of Travel Time Cost and Vehicle Operation Cost

JICA Survey Team used Travel Time Cost (TTC) savings and Vehicle Operation Cost (VOC) savings as benefit.

1) Travel Time Cost

The basic unit of Travel Time Cost (TTC) for motorcycles and small vehicles was calculated in this study using the income distribution in the "Kingdom of Cambodia data collection survey on urban transport in Phnom Penh" and other data. For heavy vehicles, the CPI (Consumer Price Index) was used to adjust the values used in the previous year's report "Preparatory survey for Phnom Penh-Bavet expressway development project in the Kingdom of Cambodia" that calculated TTC for freight based on interviews with logistics companies. The following table shows the unit of TTC.

Table 5.2-8 Travel Time Cost

(Unit: USD/hour)

Year	MC	LV	HV
2024	4.13	13.98	37.68

2) Vehicle Operation Cost

The Vehicle Operation Cost (VOC) was revised using the Consumer Price Index (CPI) after reviewing the fuel cost in the survey of the previous year's report, "Kingdom of Cambodia data collection survey on urban transport in Phnom Penh". The following table shows the VOC.

Table 5.2-9 Vehicle Operation Cost in 2020

(Unit: USD/km)

Speed	MC	LV	HV
0-10km/h	0.15	0.34	1.12
10-20km/h	0.09	0.20	0.66
20-30km/h	0.05	0.13	0.43
30-40km/h	0.05	0.12	0.39
40-50km/h	0.04	0.09	0.27
50-60km/h	0.03	0.08	0.25
60-70km/h	0.03	0.08	0.24
70-80km/h	0.04	0.08	0.25
80-90km/h	0.04	0.09	0.27

(7) Economic Evaluation

After calculating the benefit from travel time cost saving and benefit from vehicle operation cost saving, using the unit of the travel time cost and the vehicle operation cost and future traffic volumes of with and without project, EIRR of each requested project was calculated.

As a result, the EIRR exceeded the 12% economic adequacy standard in all sections except the viaduct on the 0km to 4km of NR1 and the Mekong River Tunnel.

Table 5.2-10 The EIRR of the Requested Projects

Sections		Year 2035 (Million USD)			Year 2050 (Million USD)			EIRR	NPV*
		VOC	TTC	Total	VOC	TTC	Total		
The 0km-4km section of NR1	Viaduct	5.7	23.4	29.1	10.7	32.8	43.5	2.8%	-181.9
	Flyover	2.1	9.8	11.8	13.8	39.9	53.8	13.0%	30.9
The 4km-20km section of NR1		25.1	72.8	97.9	56.5	159.7	216.3	52.4%	543.6
The 20km-54km section of NR1		10.1	23.5	33.6	4.5	11.3	15.8	17.4%	49.7
The Mekong River Bridge		83.5	236.6	320.1	117.3	411.6	528.9	29.8%	1221.8
The Mekong River Tunnel		6.2	20.3	26.5	29.2	90.0	119.2	0.0%	-712.8

*Discount rate is 10%

5.2.3 Necessity and impact of the requested projects

The table below summarizes the necessity and impact of all the requested projects. It was confirmed that all of the requested projects are necessary. In particular, "Mekong River Bridge" and "NR1: 4km-20km" were more necessary than other requested projects.

Table 5.2-11 Comparison of the Necessity for the Requested Project

Requested Project	1 Priority in CITL MP	2 Strengthen the Southern Economic Corridor Connectivity	Mitigating Traffic Congestion		Promotion of Urban Development		7 Economic Efficiency (EIRR)
			3 NR1	4 Phnom Penh's City Center	5 along NR1	6 AKC	
(1) The 0km-4km Section of NR1	Low	Medium	High	Low	High	Low	14.0%
(2) The 4km-20km Section of NR1	High	Medium	High	Low	High	Low	47.9%
(3) The 20km-54km Section of NR1	Medium	Medium	Medium	Low	Medium	Low	19.1%
(4) The Mekong River Bridge	Medium	High	High	High	Low	High	25.9%
(5) The Mekong River Tunnel	Medium	Low	Low	High	Low	High	-0.4%

The evaluation of the necessity for the requested projects is considered based on the evaluation criteria shown below.

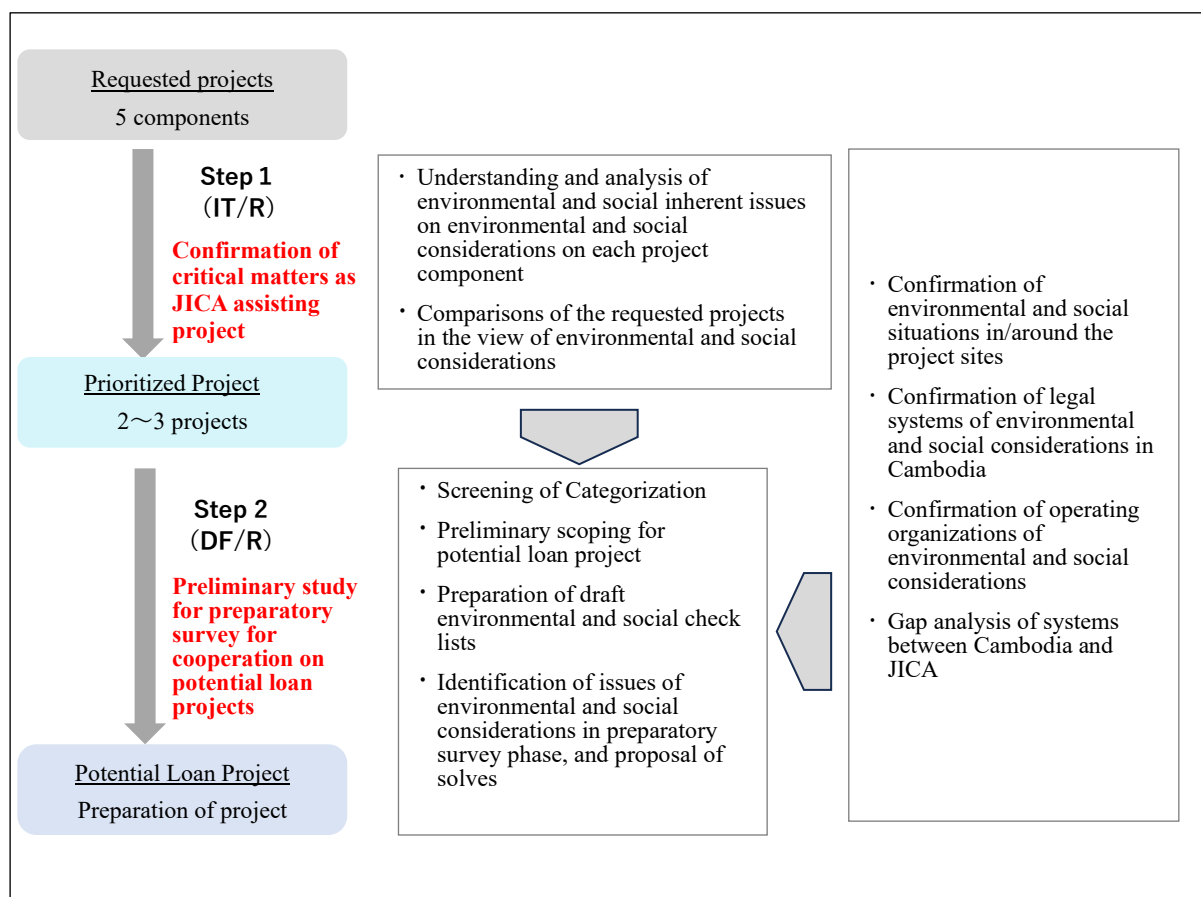
Table 5.2-12 Evaluation Criteria

Item	Evaluation Criteria
1. Priority in CITL MP	High : Identified as a short term action in upper-level plans Medium : Identified as a long term action in upper-level plans Low : Not identified in upper-level plans
2. Strengthen the Southern Economic Corridor Connectivity	High : Travel time from Tsubasa Bridge to the intersection of NR5 and RR2 will be reduced and the number of routes between them will be increased. Medium : Travel time from Tsubasa Bridge to the intersection of NR5 and RR2 will be reduced. Low : Travel time from Tsubasa Bridge to the intersection of NR5 and RR2 will not change or increase
3. Alleviating traffic congestion on NR1	High : Chronic traffic congestion on NR1 will be reduced Medium : Traffic congestion on NR1 in the peak time will be reduced Low : It will not contribute to reduce traffic congestion on NR1
4. Alleviating traffic congestion in Phnom Penh's city center	High : Traffic in the city center will be reduced. Low : Traffic in the city center will not change or increase.
5. Promotion of urban development along NR1	High : Promote urban development along NR1's urban area. Medium : Promote urban development along NR1's suburban area. Low : It will not contribute urban development along NR1
6. Promotion of urban development in AKC	High : Increase the capacity to cross the Mekong River. Low : Does not increase the capacity to cross the Mekong River

CHAPTER 6 Environmental and Social Considerations

6.1 Outlines of Environmental and Social Survey

Object of this survey is to study requested projects and propose a potential loan project. In this chapter, environmental and social aspects of each required projects are compared, preliminary scoping is conducted for the selected potential loan project, and issues and solves of the preparatory survey which will be conducted continuously are provided.



Source: JICA Survey Team

Figure 6.1-1 Flow of Environmental and Social Considerations on this Survey

In the IT/R, critical matters of each requested projects as JICA assist project are confirmed. the requested projects were compared and analyzed as alternatives. In the DF/R, preliminary study for selected projects is conducted targeting a preparatory survey.

6.2 Outlines of Requested Projects

The following five requested projects are those for which MPWT intends to utilize ODA loans.

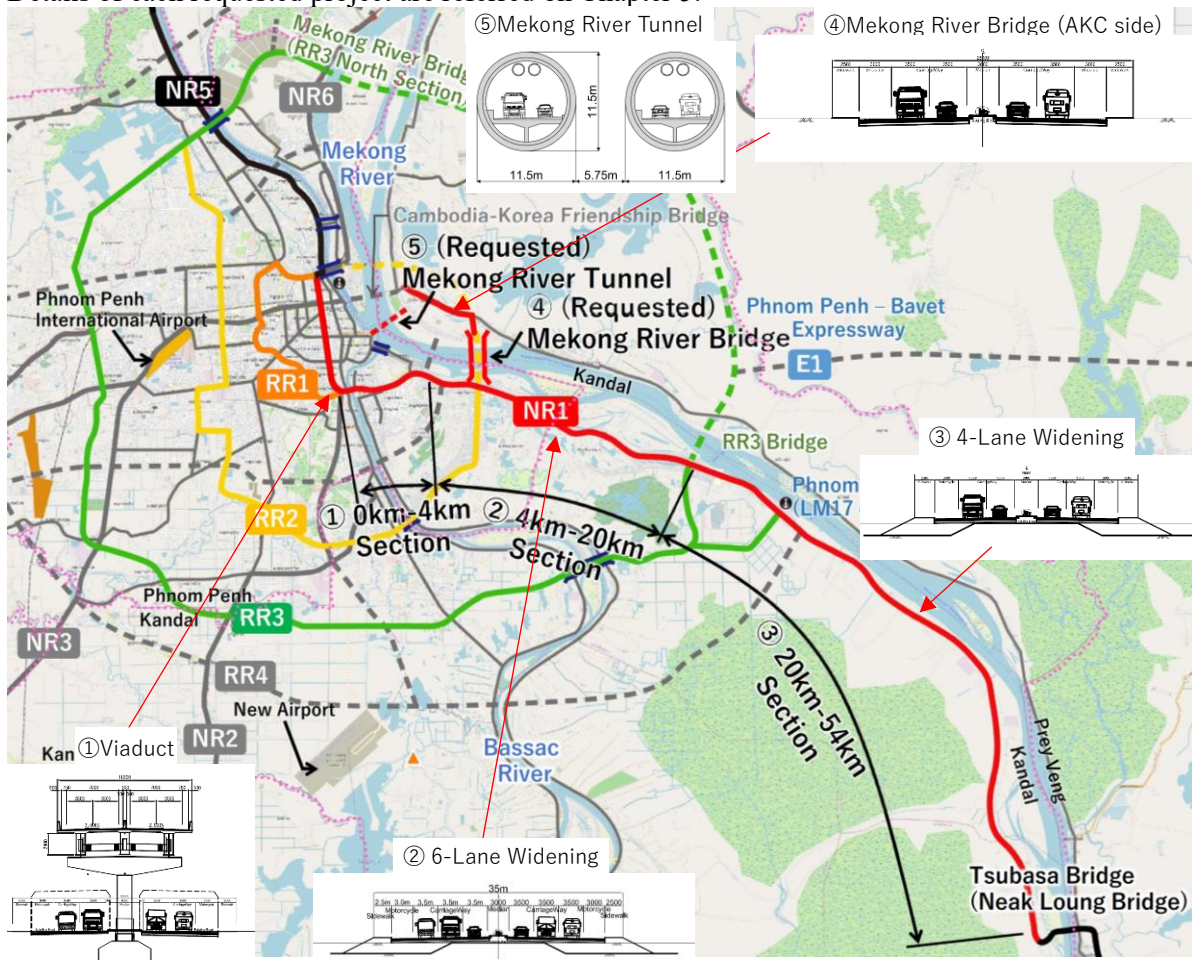
Table 6.2-1 The Requested Projects which MPWT intends to utilize ODA Loans

	Requested Projects	abbreviation
1)	Construction of a viaduct (2 lanes on each side) at a section of approximately 4.5 km of NR1 from the Monivong intersection	NR1 viaduct (0-4km)
2)	Widening of NR1 in the approximately 20km section from the 4km point mentioned above to Phnom Penh New Port (LM17 Container Terminal) (3 lanes on each side)	NR1 6-lanes widening (4-20km)
3)	Widening of NR1 in the approximately 30km section from Phnom Penh New Port to Tsubasa Bridge (2 lanes on each side)	NR1 4-lanes widening (20-54km)

	Requested Projects	abbreviation
4)	Construction of an approximately 2.6km bridge spanning the other side area of the Mekong River from the intersection of RR2 and NR1	The Mekong River Bridge
5)	Construction of an approximately 3.5km tunnel connecting the area around Sihanouk Street in Phnom Penh and the other side area of the Mekong River.	The Mekong River Tunnel

Source: JICA Survey Team

Details of each requested project are referred on Chapter 5.



Source: JICA Survey Team

Figure 6.2-1 Requested Project and Road Network (Dashed lines indicate planned or under construction)

The objectives of whole requested projects are strength of connectivity of southern economic corridor and traffic improvement of the NR1 around Phnom Penh. On the other hand, types and locations of each project are different. Therefore, it is expected that the environmental and social impacts are different.

6.3 Issues of Each Requested Project on the Environmental and Social Considerations

JICA mentions, on the Japan International Cooperation Agency (JICA) Guidelines for Environmental and Social Consideration (January 2022) (hereafter, JICA Guidelines), compliance with laws, standards, and plans for JICA assisting projects, and especially “In principle, Projects must be undertaken outside of areas that are specifically designated for conservation of nature or cultural heritages by the host county governments, and “projects shall not cause significant adverse impacts on such designated conservation areas.”¹ This means JICA cannot assist projects in national reserves including national parks. Because

¹ 4. Compliance with Laws, Standards, and Plans, Appendix 1, JICA Guidelines

this is a critical point for project implementation, firstly location of national reserves such as national parks should be confirmed.

Secondly, inherent features of each requested project are studied, and negative impacts caused by the project implementation are examined. As main features on environmental and social considerations, the following three features are raised (1) Land acquisition and involuntary resettlement, (2) Habitats with important ecological value, and (3) Negative impacts on existing traffic to be replaced.

6.3.1 Confirmation of Compliance with Laws, Standards, and Plans of Host Countries

As mentioned above, JICA Guidelines mentions “In principle, Projects must be undertaken outside of areas that are specifically designated for conservation of nature or cultural heritages by the host county governments, and “projects shall not cause significant adverse impacts on such designated conservation areas.”

National reserves such as national parks which Cambodia Government designated are shown as the below figure. (including national reserves of Vietnam)

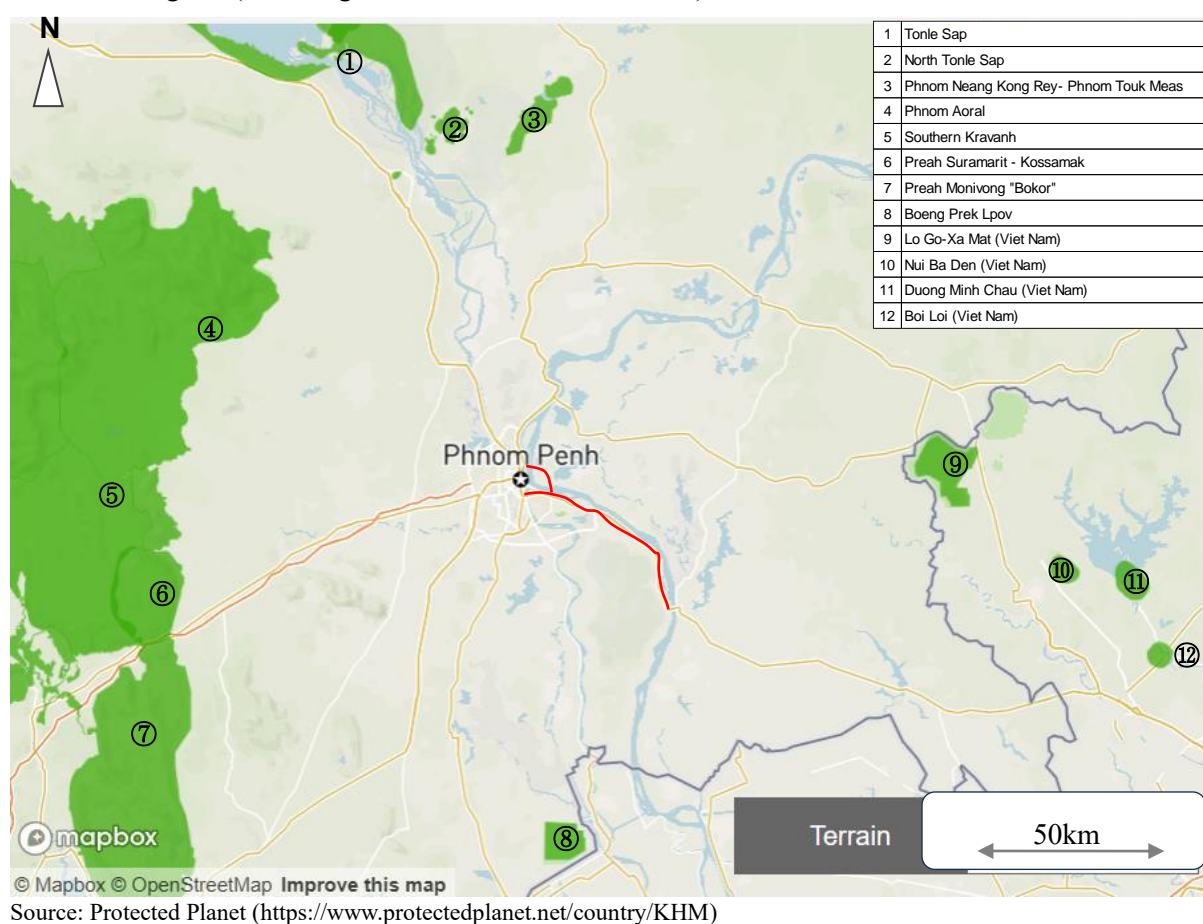


Figure 6.3-1 National Reserves around Phnom Penh

There are sixty-nine national reserves in Cambodia. The most of them are located in western, northern and eastern areas, and not located around Phnom Penh. There are no protected areas designated by the Government within a 70-80 km radius around all requested projects, and the requested projects are implemented outside the protected areas designated by the government. (The closest protected areas are Boeng Prek Lpov south of Phnom Penh and the southern end of the NR1 widening project, about 60 km away.)

Regarding cultural heritage, there are no areas or historic sites designated by the government in the vicinity of the requested project. However, there are temples along the ROW of NR1, which are

archaeological sites². Direct negative impacts against the temples are not expected because the both temples are located on outside of the ROW.

6.3.2 Land Acquisition and Involuntary Resettlement

(1) Policies of Land Acquisition and Resettlement Survey

Whole requested projects have possibility of land acquisition and resettlement. However, the scale depends on each requested project. Because the land acquisition and involuntary resettlement is a very important view point, the scale of each requested project is estimated. This survey is an information collection survey which objects is understanding of rough scale for comparison. Therefore, the estimation was conducted according to the followings.

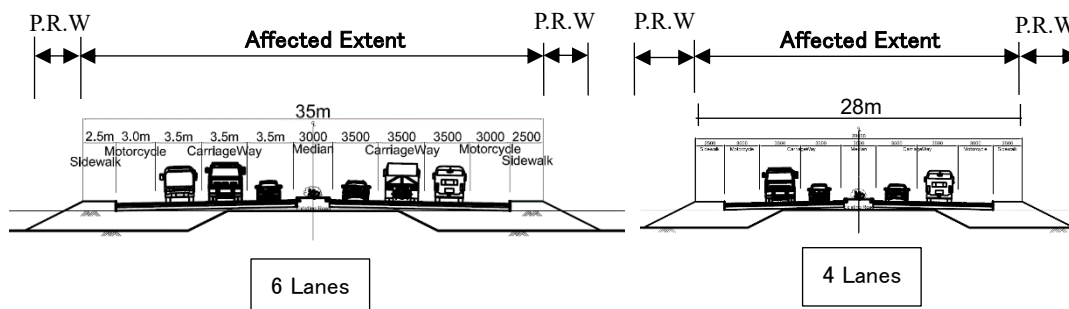
Estimation method

- Rough plan (ROW) of each requested project proposed in this survey is projected on satellite images, and the area of land and the number of affected properties (buildings, etc.) that will need to be acquired in the ROW will be visually measured on the satellite images.
- Regarding the area of land acquisition in the widened and existing road sections of NR1 excludes, estimated state-owned land.
- Land use conditions are understood through site visits.
- Estimate the number of affected households and the number of affected residents with reference to the results of RAP surveys of similar projects (NR1 and NR5) in Cambodia.



Source: JICA Survey Team

Figure 6.3-2 Affected Buildings marked on Satellite Map (Google Earth)



Source: JICA Survey Team

Figure 6.3-3 Affected Extent of NR1 Widening

The affected area was defined as the design road width. In addition, the project may require a site width for the slope of the embankment section or a temporary site for construction. (Provisional Road Width: P.R.W) However, in this survey, there are no tangible construction plans, and P.R.W is much different by the height of embankment (especially 4-lanes section). Therefore P.R.W is excluded from the affected extent.

² Wat Kien Svay Krau (Section 3) and Wat Dei Eth (Section 4) are shown as archaeological sites on the cultural property distribution map prepared by the Ministry of Culture and Fine Arts. The legal preservation obligations of both temples are unknown.

(2) Conditions of Roadsides and ROW

1) Section of NR1 Widening

Background of Improvements of NR1

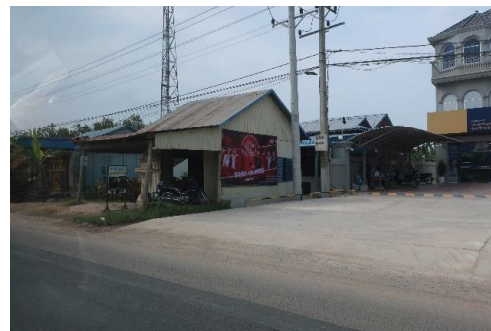
Cambodia Government designates the ROW of NR1 as 30 m (one side) under the Prakas06 (1999) and Sub-Decree Nov23, 2009. And it shall be considered on a case-by-case basis when passing through capital and urban areas³. As a general rule, private property within the ROW shall not be publicly compensated.

The section of the requested project in NR1 has been rehabilitated by Japan's grant aid for about 10 years since 2005. The project involved widening, raising, and paving the existing road, which was expected to have negative impacts on buildings and residents along the road⁴. Therefore, in order to minimize the negative impacts, a resettlement action plan has been developed with the minimum P.R.W. which required for project implementation as the affected area, against the legally mandated ROW (30 m on each side). Although the P.R.W. at this time varied from section to section, it was generally set at about 20 m on each side, and buildings within the P.R.W. were removed and residents were relocated. Since the ROW of the requested project is within this P.R.W. as of now, little or no land acquisition is expected to be required for the implementation. On the other hand, for special sections such as intersections and ramp sections, additional land acquisition may be required to increase the road width.

Conditions of the Roadsides

Along the whole sections, buildings along NR1 are mostly commercial facilities such as stores and restaurants, or business facilities such as workshops, factories and garages, and public facilities such as temples and school. There are few permanent structures built within the P.R.W. of the existing project due to the implementation of the land acquisition and resettlement of the previous improvement project. Boundary crossings into the P.R.W. are made to facilitate access to the current road. In many cases, structures that appear to be ancillary to the main structure cross the boundary by several meters. In addition, stalls and temporary stores have been set up facing the current road. Many of these temporary structures can be easily moved.

In the suburban areas away from Phnom Penh, building density is lower. Due to the narrowness of the current road compared to the suburbs of Phnom Penh, many buildings (especially commercial buildings) have to be largely overtopped onto P.R.W. in order to access to the road. However, few buildings will be completely demolished.



Source: JICA Survey Team

Figure 6.3-4 Conditions of Roadsides of NR1 (left: vicinity of Phnom Penh, right: outskirts)

The information collection survey proposes bypass routes in several sections (Section 3, 5, and 7) as alternatives. Land uses along the bypass route include residential, agricultural, forest, and undeveloped land. The bypass routes will require land acquisition because it is out of the ROW of

³ For NR1, the section from the starting point to Wat Niroth (at 1.2 km) is 20 m on each side. (according to MPWT).

⁴ Final number of affected households: 4,471 households, including 364 relocated households (FY2020 external ex-post evaluation report, JICA)

NR1, and will likely result in resettlement.



Source: JICA Survey Team

Figure 6.3-5 Conditions of Bypass Routes (left: KP14, right: KP43)

2) Mekong River Bridge

Phnom Penh side

The 600m section from NR1 to the Mekong River is dotted with housing complexes, houses, stores, kindergarten and lodging facilities along the existing alley.

Because the existing alley is narrow, in addition to land acquisition, some buildings will require complete demolition. This will cause involuntary resettlements

Areiy Ksatr City side

The land for the approach road on the Areiy Ksatr city side is agricultural land, current roads, stores, and residences. It is expected that land acquisition will be needed except the current road. As the area is still underdeveloped, very few buildings will be affected.



Figure 6.3-6 Affected Buildings of Phnom Penh side, marked on Satellite Map (Google Earth)



Source: JICA Survey Team

Figure 6.3-7 Land use in the Approach Roads of Mekong River Bridge (left: affected housing complex and stores in the side of Phnom Penh, right: the existing road in the Areiy Ksatr City)

(3) Estimation of Impacts

- i. Widening of NR1

For the 6-lane widening section, it is estimated that there will be few significant impacts on structures along the road because the existing road secures 30 to 35 m wide. However, the road width will be wider at the end of the viaduct (ramp) and at the intersection with RR2, which will require additional land acquisition and have a greater impact on buildings along the road.

Note that the degree of impact is almost the same for the proposed viaduct construction and the six-lane proposal in Section 1.

In the 4-lane widened section, the density of buildings along the road is lower than in the 6-lane section. Stores, canteens, and businesses are scattered along the roadside, with residences in the hinterland. The ROW required for the four-lane road is 28 m. As with the 6-lane widening, in principle, new land acquisition is not almost required. Partial demolition and compensation may be required for areas where roadside structures cross into the ROW. The 4-lane widened section has a greater degree of overtopping into the ROW than the 6-lane widened section. Therefore, the impact of partial demolition of each building is expected to be greater than in the six-lane widening section.

Table 6.3-1 Estimated Impacts due to the Widening and Viaduct of NRI

Requested Projects	Section		The Number of Affected Structures ⁵			Possibility of Land Acquisition	Estimated Impacts	Potential Resettlement	
			Partial Demolition	Complete Demolition	Total				
①	1	KP0+000-4+630	111	0	111	Ramp section	The current road width is about 40m, and the planned road width will be secured with partial demolition of up to 3m. The viaduct plan would require a road width of nearly 50 m at the ramp, which may require additional land acquisition. (In case of 6 lanes, the number of affected structures is 113.	The possibility of resettlement is likely small comparing the scale of affected areas because the roadside structures are commercial and the demolition is partial.	
	②	2	KP4+630 - 13+520	522	14	536	Intersection of RR2		Many structures along the road cross over into the ROW, requiring partial demolition of each structure. At the intersection with RR2, additional land acquisition may be required as the site width will be approximately 50 meters. In addition, there will be structures that will require full demolition.
		3	KP13+520 - 15+810	160	6	166			The degree of the roadside structures crossing into the ROW is large (up to 9 m), and many structures require larger partial demolition. Some structures will require the demolition of a majority of the structure.
		4	KP15+810 - 19+800	187	44	231	Shift of road center		Many of the structures along the road cross over into the

⁵ Based on visual measurements in satellite photo, buildings requiring removal of more than 60-70% of the building were accessed as "Completely Demolition".

Requested Projects	Section		The Number of Affected Structures ⁵			Possibility of Land Acquisition	Estimated Impacts	Potential Resettlement
			Partial Demolition	Complete Demolition	Total			
	5	KP19+800 - 24+720	203	0	203	ROW and require partial demolition of each structure. Many of the structures requiring demolition are simple structures such as canteens.	comparing the scale of affected areas because the roadside structures are small commercial structures, workshops, garages, etc., and the demolition is only partial.	
③	6	KP24+720 - 40+890	508	76	584			
	7	KP40+890 - 47+530	106	36	142			
	8	KP47+530 - 53+566	76	47	123			
	Total		1873	223	2096			

Source: JICA Survey Team



Note; The numbers in the table are result of the counting along the red line.

In this survey, bypass routes are proposed in traffic congested sections and bridge installation sections.

Regarding the section of the bypass route, the land use in section 5 is residential, road, agricultural land, and unused land, and land acquisition is required for the installation of a new road.

Many of the affected buildings will be completely demolished, and the most of the affected buildings are residences, likely resulting in large-scale involuntary resettlement. Since the bypass route of section 7 is agricultural land and residential buildings, land acquisition is required for the construction of a new road. Many of the structures will be completely demolished and large scale involuntary resettlement is expected as same as the Section 5.

Table 6.3-2 Estimated Impacts due to the Bypass Routes of NR1

Requested Projects	Section		The Number of Affected Structures ⁶			Land Acquisition (ha)	Estimated Impacts	Potential Resettlement
			Partial Demolition	Complete Demolition	Total			
②	3	KP13+520 - 15+810	33	34	67	8.1	New land acquisition is required for the entire bypass road. The sites are residential, agricultural, and forest land. The houses will need to be completely demolished.	The resettlement could result in the relocation of more than 40 households.
	5	KP19+800 - 24+720	183	70	253	13.9	New land acquisition is required for the entire bypass road. The sites are residential, agricultural, wetland, and forest land. The houses will need to be completely demolished.	The resettlement could result in the relocation of more than 100 households.
③	7	Bypass 2	14	51	65	20.1	New land acquisition is required for the entire bypass road. The sites are agricultural land, unused land, wetlands, and residences. Complete demolition of residences will be required.	The resettlement could result in the relocation of more than 50 households.
		Bypass 3	6	47	53	19.2		The resettlement could result in the relocation of more than 50 households.

Source: JICA Survey Team



Note; The numbers in the table are result of the counting along the red line. Black line is the alignment for the widening plan.

ii. Land Acquisition and Resettlement due to the Widening of NR1

Because the widening of NR1 will take place within the legally defined ROW, no land acquisition is expected to occur. On the other hand, additional land acquisition may be required for partial expansion at ramp sections and intersections. Implementation of the project will require partial demolition of roadside structures that cross over into the ROW. It is estimated that approximately 2,000 structures will be affected along the entire sections. Because each of these structures will be

⁶ Based on visual measurements in satellite imagery, buildings requiring removal of more than 60-70% of the building were considered “Complete Demolition”.

partially demolished and most of the structures are not residential, the resettlement is not estimated to be large. However, due to the large number of the affected buildings and possibility of residential use, the scale of the resettlement is unclear.

On the other hand, for the proposed bypass routes, since land acquisition would be required for the entire section and entirely demolition of residences are required, involuntary resettlement would occur. In particular, the bypass route of Section 5 is likely to result in large-scale involuntary resettlement in this area alone, as there are 70 structures that will require complete demolition.

The above scale estimates are based on the planned road width, and the impact area may be further expanded depending on the topographical conditions (slope) and construction conditions along the road. Especially, in the suburbs of Phnom Penh, the difference in elevation between the road surface and the roadside is large. Therefore, the road width spread is likely to be large. This point needs to be confirmed in a future preparatory survey.

As for the current road in NR1, the legal ROW is 30m on each side, and it is seen that the road width is secured more than 20m on each side in the previous improvement project. Several roadside residents are understanding to this⁷. However, individual rights should be confirmed in the preparatory survey. In addition, some Cambodian government officials also pointed out that relocated residents who have received compensation are returning. These and other aspects of compensation should be discussed in the RAP survey. (See 6.7 (5))

iii. Mekong River Bridge

For the bridge project, land acquisition and involuntary resettlement will occur due to the construction of connecting roads. Particularly on the Phnom Penh side, apartment complexes, detached houses, stores, lodging facilities, etc. will be affected. There are 36 structures that will require complete demolition. Since many of these structures are residences, large-scale involuntary resettlement is expected to occur.

On Areiy Ksatr City side, the site is mostly farmland, roads, and residences.

Structures along the current road will be affected, however only one residence will require complete demolition. The land for the connecting road on Areiy Ksatr City side has been designated as a road right-of-way according to the urban plan, and is currently under discussion with the residents or is being registered (see Chapter 4). Once the land is registered as a road right-of-way, it is considered that land acquisition will not be necessary for the project implementation. Because the location of the road in the urban plan is not clearly indicated, it is necessary to confirm the location again.

Table 6.3-3 Estimated Impacts due to the Widening and Viaduct of NR1

Section	The Number of Affected Structures			Land Acquisition (ha)	Estimated Impacts	Potential Resettlement
	Partial Demolition	Complete Demolition	Total			
Phnom Penh side	17	36	53	2.9	The current road is a narrow alley, requiring almost site equivalent land acquisition. Land uses for the site include residential, lodging, commercial, and kindergarten, and many of the affected structures will require complete demolition.	Many of the affected structures are residences including apartment. The resettlement could result in the relocation of more than 50 households.
AKC side	26	4	30	13.3	The land uses of the site are farmland, roads, stores, and residences, which require new land acquisition. Structures demolished completely are an abandoned building, a store, and a house (1 unit).	Resettlement may occur for one residence.

⁷ Due to the interview by the local consultant in this survey.

Source: JICA Survey Team

iv. Mekong River Tunnel

For the tunnel project, land acquisition and involuntary resettlement may occur due to the construction of a new connecting road, but the extent of the impact is not clear at this stage because the depth of the tunnel and other details have not yet been determined.

On the Phnom Penh side, the project is expected to have little impact on existing buildings as it will pass under and connect to the lower part of Sihanouk Avenue, which has a wide road width.

On the Areiy Ksatr City side, the project site is mostly agricultural land, roads and residences. There are approximately 15 buildings in the ROW that could be affected.

6.3.3 Examination for Sensitive Area (Habitats with Important Ecological Value)

As a project which is “likely to have significant adverse impacts on the environment and society”, JICA Guidelines gives “sensitive area”. In the vicinity of the requested projects, there are two Key Biodiversity Areas (KBAs)⁸ which are the most important places in the world for species and their habitats.

In this survey the outlines of the KBAs are understood, and negative impacts against the KBAs are studied. These two KBAs are also selected in Important Bird Area (IBA), and information as IBA is referred too. In Cambodia, there are five Ramsar Sites. However, the Ramsar Sites are located in northern and western areas including Tonle Sap lake, not located in the vicinity of the requested project sites.

1) KBAs around the Requested Projects

Around the requested projects, there are two KBAs, “Bassac Marsh” in contact with 4 lane section, and “Boeung Veal Sannap” in the vicinity of the approach road of the Mekong River Bridge on the opposite side of the Mekong river. (In addition, there is “Basset March” on the North side of Phnom Penh. However, no impacts are expected because it is more than 15km apart.)



Figure 6.3-8 KBAs around the requested projects

⁸ KBAs are areas determined to be internationally important from the perspective of biodiversity conservation based on criteria developed and published in collaboration with IUCN, experts, NGO, and government agencies. KBAs themselves are not nationally designated protected areas, and are not areas that cannot be supported by the project under JICA guidelines. However, they are ecologically important areas requiring consideration as “sensitive areas” because of their ecological importance. Note that there are IBAs as key areas for birds; KBAs are based on IBAs and expanded to other species; all IBAs are included in KBAs. In Cambodia, KBAs are under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries (MAFF), but are not legally designated as areas for nature conservation. Therefore, it is not an area that JICA Guidelines state “must be undertaken outside of (areas).”

Bassac Marsh

Outlines of Bassac Marsh

Bassac Marsh is a vast marsh which is located in around 30 km southeast of Phnom Penh, the southern Mekong river and Bassac river. The areas recommended as KBA is 524.25 km².

In the Bassac Marsh local communities are living in marsh environment, and they cultivate and fish in the wetlands.

Assessment of the Bassac Marsh by IBA

Vegetation of the Bassac Marsh is dominated by seasonally flooded shrubs and savannas, and the peripheral areas are cultivated land. During the rainy season, the area is extensively watered, and floating plants and aquatic vegetation are prominent.

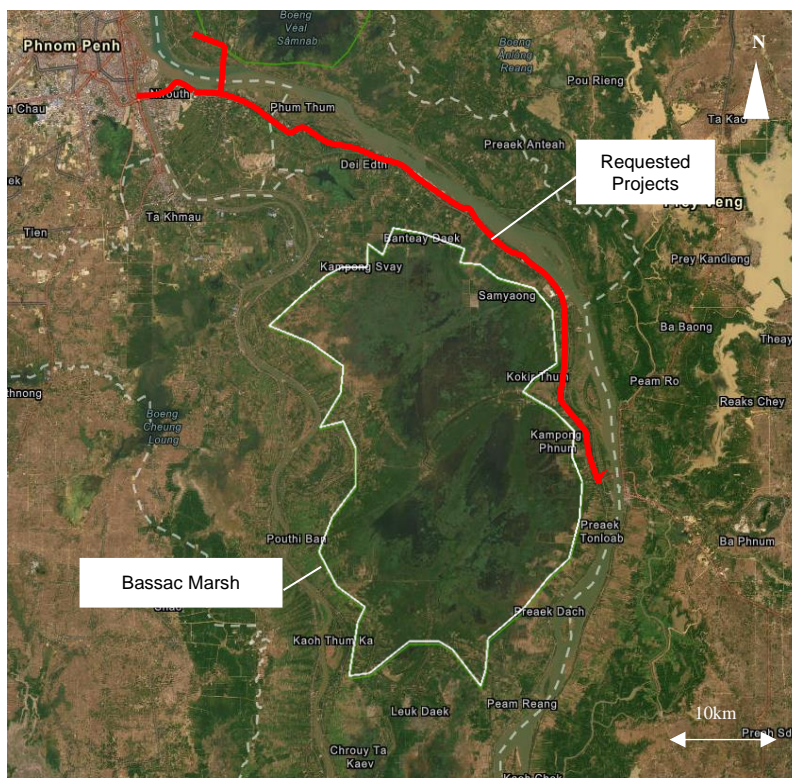


Figure 6.3-9 Location of Bassac Marsh

Including a small number of Darter (*Anhinga melanogaster* (NT)), Spot-billed Pelican (*Pelecanus philippensis*), Asian Golden Weaver (*Ploceus hypoxanthus* (NT)), a lot of water birds habitats. Furthermore, more than 1% of population of Whiskered Tern (*Chlidonias hybridus* (LC)) in Asia habitats here.

At present, they say that negative impacts against the ecosystem of the Bassac Marsh are production and social activities of the local community. Prasat Tuyoy fishing village in the Bassac Marsh depends on the natural resources of the marsh, and this is potential negative impact against water birds. More crucial factors are hunting of water birds, especially with poison.

Table 6.3-4 Impact Factors against Ecosystem of Bassac March

Threat Level 1	Threat Level 2	Threat Level 3	Timing
Agriculture & aquaculture	Annual & perennial non-timber crops	Small-holder farming	Ongoing
Biological resource use	Hunting & collecting terrestrial animals	Intentional use (species being assessed is the target)	Ongoing
Biological resource use	Logging & wood harvesting	Unintentional effects: subsistence/small scale (species being assessed is not the target) [harvest]	Ongoing
Biological resource use	Fishing & harvesting aquatic resources	Unintentional effects: large scale (species being assessed is not the target) [harvest]	Ongoing
Pollution	Agricultural & forestry effluents	Nutrient loads	Ongoing
Residential & commercial development	Commercial & industrial areas		Only in the future

Source: KBA website: <https://www.keybiodiversityareas.org/site/factsheet/16689>



Source: JICA Survey Team

Figure 6.3-10 Bassac Marsh (right: Prasat Tuyo fishing village in the Bassac Marsh)

Boeung Veal Samnap

Outlines of Boeung Veal Samnap

Boeung Veal Samnap is a vast wetland and watershed which extends Areiy Ksatr city on the other side of Mekong river. The area of the KBA is 123.88km². As same as Bassac marsh cultivated lands and wetlands are mixed. However, since Kreiy Ksatr city is close to Phnom Penh, urbanization is in progress including housing development (Borey) and resort development. An urban masterplan is in the process of being formulated by Government of Cambodia. In this process, land registration of public lands including scheduled road sites. In the view of the environmental consideration, 50~60% of the water area in the wetland is planned to leave as wetland.

Assessment of the Boeung Veal Samnap by IBA

The area surrounding the lake (Boeung Veal Samnap) is submerged when the Mekong River floods during the rainy season, forming a vast wetland, and rice is cultivated around the wetland. Floating grasses and aquatic vegetation cover the vast lakes, and the vegetation in the wetlands is predominantly herbaceous, except for a few forested areas. Large waterfowl, including a few Spot-billed Pelicans (*Pelecanus philippensis*), appear during the rainy season. In 2000, a group of Darter (*Anhinga melanogaster*) was identified.



Figure 6.3-11 Location of Boeung Veal Samnap

As for factors affecting the ecosystem, there are many settlements around Boeung Veal Samnap,

and the livelihood of the local people, especially fishing, is a factor affecting the bird habitats. Hunting for waterfowl themselves is another impact. For example, colonies of Darters and flying-foxes *Pteropus sp.* identified in 2000 were reportedly affected by local residents picking up eggs and hunting. An additional impact is the invasion of alien plants (*Mimosa pigra*). It is expanding its distribution over the large areas of the wetlands, causing loss to natural vegetation.



Source: JICA Survey Team

Figure 6.3-12 Boeung Veal Samnap

Table 6.3-5 Impact Factors against Ecosystem of Boeung Veal Samnap

Threat level 1	Threat level 2	Threat level 3	Timing
Agriculture & aquaculture	Annual & perennial non-timber crops	Small-holder farming	Ongoing
Biological resource use	Hunting & collecting terrestrial animals	Intentional use (species being assessed is the target)	Ongoing
Biological resource use	Logging & wood harvesting	Unintentional effects: subsistence/small scale (species being assessed is not the target) [harvest]	Ongoing
Biological resource use	Fishing & harvesting aquatic resources	Unintentional effects: subsistence/small scale (species being assessed is not the target) [harvest]	Ongoing
Residential & commercial development	Commercial & industrial areas		Only in the future

Source: KBA website: <https://www.keybiodiversityareas.org/site/factsheet/16689>

2) Potential Negative Impacts due to the Requested Projects against Sensitive Areas

Expected Negative impacts due to Requested Project (Widening of NR1 (20-54 km))

Among the requested projects, a section of Widening of NR1 passes along the periphery of Bassac Marsh which is a KBA. Widening section is an operated national road, and areas about 200m from the road have been already developed. And the periphery of Bassac Marsh is cultivated lands, and the marsh is separated 1~2 km from NR1. Therefore, direct negative impacts are not expected.

The bypass routes which are proposed in this survey are planned to be constructed in the side of the KBA about 500~600m, and a part of the section will pass inside of the KBA. However, because it is separated from the marsh as same as the main route, direct negative impacts are not expected.

Expected Negative impacts due to Requested Project (Mekong Bridge Project (RR2))

The approach road of Mekong Bridge among the Request Projects close to the KBA, Boeung Veal Samnap. Although the area is inside and outside of the KBA, the vicinity of the route is designated as resident areas or agritourism areas in the urban master plan of Areiy Ksatr city. And the planned approach road is separated about 2 km from the planned water surface areas. Furthermore, in the view of the character of the project (linear project), the project is not expected as “Projects must not involve significant conversion or significant degradation of critical habitats or critical forests”. However, in the point of the environmental considerations, the location is tentatively located on the existing road outside of KBA. On the other hand, considering the regional characteristics as “habitats with important ecological value”, potential negative impacts should be confirmed by field survey for ecosystem of EIA study in the future preparatory survey. The Mekong River Tunnel should be handled in the same manner because the connecting road is closer to the KBA although

the distance is greater than that of the Mekong River Bridge.

6.3.4 Negative Impacts on Existing Traffic to be replaced

Several ferry services operate in the area surrounding Phnom Penh on the Mekong River, connecting east and west.

If the Mekong River Bridge (RR2) or the Mekong River Tunnel is implemented, users of these ferry services and stakeholders who depend on ferry services (such as small businesses and street vendors near the wharf) may be affected. To estimate these impacts, interviews were conducted with ferry users and stakeholders upstream and downstream of the Mekong River Bridge. In addition, in order to understand the actual impact of the bridge crossing, an interview survey was conducted with business operators living near the Neak Loeng Ferry wharf which was discontinued when the Tsubasa Bridge was put into service.

1) Ferry Services around Phnom Penh

The survey covered three ferry services near the Mekong River Bridge, the requested project.

The Taprom - Moat Krasah Ferry, which has operated in the same location of the Mekong River Bridge until April, will cease operations from May due to a decrease in passengers.

Table 6.3-6 Ferry Services surveyed

Ferry Service		Number of Ferries	Number of Operations (per day)	Operating Hours	Note
Up-stream	Phnom Penh–Akreyi Ksatr Ports	24	100 rounds (maximum)	4:00~22:00	Under business contract up to 2040 with Government
Down-stream	Koah Reah–Koah Prak Ports	3	20 rounds	4:30~18:00	Under business contract up to 2026 with Government
	Wooden Factory–Plov Trey Ports	3	20 rounds	5:00~20:00	

Source: JICA Survey Team



Source: JICA Survey Team

Figure 6.3-13 Location of the Ferry Services

2) Interview for Ferry Users and Stakeholders

Ferry Operators

Interviews were conducted with the managers (or their representatives) of the surveyed ferry operators. The subjects are all private operators who have entered into operating contracts with the government for a certain period of time to conduct business. If the bridge project is implemented, the negative impacts on ferry operators are expected to be significant. Therefore, the following comments were made.

- We are in favor of the development of transportation infrastructure, including bridges, as it will contribute to the convenience of the region.
- However, the ferry service generates a large number of jobs, and the impact of abolition would be extremely significant. The negative impact on livelihoods is especially severe in many cases where entire families are employed by the ferry service.
- If the ferry has to be discontinued, there is no government compensation for the remaining contract period.
- We want to see government support, including livelihood assistance.



Source: JICA Survey Team

Figure 6.3-14 Interview for Ferry Operator

Ferry Users

For all ferries, there were many complaints about the time required for ferry service (waiting time and boarding time) and the operating hour (daytime only). In addition, there are many concerns about safety during stormy weather in the rainy season. All users interviewed expressed a strong desire for the bridges and tunnels to be built as soon as possible.

Small Businesses near the Wharf

Many vendors are dealing with snacks, beverages and fruits, and indicated that they have been doing business here for 2 to 10 years or more. Many respondents indicated that if the ferry service is discontinued, they would immediately move to other areas to continue their business. Some respondents expressed a desire for government support, including livelihood assistance.

3) Interviews for the Stakeholders of discontinued Ferry Service

Interviews were conducted with 20 street vendors and others around the wharf of the Neak Loeng Ferry, which was discontinued due to the operation of the Tsubasa Bridge. Responses and comments are as follows.

- Ninety percent of respondents indicated that their livelihoods deteriorated after the Tsubasa Bridge was built. The reason is that the discontinuation of the ferry service has resulted in a decrease in sales from ferry users.
- On the other hand, 10% of respondents (2 respondents) reported that their livelihoods were better than before.
- The government should develop new attractive business venues (night markets, etc.).

4) Potential Impacts due to the Bridge Project

The bridge project will bring very large benefits for the most of ferry users in terms of significantly reducing crossing time and improving safety. On the other hand, the project will give significant

negative impacts against ferry operators and related businesses because it will lose the basis of livelihoods of them. Although impact or not can be estimated easily, it is difficult to quantify the impacts (such as income losses) of each business and proving causality, and direct compensations by the Government is difficult. Some mitigation measures such as providing alternative livelihoods is desired. This point should be surveyed in the preparatory survey.

6.3.5 Comparisons of Requested Projects in terms of Environmental and Social Considerations

(1) Option which the Projects are not implemented

Cambodia is located on the center of the southern corridor connecting the Mekong areas. NR5 connecting Thailand of west and NR1 connecting Viet Num of east are forming a corridor supporting transportation and logistics. The area is hoped to be a logistics center of international trade with surrounding countries including Thailand and Viet Num. Overland transportation accounts for 90% of the transportation within Cambodia's domestic segment, however the extension of major national roads with four or more lanes is also less than 10% of the total. Slow development of road infrastructure impedes smooth logistics in relation to the increasing traffic volume in recent years.

With regard to improving the connectivity of the Southern Economic Corridor, which contributes to strengthening the domestic economic base, there are still sections of the corridor as a whole that need to be rehabilitated. Particularly in urban areas, the corridor has been affected by increasing traffic, creating a bottleneck that hinders connectivity in the Mekong region. In some sections, large trucks, passenger cars, and motorcycles are traveling together on a one-lane road, creating a serious traffic safety issue.

In addition, Phnom Penh is facing serious traffic congestion caused by the rapid growth of the urban area and population. In order to cope with the further increase in traffic in the future, it is essential to promote the use of public transportation, and at the same time, to improve and widen the road network, including ring roads, etc. Without these improvements, the Phnom Penh metropolitan area is likely to experience stagnant economic development and environmental degradation.

(2) Comparisons of Requested Projects in terms of Environmental and Social Considerations

The implementation of the requested project will contribute to avoiding the situation anticipated by the “no project option”. On the other hand, the implementation of the requested project may have negative impacts on the environment and society. Compare and discuss the anticipated environmental and social impacts of each of the requested projects and the direction of mitigation measures. The anticipated environmental and social impacts of each requested project are discussed, and the policies of mitigation measures are considered.

Table 6.3-7 Comparisons of Environmental and Social Impacts and Project Effects due to the Requested Projects

Compared Items	①NR1 viaduct (0-4km)	②NR1 6-lanes widening (4-20km)	③NR1 4-lanes widening (20-54km)	④The Mekong River Bridge	⑤The Mekong River Tunnel
Compliance with Laws, Standards, and Plans	<ul style="list-style-type: none"> The requested projects (except ①) are based on CITL-MP which prioritized improvements and rehabilitation of national roads. The requested projects are outside of areas that are specifically designated for conservation of nature or cultural heritages by Cambodia government, and not in the vicinity or such areas. 				
Possibility of significant adverse impacts on the environment and society	None.	If the bypass route is adopted, the scale of land acquisition and resettlement is	If the bypass route is adopted, the scale of land acquisition and resettlement is	Because the project is adjacent to KBA which is a sensitive area,	Because the project is adjacent to KBA which is a sensitive area,

Compared Items		①NR1 viaduct (0-4km)	②NR1 6-lanes widening (4-20km)	③NR1 4-lanes widening (20-54km)	④The Mekong River Bridge	⑤The Mekong River Tunnel	
			likely to be large.	likely to be large.	negative impacts shall be surveyed sufficiently. The scale of land acquisition and resettlement is likely to be large.	negative impacts shall be surveyed sufficiently.	
Environment	Pollution Control	Noise impacts could be particularly high beneath of viaduct structure.	None.	None.	Construction of new 6 lanes road can cause noise and air pollution on the road sides.	A large amount of excavation soil will be generated. Policies for utilization need to be considered.	
	Natural Environment	None.	None.	None. Although the project is adjacent to KBA, the negative impact is expected to be small because it is more than 1 to 2 km away and the project is an improvement of a road in service.	Referred to the row of significant adverse impacts on the environment and society.	Because the project is adjacent to KBA, the negative impact should be confirmed in the EIA study.	
Social Impacts (Involuntary Resettlement)		Partial demolition of the affected buildings is required at the Monivong Bridge connection and ramp. The potential of physical resettlement is small.	Partial demolition of buildings is required for all sections. Building demolition is minor and unlikely to result in resettlement. The area affected may increase due to the occurrence of slopes and construction sites.	Partial demolition of buildings is required for all sections. The degree of building demolition is greater than in the 6-lane section, and the concerns of resettlement occurring is higher than in the 6-lane section. The area affected may increase due to the occurrence of slopes and construction sites.	Land acquisition and partial or complete demolition of structures will be required on the approach road section. This may result in large scale involuntary resettlement. The area affected may increase due to the occurrence of slopes and construction sites.	Land acquisition and partial or complete demolition of structures will be required on the approach road section. This may result in resettlement.	
		Land Acquisition	Land acquisition may occur at the ramp.	Land acquisition may occur at the intersection with RR2.	Land acquisition may occur due to the shifting of the road center.	Phnom Penh side Approximately 2.9ha AKC side Approximately 13.3ha	AKC side Approximately 4ha
		Affected Structures	Partially demolition 111 structures	933 structures including 64 structures of complete	1,052 structures including 159 structures of complete	Phnom Penh side 53 structures including 36 structures of	AKC side 15 structures will be affected.

Compared Items		①NR1 viaduct (0-4km)	②NR1 6-lanes widening (4-20km)	③NR1 4-lanes widening (20-54km)	④The Mekong River Bridge	⑤The Mekong River Tunnel
			demolition	demolition	complete demolition AKC side 30 structures including 4 structures of complete demolition	
	Alternatives Other Impacts	At grade plan (6 lanes) Partially demolition 111 structures	Bypass route The number of affected structures will decrease by 95, but the number of structures to be completely demolished will increase by 28. Land acquisition Approximately 8.1ha	Bypass route The number of structures requiring complete demolition will increase. Land acquisition Approximately 13.9~33.9ha	Ferry services and related businesses close to the bridge location will be affected by the decrease in passengers, including the closure of their businesses. Ferry users will benefit greatly from improved convenience and safety.	As same as the Mekong River Bridge
	Policies of mitigation measures	Based on the prediction and evaluation of pollution items including noise and air quality, mitigation measures should be examined.	Affected areas should be controlled or reduced by basic design and detail design on the next stage.	Affected areas should be controlled or reduced by basic design and detail design on the next stage.	Based on EIA study on the next stage, mitigation measures for the KBA should be proposed. Affected areas should be controlled or reduced by basic design and detail design on the next stage.	Based on EIA study on the next stage, mitigation measures should be proposed.
Evaluation	Consistency with Higher Level Plans	None	Positioned as short-term policy	Positioned as long-term policy	Positioned as long-term policy	Positioned as long-term policy
	Connectivity of the Southern Economic Corridor	Medium	Medium	Medium	High	Low
	Mitigation of Road Congestion of NR1	High	High	Medium	High	低い
	Mitigation of Congestion of Phnom Penh City	Low	Low	Low	High	High
	Promoting of Urban Development along the NR1	High on NR1	High on NR1	Medium	High in Areiy Ksatr city	High in Areiy Ksatr city
	EIRR	14.0%	47.9%	19.1%	25.9%	-0.4%

Compared Items	①NR1 viaduct (0-4km)	②NR1 6-lanes widening (4-20km)	③NR1 4-lanes widening (20-54km)	④The Mekong River Bridge	⑤The Mekong River Tunnel
Environmental and social considerations	There are no major issues on environmental and social considerations. It is expected to have the smallest impact among the four requested projects.	Land acquisition and resettlement should be taken into consideration. Particular attention should be paid to the lands which will be expanded outside the width of the road. The bypass route has a significant impact on land acquisition and resettlement, and should be avoided.	Land acquisition and resettlement should be taken into consideration. The degree of impact is greater than on the six-lane section. Particular attention should be paid to the lands which will be expanded outside the width of the road. The bypass route has a significant impact on land acquisition and resettlement, and should be avoided.	Natural environment (KBA) and land acquisition and large scale involuntary resettlement with high potential for large scale are matters to be considered. Based on adequate survey, mitigation measures need to be considered. Mitigation of impacts on ferry operators should be considered.	Based on adequate survey, mitigation measures including the utilization of the excavation soil need to be considered. Mitigation of impacts on ferry operators should be considered.
General Evaluation	In terms of the project plan, while there is a need for the project for all of the requested projects, the need for ④ the Mekong River Bridge and ② the 6-lane widening of NR1 (4-19km) was rated particularly highly. (see 5.2.3) With regard to the environmental and social considerations, the negative impacts of the NR1 widening (1) to (3) are expected to be relatively small, while the impacts of the Mekong River Bridge are expected to be significant. However, there are no obstacles to the implementation of any of the projects due to appropriate mitigation measures.				

Source: JICA Survey Team

Compliance with Laws, Standards, and Plans

All of the requested projects are to be implemented based on the Cambodia's higher level plan (CITL-MP). It is also not in or near a nature protected areas or cultural protection areas designated by the Government of Cambodia. Therefore, under JICA Guidelines, there are no obstacles to the implementation of the project.

Significant Adverse Impacts on the Environment and Society

All of the requested projects are expected to have negative impacts on residents and their properties, due to land acquisition and relocation of residents. The “Mekong River viaduct” is likely to have a large impact on housing and cause large-scale involuntary resettlement. In the NR1 widening project, most of affected objects involves partial demolition of stores, canteens, workshops, etc. along the roadside, and the potential for resettlement except in special areas such as ramp sections and intersections. However, because of the large number of the affected buildings, the estimation of the scale of resettlement is difficult. The degree of impact will vary depending on the section. In the sections close to Phnom Penh, (1) and (2), the impacts are expected to be relatively small, as few buildings, with some exceptions, will require complete demolition. On the other hand, special sections such as intersections and ramps will require wider road widths and may have a greater impact.

Furthermore, the topography (elevation difference) along the road and the construction plan may increase the required site width, which should be considered under the planning. The bypass routes, which are proposed as alternatives to NR1, is undesirable from the standpoint of environmental and social considerations, as it is likely to cause large-scale involuntary resettlement in addition to new land acquisition. The Cambodian government, for its part, has expressed its desire to avoid new land acquisition and resettlement as much as possible.

In terms of the natural environment, the approach road of the Mekong River Bridge is adjacent to the KBA, a “sensitive area”. Although this KBA (Boeung Veal Samnap) is a large wetland with a rich ecosystem, endanger species (CR, EN, VU) has not been observed, and there are no species whose habitat is limited in this area, and the negative impacts of the project is expected to be small.

Other Negative Impacts

On a flat road with an elevated roadway, the reflection of the backside of the viaduct may increase the impact of road traffic noise. Appropriate mitigation measures based on prediction in future surveys would be desirable.

Several ferry services operate on the Mekong River. While the implementation of the Mekong River Bridge will benefit ferry users, it is expected to have serious impacts on the livelihoods of ferry operators and related businesses. It is desirable that some mitigation measures be considered and implemented in this regard. The Mekong River Tunnel will generate a large amount of excavation soil during construction. Disposal and utilization of the excavation soil must be confirmed.

Project Effects

All of the requested projects will be effective in alleviating traffic congestion and promoting development in the region. Among them, the "Mekong River Bridge" is expected to have the greatest effect on improving connectivity of the Southern Economic Corridor, easing congestion in downtown Phnom Penh, and promoting development. (See Chapter 5 for details.)

As a result of considering the above, the main issues of the Mekong River Bridge are resettlement which is likely to be large, the natural environment (KBA), and the negative impacts on ferry operators and mitigation measures for them. For the NR1 widening, resettlement will be the main negative impact factor, however the impact will vary greatly depending on the section to be implemented. The impact is expected to be relatively small in the section near Phnom Penh. For the Mekong River Tunnel, in addition to the utilization of the large amount of leftover soil, there is the same issue as the Mekong River Bridge (on ferry operators).

However, none of the requested projects is denied under appropriate mitigation measures.

Table 6.3-8 Summary of Comparisons for Requested Projects

Compared Items	①NR1 viaduct (0-4km)	②NR1 6-lanes widening (4-20km)	③NR1 4-lanes widening (20-54km)	④The Mekong River Bridge	⑤The Mekong River Tunnel
Project Effects	Highly effective in easing congestion and promoting development in NR1 is expected. EIRR=14.0%	Highly effective in easing congestion and promoting development in NR1 is expected. EIRR=47.9%	The project is expected to improve connectivity of the Southern Economic Corridor, reduce congestion along the corridor, and promote development. EIRR=19.1%	The project is expected to be highly effective in improving the connectivity of the Southern Economic Corridor, easing congestion along the road and in Phnom Penh, and promoting development on the AKC side.	The project is expected to be highly effective in easing congestion in Phnom Penh and promoting development on the AKC side. EIRR=-0.4%

Compared Items		①NR1 viaduct (0-4km)	②NR1 6-lanes widening (4-20km)	③NR1 4-lanes widening (20-54km)	④The Mekong River Bridge	⑤The Mekong River Tunnel
					EIRR=25.9%	
Pollution Control		Noise on the viaduct section. A or B	None. B	None. B	Air pollution and noise along the connecting roads. B	Disposal and utilization of excavation soil. B
Natural Environment		None. C	None. C	Negative impacts against the KBA. B	Negative impacts against the KBA. B or A	None. C
Social Environment	Land acquisition and resettlement	Most affected structures are partially removed. B	Most affected structures are partially removed. B	A lot of affected structures are completely removed. A or B	A lot of affected structures (houses) are completely removed. A	Affected structures are minor. B
	Others	None. C	None. C	None. C	Negative impacts against ferry operators. B	Negative impacts against ferry operators. B

A: Significant negative impacts are expected.

B: Negative impacts are expected. However, it is not significant.

C: Negative impacts are minor.

6.4 Preliminary Studies for a Preparatory Survey for Requested Loan Projects

Based on the study in STEP 1, the most desirable loan projects were proposed in this survey through technical studies of the requested projects and consultations with relevant organizations, including the implementing agencies in the host country. (For details on candidate loan projects and studying process, see Chapter 5 and 7). In this section, a preliminary study is conducted to prepare a preparatory survey on the requested loan projects. An overview of the environmental and social situation in the vicinity of the requested project is provided, and the information of the environmental and social considerations (e.g. environmental assessment procedures) necessary for the implementation of the project are found. A preliminary scoping for the requested loan projects is conducted, and issues related to environmental and social considerations in the preparatory survey are identified. Based on this, a policy of the preparatory survey is proposed.

1) Outlines of the Requested Loan Projects

See Chapter 7.

This survey recommends the below projects as the candidate loan project.

- The Mekong River Bridge
- NR1 viaduct (0-4km)
- NR1 6-lanes widening (4-20km)
- NR1 4-lanes widening (20-54km) including the approach roads and the flyover of intersection of NR1-RR2

2) Estimated Environmental Category and Reason

See 6.7 (1)

3) Project Proponents

Ministry of Public Works and Transport: MPWT

6.5 Environmental and Social Baselines of Requested Projects

1) Meteorology

Outlines of climate

Cambodia has a tropical monsoon climate with two seasons: the dry season and the rainy season. The dry season is from November to April. Of these, November-January is the coolest, with temperatures rising from February to April. The rainy season is from May to October.

Temperature and precipitation

The average annual temperature in and around Phnom Penh is 27.9°C, with a maximum temperature of around 35°C (April) and a minimum of around 23°C (December and January). Rainfall is highest from August to October.

Table 6.5-1 Temperature and Precipitation around Phnom Penh

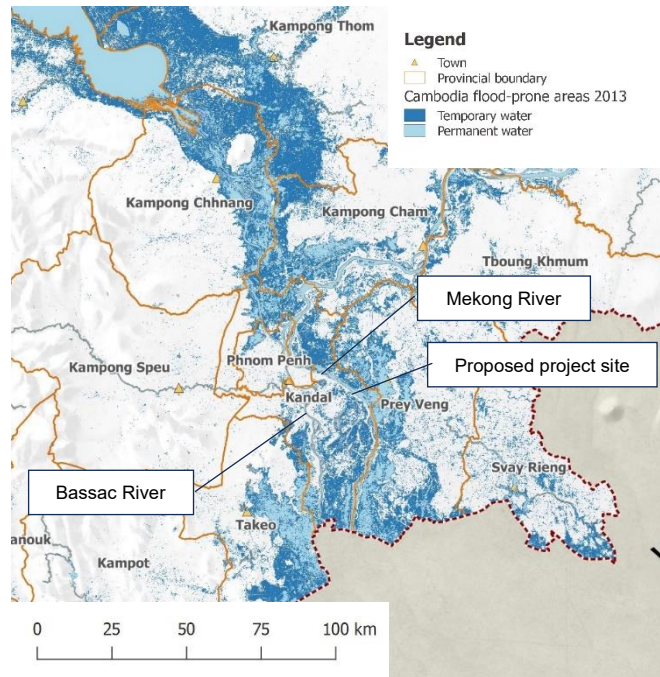
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Avg. Temperature (°C)	27.0	28.4	29.6	29.8	28.9	28.1	27.8	27.6	27.1	26.8	26.7	26.4	27.9
Min. Temperature (°C)	22.6	23.5	25.3	26.0	25.8	25.4	25.1	25.0	24.6	24.2	23.7	22.6	-
Max. Temperature (°C)	31.7	33.4	34.6	34.7	33.4	32.3	31.9	31.8	31.1	30.6	30.5	30.7	-
Precipitation / Rainfall (mm)	17	9	41	86	163	157	159	185	255	246	86	28	1432
Humidity(%)	60	57	60	66	75	77	77	78	82	83	76	66	71
Rainy days (d)	2	1	5	11	17	17	18	19	20	18	9	4	141

Source: Climate Data <https://weatherandclimate.com/cambodia/phnom-penh>

2) Hydology (Water system)

Cambodia has two water systems, the Mekong River and Tonle Sap Lake. The Mekong River and its tributaries form one of the largest water systems in the world. The Tonle Sap Lake system accounts for more than half of the water volume in the rainy season and is the most important water system in Cambodia. The proposed project site is located in the Bassac River watershed, which branches off from the confluence of the Mekong River and the Tonle Sap River, the lower reaches of Lake Tonle Sap.

The Mekong and Bassac rivers rise in water level during the rainy season, and the watershed is affected by this.



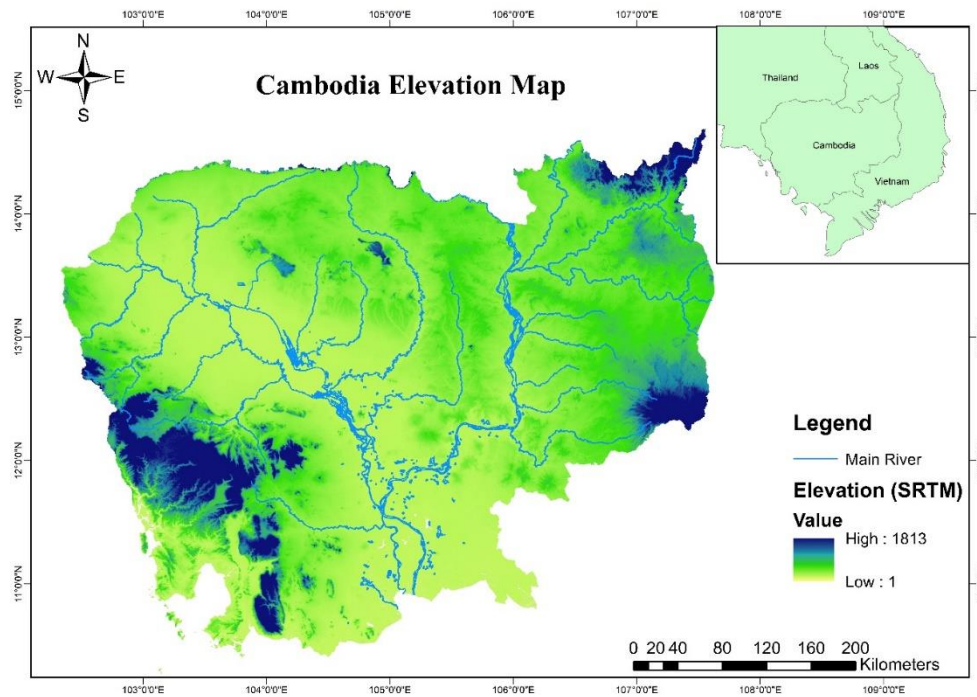
Source: Open Development Cambodia (ODC)

Figure 6.5-1 Water Systems around the Requested Projects

3) Topography and Geology

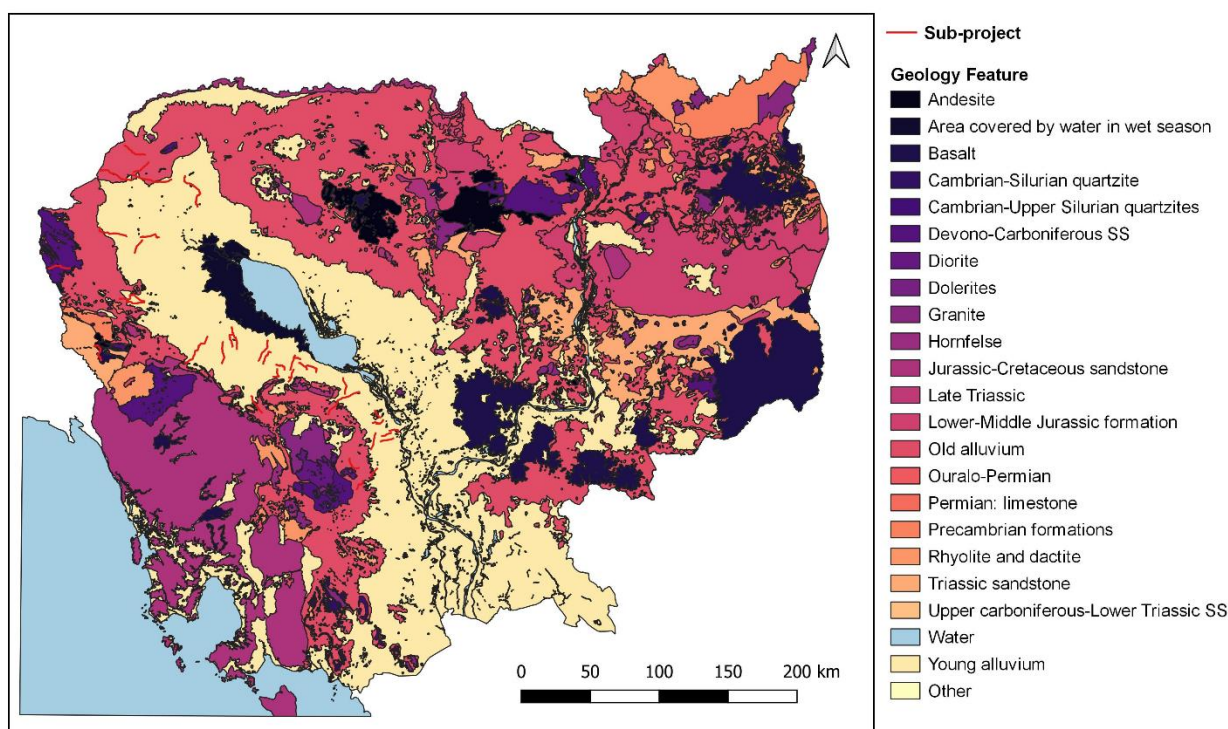
Cambodia has three topographic features: central plains, highlands, and mountains.

The Cardamom and Elephant mountain ranges extend from the west to the southwest, and the Dangrek mountain range borders the country to the north and east. On the other hand, the area around Phnom Penh and Kandal is a vast plain of alluvium. The elevation of the whole country ranges from 1m to 1,813m, and the elevation in Phnom Penh is 5 to 20m.



Source: Survey Team

Figure 6.5-2 Topography of Cambodia



Source: Atlas Data, 2006

Figure 6.5-3 Geology of Cambodia

4) Protected Areas

See 6.1.3

There are no natural protected areas or cultural heritage protected areas designated by the Cambodian government in the vicinity of the requested projects. There are also no designated areas such as Ramsar. On the other hand, the project sites are adjacent to two KBAs.

5) Ecosystem

Ecosystem

See 6.1.3 and 6.3.3

Cambodia is a country rich in nature, and important ecosystems have been established as protected areas. In the southern part of the NR1 widening project and on the Areiy Ksatr City side of the Mekong Bridge, a large wetland area (KBA), which is a habitat for waterfowl, is adjacent to the project sites. The Mekong River, located to the north of the Mekong River Bridge and NR1 Widening, forms a vast freshwater ecosystem, including the nearby Tonle Sap and Bassac Rivers. The river systems are home to over 1,000 species of fish. Fisheries resources are extremely abundant, and fisheries are conducted in these rivers and in natural and artificial ponds in the vicinity of the requested projects.

During the field reconnaissance by the local consultant in this survey, the fish listed in the table below and the amphibians and reptiles shown in the figure were observed.

Table 6.5-2 Fish Species observed in the Vicinity of the Requested Projects during the Survey

Scientific name	Common name	IUCN Red List
<i>Trichogaster trichopterus</i>	Three spot gouramis	LC
<i>Macrogathus siamensis</i>	Peacock eel	LC
<i>Mystus wolffi</i>	Wolff's mystus	DD
<i>Anabas testudineus</i>	Climbing perch	LC
<i>Channa micropeltes</i>	Giant snakehead	LC

Scientific name	Common name	IUCN Red List
<i>Channa striata</i>	Snackhead murrel	LC
<i>Barbonymus gonionotus</i>	Java/Silver barb	LC

Source: JICA Survey Team



Figure 6.5-4 Green Paddy Frog



Figure 6.5-5 Golden Tree Snake

Threatened species

Cambodia has a diverse ecosystem ranging from terrestrial to aquatic, and is home to more than 200 rare species.

Table 6.5-3 The Number of Rare Species in Cambodia

	EX	EW	CR	EN	VU	Total
Animal	0	0	19	39	134	192
Plant	0	0	9	14	10	33

Notes: EX: Extinct in the wild; EW: Extinct in the wild; CR: Critically endangered; EN: Endangered; VU: Vulnerable

Source: IUCN(2012b)

As for CITES, which restricts international trade in rare species, 275 species found in Cambodia are listed (Appendices I-III).

The KBAs (Bassac Marsh and Boeung Veal Samnap) adjacent to the southern part of the NR1 widening project and the Mekong Bridge are extensive wetlands and waterfowl habitats. Both have similar ecosystems and habitat species, and the rare species listed in the table below have been observed.

Table 6.5-4 Rare Species observed in the KBAs (Bassac Marsh, Boeung Veal Samnap)

Name	Scientific Name	IUCN Category
Darter	<i>Anhinga melanogaster</i>	NT
Spot-billed Pelican	<i>Pelecanus philippensis</i>	NT
Asian Golden Weaver	<i>Ploceus hypoxanthus</i>	NT
Whiskered Tern	<i>Chlidonias hybridus</i>	LC

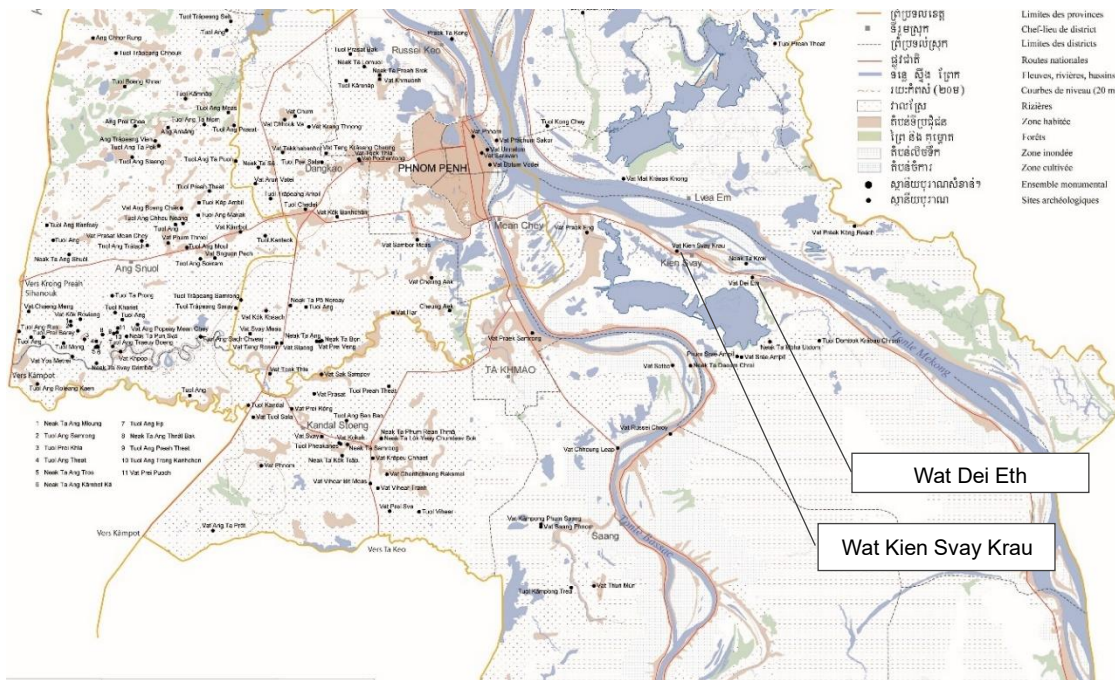
Source: KBA website

6) Cultural heritage

Many important historical sites, including World Heritage sites, remain within Cambodia. The registration of Angkor Wat as a World Heritage Site in 2012 triggered the enactment of a law on the protection of cultural heritage (National Law on the Protection of Cultural Heritage (NS/RKM/0 196/26). (National Law on the Protection of Cultural Heritage (NS/RKM/0 196/26). Since then, related laws have been developed. At the same time, a survey and inventory of the country's cultural heritage is underway, and more than 400 cultural heritage sites have been listed. However, although the legal framework for cultural heritage conservation is being developed, the policies and methods of conservation for individual listed cultural heritage sites are not yet in place.

Along the requested project (NR1 widening), there are two cultural heritage sites (Buddhist temple: Wat Kien Svay Krau and Wat Dei Eth) listed as Archaeological Sites. However, no specific conservation policy has been published for either of the two temples.

Since both temples are designated as “Sites” rather than “Areas” and are outside the ROW of the requested project, no direct impacts are anticipated. Although the legal system for the conservation of cultural properties is being developed, the tangible method of conservation for each listed cultural heritage site has not yet been developed. Specific conservation policies for both temples have not been announced.⁹



Source: CARTE ARCHEOLOGIQUE DU CAMBODGE (Ministry of Culture and Fine Arts)

Figure 6.5-6 Cultural Heritages around Phnom Penh



Figure 6.5-7 Wat Kien Svay Krau



Figure 6.5-8 Wat Dei Eth

As both temples are adjacent to the project but outside the ROW, no direct impacts from the project are envisaged. However, mitigation measures are desirable if necessary after confirmation of the conservation policy, etc.

⁹ The locations of both temples were excluded from the loan candidate project, and any negative impacts are not expected.

7) Pollution control

Air quality

“Sub-Decree No: 42 ANRK BK on Air Pollution Control and Noise Disturbance” was enacted in July 2000. This Sub-Decree stipulates that the environment and health will be protected from air pollution and noise through monitoring and mitigation measures. All mobile and stationary sources of air pollution and noise are covered. Below table shows standards of ambient air quality.

Table 6.5-5 Standards of Air Quality of Cambodia (comparison with IFC Guidelines)

Parameter	Unit	MOE standard*				IFC Guidelines**			
		1 Hour	8 Hours	24 Hours	1 Year	1 Hour	8 Hours	24 Hours	1 Year
CO ₂	mg/m ³	40	20	-	-	-	-	-	-
NO ₂	mg/m ³	0.3	-	0.1	-	0.2	-	-	0.04
SO ₂	mg/m ³	0.5	-	0.3	0.1	-	-	0.02	-
O ₃	mg/m ³	0.2	-	-	-	-	0.1	-	-
Lead	mg/m ³	-	-	0.005	-	-	-	-	-
TSP	mg/m ³	-	-	0.33	0.1	-	-	-	-

* Sub-Decree No: 42 ANRK BK on Air Pollution Control and Noise Disturbance ANNEX 1,

** IFC (2007) . Environmental, Health, and Safety (EHS) Guideline: Noise Management (for Residential, institutional, educational)

Water Quality

Sub-Decree No: 27 ANRK BK on Water Pollution Control” was enacted in April 1999. The Sub-Decree stipulates that the Ministry of Environment (MOE) is responsible for monitoring water quality, inspecting and reporting on pollution activities, and that companies and organizations that discharge or transport wastewater must be licensed by the MOE. The Sub-Decree specifies effluent standards and water quality standards for public waters.

Table 6.5-6 Standards of Water Quality

No.	Surface water quality parameters	Unit	Standard*
<i>River</i>			
1	pH	mg/l	6.5 – 8.5
2	BOD5	mg/l	1 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coli form	MPN/100ml	< 5000
<i>Lakes and Reservoirs</i>			
1	pH	mg/l	6.5 – 8.5
2	COD	mg/l	1 – 8
3	Suspended Solid	mg/l	1 – 15
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coli form	MPN/100ml	< 1000
6	Total Nitrogen	mg/l	1.0 – 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05
<i>Coastal water</i>			
1	pH	mg/l	6.5 – 8.5
2	COD	mg/l	1 – 8
3	Dissolved Oxygen	mg/l	2.0 - 7.5
4	Coli form	MPN/100ml	< 1000
5	Oil content	mg/l	0

No.	Surface water quality parameters	Unit	Standard*
6	Total Nitrogen	mg/l	1.0 – 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05

Source: * Sub-Decree No: 27 ANRK BK on Water Pollution Control Annex 4

Noise, Vibration

The environmental standards for noise are shown in the table below. The time periods are divided into three categories, which are generally equivalent to international indices.

Table 6.5-7 Standards of Noise (dB(A))

No.	Area	MOE standard*			IFC Guidelines **	
		From 6:00 AM to 18:00	From 18:00 to 22:00	From 22:00 to 6:00 AM	From 7:00 AM to 22:00	From 22:00 to 7:00 AM
1	Quiet area: - Hospital - Libraries - School - Kindergarten	45	40	35	55	45
2	Residential area: - Hotels - Administration offices - House	60	50	45		
3	Commercial and service areas and mix	70	65	50	70	70
4	Small industrial industries intermingling residential areas	75	70	50		

Source: * Sub-Decree No: 42 ANRK BK on Air Pollution Control and Noise Disturbance ANNEX 6

** IFC (2007) . Environmental, Health, and Safety (EHS) Guideline: Noise Management (for Residential, institutional, educational)

The standards of noise sources are shown in the table.

Table 6.5-8 Standard of Noise Sources (vehicle)

No.	Category of vehicle	Maximum noise level permitted (dB (A)) *
1	Motorcycle, cylinder capacity (CC) of engine does not exceed 125cm ³	85
2	Motorcycle, CC of the engine exceeds 125cm ³	90
3	Motorize tricycles	90
4	Car, taxi, passenger vehicle for carriage of less than 12 passengers	80
5	Passenger vehicle for carriage of more than 12 passengers	85
6	Truck permitted maximum weight does not exceed 3.5 tones	85
7	Truck permitted maximum weight does not exceed 3.5 tones	88
8	Truck engine is more than 150 KW	89
9	Tractor or any other truck not elsewhere classified of described in this column of the table	91

Source: * Sub-Decree No: 42 ANRK BK on Air Pollution Control and Noise Disturbance ANNEX 5

No vibration standards have been established. There are no internationally recommended values for vibration. It is advisable to refer to values such as those in the Vibration Regulation Law of Japan (construction work: 75 decibels, road traffic: 60-70 decibels) when making an assessment.

8) Basic Socio-economic Information

Demographic and socio-economic situation

i) Population

The population of Cambodia, Kandal Province and Phnom Penh is shown on the table below. Over the 25 years to 2023, the population of Cambodia increased by a factor of 1.5. In contrast, the population of Phnom Penh and Kandal Province increased by a factor of 2.4 and 1.2, respectively, over the same period. While Phnom Penh's population growth has been significant, Kandal Province has been somewhat stagnant.

Table 6.5-9 Demographics of Cambodia, Kandal Province and Phnom Penh

Cambodia /Province	Population				Annual growth rate		
	1998	2008	2013	2023	1998-2008	2008-2013	2013-2023
Cambodia	11,437,656	13,395,682	14,676,591	17,091,464	1.54	1.83	1.62
Kandal	1,075,125	1,091,170	1,115,965	1,292,479	1.62	0.45	1.34
Phnom Penh	999,804	1,501,725	1,688,044	2,352,680	2.83	2.34	3.16

Source: National Institution of Statistics and <https://worldpopulationreview.com/world-cities/phnom-penh-population>

ii) Education

The Cambodian government has been strongly promoting the improvement of the educational environment, and in the last decade, quantitative improvements have been seen in terms of enrollment, school construction, number of teachers, and support for poor students. In terms of the quality of education, the government is also developing a detailed curriculum and improving the training environment for teachers. The Ministry of Education, Youth and Sport has identified nine priorities for 2022 and beyond, including education adapted to information technology, further improvement of teacher quality, and education using digital technology.¹⁰

Table 6.5-10 Indicators of School

Cambodia/Province	Cambodia	Phnom Penh	Kandal
Total number of schools	13,681	380	761
Total number of students	3,277,076	245,356	263,766
Total number of kindergarten students	217,787	9,743	15,822
Total number of primary school students	2,036,566	135,555	161,700
Total number of secondary school students	662,106	13,326	32,073
Total number of high school students	360,617	86,732	54,191

Source: Public Education Statistic & Indicator, 2021-2022

iii) Sewerage and Sanitation

The toilet coverage rate in the entire country of Cambodia is estimated to be 82.8%. While the national average of households without toilets is 17.2%, the rate is 11% in Kandal Province and 6.1% in Phnom Penh Metropolis, both higher than the national average.¹¹

iv) Employment and Poverty

The table below shows indicators pertaining to employment in Kandal Province and Phnom Penh in 2019. The unemployment rate is extremely low.

Table 6.5-11 Indicators of Employment (15 years and older)

Province/Capital	Employment Rate			Unemployment Rate		
	Both Sexes	Male	Female	Both Sexes	Male	Female
Kandal Province	99.2	99.3	99.1	0.8	0.7	0.9
Phnom Penh Capital	98.6	98.9	98.3	1.4	1.1	1.7

Source: General Population Census in Cambodia (GPCC), 2019

¹⁰ Education Congress The Education, Youth and Sport Performance in the Academic Year 2021-2022 and Goals for the Academic Year 2022-23 (Ministry of Education, Youth and Sport, 10-11-12 April 2023)

¹¹ Home toilet access improving | Phnom Penh Post, publication date: February 16, 2021

The poverty situation varies widely by region within Cambodia. Phnom Penh has the lowest poverty rate at 4.2%, while other urban areas and rural areas have the highest poverty rate at 12.6% and 22.8%, respectively. The poverty rate has improved by 1.6% over the last decade or so as wages have risen.

v) **Economy and Industry**

The economic structure of Cambodia is shifting toward industrialization and modern industry. The table below shows the percentage of workers by industry in Kandal Province and Phnom Penh. The agriculture, forestry, and fisheries industry accounts for 40.6% in Kandal Province and 4.5% in Phnom Penh, showing a large difference. On the other hand, the percentages for the manufacturing sectors are almost equal, at 24.9% and 24.2%, respectively. Wholesale and retail trade accounted for 11.9% and 24.3%, respectively. In general, Phnom Penh presents an urban industrial structure, while Kandal Province can be said to have an industrial structure of a somewhat rural economy.

Table 6.5-12 Percentage of workers by industry in Kandal Province and Phnom Penh

No.	Group of Industry	Province (%)	
		Kandal	Phnom Penh
1	Agriculture, Forestry and Fishing	40.6	4.5
2	Mining and Quarrying	0.3	0.1
3	Manufacturing	24.9	24.2
4	Electricity, Gas, Steam and Air-Con Supply	0.3	0.5
5	Water Supply, Sewerage, Waste Management and Remediation Activities	0.1	0.3
6	Construction	6.2	6.1
7	Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles	11.9	24.3
8	Transportation and Storage	3.0	5.4
9	Accommodation and Food Services Activities	2.1	4.5
10	Information and Communication	0.1	0.3
11	Finance and Insurance Activities	0.7	1.9
12	Real Estate	0.5	1.6
13	Professional, Scientific and Technical Activities	1.9	10.0
14	Administrative and Support Service Activities	2.4	7.9
15	Public Administration and Defense, Social Security	1.8	2.3
16	Education	0.6	1.5
17	Human Health and Social Work Activities	0.6	1.4
18	Art, Entertainment and Recreation	1.9	3.3
19	Other Service Activities	0.0	0.0
20	Use Activities of Households as Employers	0.0	0.0
21	Activities of Extraterritorial Organizations and Bodies	0.0	0.0

Source: General Popular Census in Cambodia (GPCC), 2019

vi) **Land use**

Land use in Phnom Penh is predominantly residential, government facilities, cultural and religious areas, and commercial areas. In Kandal Province, land use is residential, commercial, and industrial, as well as agricultural land, forests, and rivers.

vii) **Land Acquisition and Resettlement**

See 6.3.2 for information on the situation along the roadside and the potential for land acquisition and resettlement. The Mekong River Bridge will require the construction of new connecting roads which require land acquisition and the removal of buildings, including dwellings. For the NR1 widening, there are structures that appear to have been extended within the ROW throughout the roadside. Some of these extensions will require removal. See 6.6(2) for more information on the system of the land acquisition and resettlement.

9) Indigenous Peoples

The Cambodian government defines “indigenous peoples” as ethnic groups with their own language,

culture, traditions, and customs that differ from those of the Khmer people. Currently, there are 22 identified indigenous peoples known as “Hill Tribes. Many of them live in remote areas. The project site is located near the capital city and its suburbs, where there are no areas inhabited by such indigenous peoples/minority groups.

6.6 Legal Systems and Procedures for Environmental and Social Considerations

(1) Environmental Assessment in Cambodia

Legal systems

In 1996, the Law on Environment Protection and Natural Resources Management was enacted. In 1999, the Sub-Decree on Environmental Impact Assessment Process was enacted, which stipulates projects that require submission of EIA reports and public participation. Since then, the EIA system has been operated based on the following guidelines and laws.

- Prakas No.376, MOE
- The Prakas (Declaration) on General Guidelines for Conducting Initial and Full Environmental Impact Assessment Reports (2009)
- The Joint Prakas (Declaration) on the Establishment of Service fee for Reviewing report of EIA and Monitoring the Project implementation (2000 and 2012)

Project proponents must conduct an environmental study in accordance with the EIA system and obtain an environmental permit prior to the start of the project.

Procedure of EIA

In 2020, the Ministerial Decree on the Classification of EIAs for Development Projects (Prakas No. 021 on the Classification of Environmental Impact Assessment for Development Projects) came into effect. It stipulates three procedures depending on the type and scale of the project.

Table 6.6-1 Category of EIA Procedure

Category of Procedure	Requirement
Environmental management contract (EMC)	This procedure is for projects with minor environmental and social impacts. An Environmental Management Plan (EMP) must be prepared and submitted.
Initial environmental impact assessment (IEIA)	For projects with moderate environmental and social impacts, an IEIA report is required to be prepared and submitted.
Full environmental impact assessment (Full EIA)	For projects with significant environmental and social impacts, an Full EIA report is required to be prepared and submitted.

Source: Prakas No.21 MOE

The types of EIA procedures and requirements for infrastructure projects are set out in legislation (Table 6.6-2). In principle, project proponents are required to follow the relevant procedures according to this table. However, the actual procedures are determined by MOE screening (see below). Among the projects, the NR1 Widening falls under “179. Road Construction” and the type of the EIA depends on the total length of the project. The development for total length (54km) is expected to be required to prepare and submit an I.R.I.S.A.R. As for the Mekong River Bridge, it falls under the category of “189. Road Bridge Construction,” and it is said that I.E.I.S.A.R. is required to be prepared and submitted.

Table 6.6-2 EIA Procedures for Infrastructure Projects

No.	Type of Project	Classification of Environmental Impact Assessment in accordance with Sizes of Development Project		
		F.E.S.I.A.R	I.E.I.S.A.R	Environmental Protection Contract
6. Infrastructure Sector				
167	Airport Construction	(All sizes)		
168	Urban development	(All sizes)		
169	Stadium Construction	(All sizes)		
170	Industrial Waste field	(All sizes)		
171	Industrial Zone/SEZ	(All sizes)		
172	Mechanical and sewer treatment base	(All sizes)		
173	Railway Construction	(All sizes)		
174	Port Construction, except family port construction	(All sizes)		
175	Construction and operation of submarine cables and infrastructure, including overland cable connections	(All sizes)		
176	All Construction building (Office, Multi-purpose building, Trade building construction, Condo, Complex and Villas, Supermarket, and other constructions.)	(Construction Area > 45 000 m ²)	(Construction Area > 15 000 – 45 000 m ²)	(Construction Area > 3 000 – 15 000 m ²)
177	Costal Area Hotel Construction/ Riverside	(> 230 rooms)	(≥ 60-230 rooms)	(< 60 rooms)
178	Construction of buildings outside the coastal area/ Riverside	(> 250 rooms)	(≥ 80-250 rooms)	(< 80 rooms)
179	Road Construction	(> 100 km)	(≥ 30-100 km)	(10 - <30 km)
180	Construction of road and railway extension	(> 100 km)	(≥ 50-100 km)	(10 - <50 km)
181	Road construction in protected areas	(> 30 km)	(≥ 10-30 km)	(< 10 km)
182	Road repair, extension construction in protected areas	(> 50 km)	(≥ 10-50 km)	(< 10 km)
183	Power transmission line	(> 230 KV)	(≥ 115-230 KV)	(< 115 KV)
184	Mud pumping	(≥ 50 000 m ³)		(< 50 000 m ³)
185	Guest House Construction		(≥ 80 rooms)	(< 80 rooms)
186	Navigation		(≥ 100 Tons)	(< 100 Tons)
187	Natural treatment base and sewer system		(All sizes)	
188	Landfill		(All sizes)	
189	Road Bridge Construction		(Support weight ≥ 30 Tons)	
190	Telecommunication and Information Technology Network		(All sizes)	
191	Overland Fiber Optic Network		(All sizes)	
192	Data Centre		(All sizes)	
193	Laboratory Center including QC Technical and Certificate		(All sizes)	
194	Basic Telecommunication Services (Mobile, Landline, Internet, and Bonus)			(All sizes)
195	Booth construction project and Sky market			(All sizes)

No.	Type of Project	Classification of Environmental Impact Assessment in accordance with Sizes of Development Project		
		F.E.S.I.A.R	I.E.I.S.A.R	Environmental Protection Contract
196	Phone system installation location			(All sizes)
197	Cemetery			(≥ 5 hectare)

Note:

F.E.S.I.A.R: Full Environmental and Social Impact Assessment Report

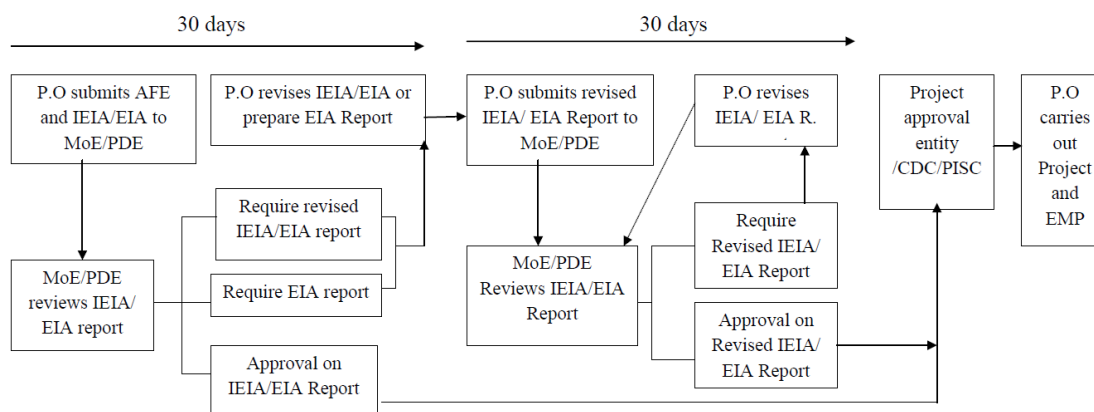
I.E.I.S.A.R : Initial Environmental and Social Impact Assessment Report

Source: Prakas No.21 MOE

Although there are no specific provisions in the law, prior to conducting an EIA study, prior consultation between the project proponents and the MOE is conducted. In this prior consultation, the MOE conducts screening and determines the type of procedures and TOR, taking into account the background and circumstances of each project. Based on this decision, the project proponents conduct surveys, EIAs, and other reports are prepared.

The procedural flow after the submission of the EIA report and other documents to the MOE is stipulated in Prakas No. 376. The project proponents prepare a FESIAR or IESDAR and submits it to the MOE and PDE (Provincial Department of Environment) together with an AFE (Application Form of Environment). The MOE/PDE will review the submitted documents and issue correction instructions as necessary. (In some cases, the FESIAR may be requested in response to the submitted IESDAR.) After two reviews and revisions, the FESIAR/IESDAR is approved and the project can be implemented. 60 working days are required from the submission of the FRSIAR/IESDAR to the approval.

Process for EIA clearance for proposals with endorsement from project approval entity/ CDC or by provincial Investment Sub-committee



NOTE: IEIA: Initial Environmental Impact Assessment MoE: Ministry of Environment P.O: Project Owner
 EIA: Full Environmental Impact Assessment PISC: Provincial Investment Sub-committee
 CDC: Council for Development of Cambodia PDE: Provincial Department of Environment
 EMP: Environmental Management Plan AFE: Application Form of Environment

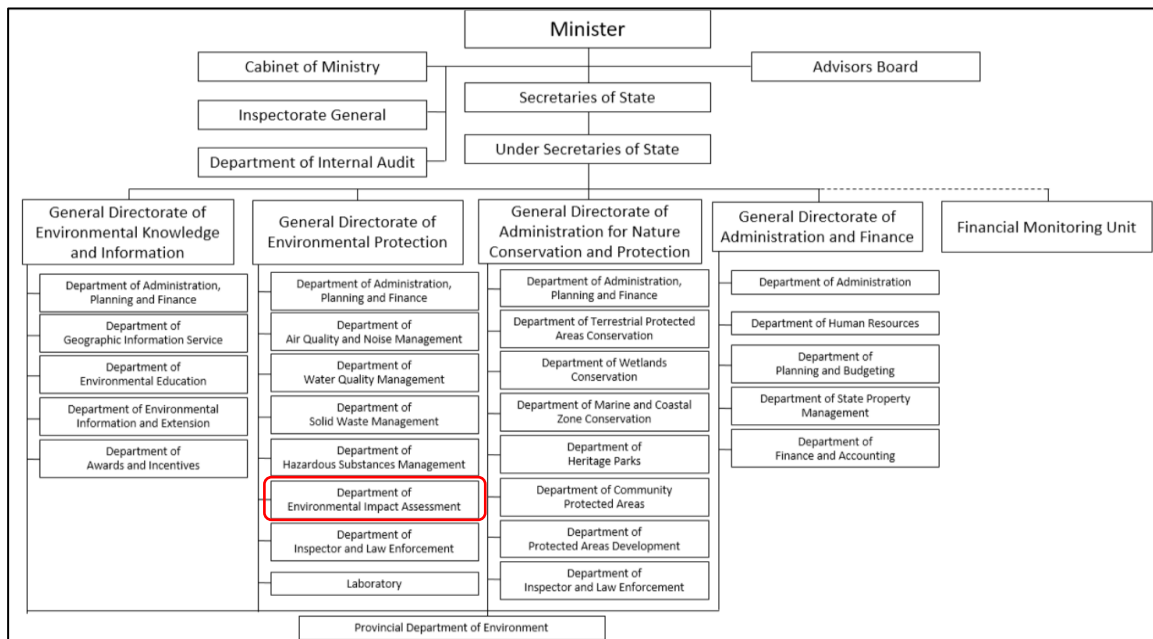
Source: Prakas No.376

Figure 6.6-1 Flow of EIA Procedure in Cambodia (after submission of EIA report)

Administrative Organizations Related to Environmental Assessment

The Department of Environmental Impact Assessment (DEIA) of the MOE is responsible for environmental assessment in Cambodia. DEIA has the authority to conduct all matters related to EIA, including EIA procedures, registration of environmental consultants, coordination with relevant ministries and agencies, and matters related to monitoring. The review of EIA reports is conducted by

PDE in addition to DEIA.



Source: Survey Team

Figure 6.6-2 Organization Chart of MOE (Ministry of Environment)

Public Participation, Public Consultation and Information Disclosure

The EIA procedure in Cambodia stipulates the involvement of stakeholders related to the project. Stakeholders include relevant ministries and agencies, local governments, companies, representatives of local residents, and related NGOs, etc. Public consultation meetings are held for these stakeholders to promote public participation and information disclosure on the project. The results of the public consultation meetings will be recorded in the EIA reports. There are no specific regulations regarding the specific implementation method (location, number of meetings, etc.) of the public consultation meetings.

Monitoring and Evaluation

An Environmental Management Plan (EMP) is required in the EIA report. The following items are to be included as part of the EMP:

- Summary of major environmental impacts and mitigation measures
- Monitoring plan during construction and under service (implementation entity, monitoring items, methods, standards and guidelines, implementation process, evaluation of results, and submission of quarterly reports to the MOE and relevant ministries)

(2) Land Acquisition and Resettlement Systems in Cambodia

Legal systems and procedures

Land acquisition and resettlement are implemented under the following laws.

- Constitution of the Kingdom of Cambodia 1993
- Land Law 2001
- Expropriation Law 2010

Furthermore, in 2018, Sub-Decree No. 22 ANK/BK: Land Acquisition and Involuntary Resettlement - Standard Operating Procedures for Externally Financed Projects in Cambodia 2018 ('SOP') came into force. The SOP was prepared as a guideline for land acquisition and resettlement occurring in public infrastructure projects for Cambodian government officials involved in land acquisition and resettlement, as well as aid agency officials, consultants and NGOs. In particular, the guidelines are designed with projects supported by overseas aid agencies, and require consideration of the policies and guidelines of aid agencies. The project is designed to comply with the laws and regulations and systems of Cambodia, as well as with the JICA Guidelines for Environmental and Social Considerations 2022 and The World Bank Environmental and Social Framework 2017, while complying with Cambodian laws and institutions.

The SOP establishes the following procedures for land acquisition and resettlement.

1. Preparation of Basic Resettlement Plan

During the basic planning phase of the project, the project operator (EA) prepares a resettlement plan (BRP), which is approved by the General Department of Resettlement (GDR; see next section).

2. Preparation of Detailed Resettlement Plan

At the detailed design stage, GDR prepares a Detailed Resettlement Plan (DRP), which assesses the affected assets based on the detailed survey and calculates the amount of compensation. After approval by the DRP, the land acquisition and resettlement will be implemented.

3. Grievance redress mechanism and monitoring

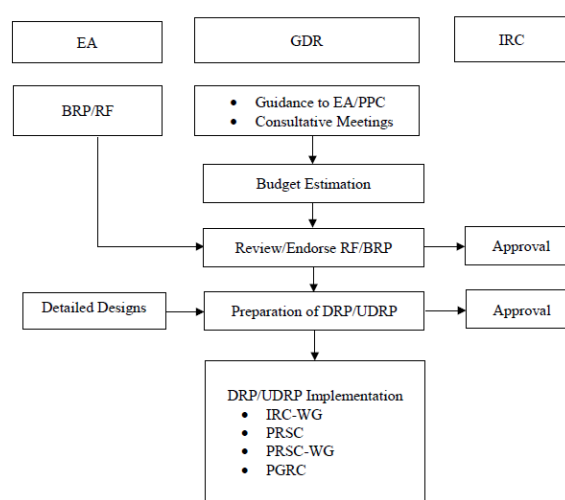
For the Grievance Redress Mechanism, a four-step grievance resolution process has been established, beginning with a petition to the Community Office, followed by the District Office, GDR, and PGRC, and finally, resolution at the Court of Justice. Monitoring is conducted by the Dept. of Internal Monitoring and Data Management (DIMDM) based on reports from the GDRs that implement the DRP, and by the External Monitoring Agency (EMA). External Monitoring Agency (EMA) will conduct monitoring.

Implementation organization for land acquisition and resettlement

In Cambodia, the Ministry of Economy and Finance (MEF) has jurisdiction through the Inter-Ministerial Resettlement Committee (IRC). The IRC is an inter-ministerial committee established to review and evaluate land acquisition and resettlement by public works projects. Under the IRC,

Appendix 1

Role in Resettlement Planning and Implementation



- RF/BRP - Resettlement Framework/Basic Resettlement Plan
- DRP - Detailed Resettlement Plan
- UDRP - Updates Detailed Resettlement Plan
- IRC-WG - IRC Working Group
- PRSC - Provincial Resettlement Sub-Committee
- PRSC-WG - PRSC-Working Group
- PGRC - Provincial Grievance Redress Committee

Source: Land Acquisition and Involuntary Resettlement Standard Operating Procedures for Externally Financed Projects in Cambodia

Figure 6.6-3 Flow of RAP Procedure in Cambodia

the General Department of Resettlement (GDR) serves as the technical secretariat and is responsible for substantive work ranging from preparation to monitoring of land acquisition and resettlement. The Provincial Resettlement Sub-Committee (PRSC), established at the regional level, provides practical support closer to the community.

(3) Gap Analysis between Cambodian Law and JICA Guidelines on Environmental and Social Considerations

As Cambodia has an appropriate EIA system and a system for land acquisition and resettlement, there are no major gaps with the JICA Guidelines. The table below shows the existence of gaps and the policy for addressing them with regard to Cambodia's legal system and the JICA Guidelines' policy for the environmental and social considerations.

Table 6.6-3 Comparisons between Systems of Cambodia and JICA Guidelines

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
Basic Principles	1. Environmental and social impacts caused by projects must be assessed and examined at the earliest possible planning stage. Alternatives or mitigation measures must be examined, in order to avoid such impacts as much as possible, and to minimize, reduce or mitigate them when such avoidance is impossible. The result of the examinations must be reflected into the project plan.	Project proponents conduct an EIA study prior to project implementation to ensure that environmental and social impacts avoided, minimized, mitigated, and mitigated are reflected in the project.	No significant gaps.
	2. Such examinations must be endeavored to include an analysis of environmental and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis, and to be in a close harmony with the economic, financial, institutional, social, and technical analyses of projects.	There is no provision for quantitative evaluation in the EIA study.	In the preparatory survey, efforts will be made to assess as quantitatively as possible. In addition, a qualitative assessment will also be added to the evaluation.
	3. The findings of the examination of environmental and social considerations, including alternatives and mitigation measures, must be documented as an independent document or as a part of other documents. Environmental assessment reports must be prepared for projects with potential significant impacts.	It is stipulated that EIAs and IEEs shall be conducted and reports prepared depending on the project type and size.	No significant gaps.

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
	<p>4. For projects which may have significant impacts in particular, or for controversial projects, a committee of experts may be formed so that projects may seek their opinions, in order to increase accountability.</p>	<p>There is no provision for the establishment of a committee of experts on EIA reports.</p>	<p>For Category A projects, the advice of the JICA Advisory Committee on Environmental and Social Considerations will be reflected.</p>
<p>Examination of Measures</p>	<p>1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts by the project and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts. When this is not possible, minimization, reduction, and then mitigation of the impacts must be considered, in accordance with the mitigation hierarchy. Compensation measures must be examined only when significant impacts are still remain even with the aforementioned measures.</p>	<p>There are no provisions studying alternatives in the EIA study. On the other hand, there is a provision for consideration of mitigation measures.</p>	<p>Alternative studies will be conducted in the preparatory study to avoid, minimize, reduce, or mitigate impacts.</p>
	<p>2. Appropriate plans and systems for measures, such as monitoring plans and environmental management plans, must be prepared. The costs of implementing such plans and systems, and the financial methods to fund such costs, must be determined. For projects with particularly significant impacts, detailed environmental management plans must be prepared.</p>	<p>It is stipulated that an Environmental Management Plan (EMP) be developed in the EIA report.</p>	<p>No significant gaps.</p>
<p>Scope of Impacts to Be Assessed</p>	<p>1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water use, climate change, biodiversity, and ecosystem services, including trans-boundary or global scale impacts. These also include social considerations such as: Migration of population including involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-</p>	<p>For the environmental and social baseline, a wide range of information from the natural environment to the social environment should be collected. On the other hand, there is no specific provision for evaluation items.</p>	<p>The extensive items specified in the JICA guidelines will be supplemented in the preparatory survey.</p>

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
	<p>making institutions, existing social infrastructures and services, vulnerable social groups such as poor peoples and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.</p>		
	<p>2. In addition to the direct and immediate impacts of projects, derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects are also to be examined and assessed to a reasonable extent. It is also desirable to consider the impacts through a project life cycle.</p>	<p>The provisions are set forth regarding the identification of cumulative effects.</p>	<p>Review the project and, if necessary, investigate derivative and secondary impacts, cumulative impacts, and impacts of indivisible projects.</p>
Compliance with Laws, Standards, and Plans	<p>1. Projects must comply with the laws, ordinances, and standards related to environmental and social considerations established by host country governments, including local governments. Projects must also conform to the environmental and social consideration policies and plans of the host country governments.</p>	<p>There are no provisions.</p>	<p>In formulating projects, consistency with laws, regulations, and standards will be checked.</p>
	<p>2. In principle, Projects must be undertaken outside of areas that are specifically designated for conservation of nature or cultural heritages by the host county governments, unless the main purpose of the Projects is to promote or restore the protection of such areas. Also, projects shall not cause significant adverse impacts on such designated conservation areas.</p>	<p>There are no provisions.</p>	<p>In this survey, it was confirmed that the project would take place outside of the area in question. In addition, sufficient separation distances have been established to ensure that no impacts will occur.</p>
Social Acceptability	<p>1. Projects must be adequately coordinated so that they are accepted in a socially appropriate manner for the countries and areas where the projects are planned. For Projects with potentially significant environmental</p>	<p>An EIA study will be conducted prior to project implementation. During the EIA study, the project</p>	<p>No significant gaps. Consideration will be given to ensure that useful opinions are</p>

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
	<p>and social impacts, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans are examined. The outcome of such consultations must be incorporated into the project plans.</p>	<p>overview, environmental and social impacts, and mitigation measures will be explained to the local community. There is no clear provision for the results of stakeholder consultations to be reflected in projects.</p>	<p>reflected in the project, based on the multiple rounds of public consultation that will be carried out during the preparatory survey.</p>
	<p>2. Appropriate considerations must be given to vulnerable social groups, such as women, children, elderly peoples, people in poverty, indigenous peoples, persons with disabilities, refugees, internally displaced persons, and minorities. Such vulnerable social groups are susceptible to environmental and social impacts and may have little access to decision-making processes within society.</p>	<p>There is no provision for consideration of access for the socially vulnerable.</p>	<p>If stakeholders include socially vulnerable groups, consideration should be given to access to public consultations, etc.</p>
Climate Change	<p>1. For projects that are expected to generate more than a certain amount of greenhouse gas emissions, the total amount of greenhouse gas emissions will be estimated and disclosed before the project implementation.</p>	<p>There are no provisions.</p>	<p>In case that a certain amount of GHG emissions is expected, the total GHG emissions shall be estimated in the preparatory study and included in the report.</p>
Biodiversity	<p>1. Projects must not involve significant conversion or significant degradation of critical habitats or critical forests.</p>	<p>There are no provisions.</p> <p>(See above, from 'Basic Principles' to 'Biodiversity 1', as stipulated in Prakas on Guidelines for Developing Initial and Full Environmental Impact Assessment Reports.)</p>	<p>It is likely that the project will not involve significant conversion or significant degradation of critical habitat or critical forests. This will be confirmed again in the preparatory survey.</p>
	<p>2. Illegal logging of forests must be avoided. Project proponents need to obtain logging permits from regulatory agencies, and are encouraged to obtain forest certifications for forestry projects, in order to ensure the prevention of illegal logging.</p>	<p>There are no provisions. Prohibited acts against forests, penalties, etc. are stipulated. On the other hand, provisions are made</p>	<p>The requested projects will not occur forest clearance. However, the eligible projects are implemented in accordance</p>

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
		for the effective use of forests, such as the concession system. (Law on Forestry 2003)	with the relevant laws and regulations.
Involuntary Resettlement and Loss of Livelihood	1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. If avoidance is not possible even after such examination, effective measures to minimize impacts and to compensate for losses must be taken upon agreement with the affected people.	There is no explicit discussion of how to avoid it.	Avoidance or minimization of impacts will be discussed in the preparatory survey.
	2. Project affected people, such as people to be resettled involuntarily and/or people who may lose their livelihoods by the project, must be provided sufficient compensations and supports by the project proponents in a timely manner. Compensations must be calculated at full replacement cost as much as possible, and provided in advance. Project proponents must make efforts for the affected people to improve or at least restore their standards of living, income opportunities and production levels to the pre-project levels. Measures to achieve this may include: Providing land or monetary compensations for losses of land or assets, supporting for alternative sustainable livelihood, supporting for expenses necessary for relocation, and supporting for re-establishment of communities at resettlement sites.	For involuntary resettlement, relocation will take place under a relocation agreement with appropriate compensation. The level of compensation will be addressed under the grievance procedure.	The level of compensation meeting with the JICA guidelines will be agreed with implementing agency.
	3. Compensation standards are disclosed and consistently applied. The project affected persons need to be aware of the compensation standards. In principle, the contents of the individual compensation to be agreed are explained to the project affected persons in writing, and the project affected persons can confirm the contents at any time.	A contract is concluded for the resettlement. Compensation is based on market prices assessed by an independent institution.	Obtain agreement with the original implementing agency to compensate at the reacquisition price identified by the RAP survey.

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
	<p>4. Appropriate participation of the project affected people and their communities must be promoted in the planning, implementation and monitoring of measures against involuntary resettlement and loss of livelihood.</p>	<p>There are no specific provisions.</p>	<p>Community involvement in the implementation of resettlement will be discussed in the RAP survey.</p>
	<p>5. For projects that result in large-scale involuntary resettlement, a Resettlement Action Plans (RAP) must be prepared and made available to the public prior to the resettlement and provision of compensation and support. In preparing the RAP, consultations must be held with the project affected people and communities, based on sufficient information made available to them in advance. When consultations are held, explanations must be given in languages and forms that are understandable to the project affected people. It is desirable that the RAP includes elements laid out in the Environmental and Social Standard (ESS) 5 of the World Bank's environmental and social policies.</p>	<p>For large-scale involuntary resettlement, a Basic Resettlement Plan (BRP) is prepared. Stakeholders meetings are held to prepare the BRP.</p>	<p>No significant gaps.</p>
<p>Indigenous Peoples</p>	<p>1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. If avoidance is not possible even after such examination, effective measures for indigenous peoples must be taken to minimize the impacts and to compensate for the losses.</p>	<p>Indigenous peoples are considered vulnerables. If a project affects indigenous peoples, an Indigenous Peoples Plan will be developed.</p>	<p>No impacts on indigenous peoples are expected to occur under the project implementation. If negative impacts do occur, consideration will be given in accordance with the SOP, WB OP 4.10 and JICA Guidelines.</p>
	<p>2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of the relevant international declarations and treaties, including the United Nations Declaration on the Rights of Indigenous Peoples. Efforts must be made to obtain the Free, Prior, and Informed Consent (FPIC) of the</p>	<p>Ditto</p>	<p>Ditto</p>

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
	<p>affected indigenous peoples.</p> <p>3. Measures for the affected indigenous peoples must be prepared as an Indigenous Peoples Plan (IPP), which may constitute as a part of other documents for environmental and social considerations, and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the IPP, efforts must be made to obtain the FPIC of the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, explanations are given in languages and forms that are understandable to the indigenous peoples concerned. It is desirable that the IPP includes the elements laid out in the ESS 7 of the World Bank's environmental and social policies.</p>	<p>While there is a requirement for the preparation of an Indigenous Peoples Plan, the content of the plan is not defined in detail.</p> <p>See above, from 'Involuntary Resettlement and Loss of Livelihood' to 'Indigenous Peoples', SOP for Externally Financed Projects in Cambodia 2018.</p>	<p>Ditto</p>
Monitoring	<p>1. During the project implementation, project proponents monitor whether any unforeseeable situations occur, and the performance and effectiveness of the planned mitigation measures. Project proponents take appropriate measures based on the results of such monitoring.</p> <p>2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, Project proponents must ensure that the project plans include feasible monitoring plans.</p> <p>3. Project proponents should make efforts to make the monitoring results available to local stakeholders involved in the project.</p> <p>4. When third parties point out specifically that environmental and social considerations are not being fully undertaken, project proponents should make efforts to reach an agreement on the procedures to resolve</p>	<p>Environmental monitoring plan (EMP) is required in the EIA report.</p> <p>Description of responsibility and methodology is required.</p> <p>There is no requirement for the publication of monitoring results.</p> <p>No consultation or consideration of third-party observations on monitoring is</p>	<p>No significant gaps.</p> <p>No significant gaps.</p> <p>Encouraged the implementing agency to disclosure of the results of monitoring.</p> <p>In the preparatory survey, discussions with third parties during the</p>

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
	the problems, through forums for discussions and examinations of the countermeasures with participation of stakeholders involved in the projects, based on sufficient information disclosure.	requested.	implementation period will be studied.
Grievance Redress Mechanism	1. A mechanism for handling concerns and grievances from people and communities affected by the project's environmental and social impacts must be in place.	There are no provisions for EIAs pertaining to grievance procedures. Procedures are stipulated for site acquisition and resettlement.	A grievance mechanism, including an EIA will be considered in the preparatory survey.
	2. The grievance redress mechanism needs to be easily accessible for the project affected people and communities. Project proponents disseminate the information about the grievance redress mechanism through consultations with local stakeholders. The project affected people and communities must not be disadvantaged by filing a grievance.	Ditto	The specifics of the procedures will be confirmed in the preparatory survey, and measures will be incorporated as necessary.
	3. Project proponents should make efforts to respond promptly to the grievances they receive, taking into account the concerns and needs of the project affected people and communities.	Ditto See above, from 'Monitoring' to 'Grievance Redress Mechanism', Prakas on Guidelines for Developing Initial and Full Environmental Impact Assessment Reports and SOP for Externally Financed Projects in Cambodia 2018 regulations.	Ditto
Information Disclosure	1. In principle, project proponents disclose information about environmental and social considerations of their projects. JICA assists the project proponents through implementing cooperation projects as needed.	Information is disclosed by the public consultation of the EIA survey.	How to access the EIA report from time to time will be consulted with the implementation agency.
	2. JICA discloses important information about environmental and social considerations at the key stages of cooperation projects, in an appropriate manner in accordance with the JICA Guidelines.	—	The JICA website discloses information on Category A projects implemented in the past. It will be confirmed that implementation agency will

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
			follow it.
	3. JICA discusses and agrees with project proponents on the frameworks that ensure information disclosure at the early stage of cooperation projects.	—	Same as 1 and 2
	4. The information to be disclosed has to include environmental and social considerations, as well as the project information.	The EIA report contains information on the project itself.	No significant gaps.
	5. In addition to the information to be disclosed, JICA provides information about environmental and social considerations to third parties to the extent possible in response to their requests.	—	
	6. JICA actively encourages project proponents to disclose and present information about environmental and social considerations of their projects to local stakeholders.	Same as 1	Same as 1
	7. Project proponents disclose information well in advance when they have consultations with local stakeholders in cooperation with JICA. On such occasions, JICA supports project proponents in preparation of documents in an official or widely used language(s) and in a form understandable by local peoples.	—	JICA's policy will be agreed with the implementing agency in the preparatory survey.
	8. JICA discloses information on its website in Japanese, English, official language(s) and/or language(s) widely used in the host countries. It also provides the relevant reports for public reading at the JICA library and at related overseas offices.	—	JICA's policy will be agreed with the implementing agency in the preparatory survey.
	9. JICA pays due consideration to the confidentiality of the commercial and other matters of project proponents, taking into account their competitive relationships. JICA encourages project proponents to exclude confidential information from any documents on environmental considerations that they submit which may later be subject to public disclosure. JICA takes into account the management of information of project proponents, and	There is no clear provision.	This point will be confirmed to the implementing agency during the preparatory survey

Items	Policies of JICA GL	Systems of Host Country	Gaps and Policies
	discloses their documents subject to their approval. Any information that is prohibited from public disclosure in the agreement documents between JICA and project proponents may be disclosed only upon obtaining the approval of the project proponents or in accordance with legal requirements.		

6.7 Pre-Scoping for Selected Requested Projects

(1) Possible Environmental Categories and the Reasons

【Sensitive Sectors】

The project falls under the category of ‘Roads, Railways and Bridges’ as illustrated in the JICA Guidelines. The Mekong River Bridge is a large-scale project to construct a 2.95 km long, six-lane bridge over a large river. The NR1 widening is an improvement project of the existing road and falls under IEISAR (equivalent to IEE) in the EIA system of Cambodia. Therefore, the bridge project is assumed to be Category A and the NR1 widening is assumed to be Category B.

【Sensitive Characteristics】

The project is likely to generate land acquisition and involuntary resettlement.

For the Mekong River Bridge, there are approximately 80 buildings that will be affected along with new land acquisition. Many of these buildings are likely to result in large-scale involuntary resettlement, as they will be totally demolished and include a large number of residential buildings.¹²

For the NR1 widening project, the number of affected buildings is expected to exceed 2 000. Most of these buildings will only be partially demolished and only around 200 buildings will require full demolition. Most of the affected buildings appear to be commercial premises, workshops, etc., which are extensions to existing buildings outside the ROW, and none are found to be used for residential purposes. However, due to the large number of these buildings, it is difficult to estimate the number of affected persons who would need to be relocated. As most of the land along the existing road has already been acquired, it is estimated that most of the affected residents are informal residents.

Based on the above description, the project as a whole is likely to involve large-scale involuntary resettlement and is assumed to be Category A. Other ‘sensitive characteristics’ (large-scale groundwater pumping, large-scale land reclamation, land development, and land clearing, and large-scale logging) are not applicable.

【Sensitive Areas】

The approach roads of the Mekong River Bridge of the Project is in close proximity to the KBA. In view of the status of species inhabiting the KBA concerned and the location of the project and the KBA, the negative impacts due to the implementation of the project is not considered to be significant. However, confirmation is needed again in the preparatory survey. The project does not fall into any other ‘sensitive areas’.

【Aspects on Cambodia’s Environmental and Social Considerations】

The Project includes the Road Project and the Bridge Project. However, the NR1 widening project and the Mekong River Bridge may request separate EIA procedures, as each is considered a separate project under the EIA system in Cambodia. As for the required procedures, under Cambodian law, IESIA is the principle for bridge projects. For road projects, IESIA is the principle for road projects with a length of 30

¹² Resettlement on a scale where the number of affected persons due to physical relocation involving the loss of a place to live, such as the expropriation of a dwelling, generally exceeds 200 persons is considered to be large-scale resettlement and is judged to be Category A.

km to 100 km. However, as the procedures for individual projects are ultimately determined by screening of the MOE, there is a possibility that Environmental Social Impact Assessment (FESIA: equivalent to EIA) may be imposed on projects equivalent to IESIA, depending on the MOE's decision¹². If the project becomes a FESIA, it will be equivalent to Category A. If it becomes an IESIA, it will be equivalent to Category B.

The above factors, including the possibility of large-scale involuntary resettlement, especially for the Mekong River Bridge, make it a Category A project, and therefore, at present, the candidate loan projects (Mekong River Bridge and NR1 Widening) as a whole are considered Category A-eligible.

(2) Indivisible Projects and Estimated Derivative/Secondary Projects

For the Mekong River Bridge (including approach roads) and NR1 Widening Project proposed in this survey, there are no related projects that are contingent on the implementation of these projects, and they are both stand-alone projects that will produce development effects. Therefore, there are no other indivisible projects. No obvious negative impacts are envisaged at this stage in terms of derivative and secondary impacts. However, confirmation will be needed again in the preparatory survey.

(3) Preliminary Scoping

Preliminary scoping of the negative environmental and social impacts expected to be generated by the requested project was examined based on JICA guidelines.

¹² It is reported that a Full ESIA has been requested for a South Korean-supported bridge that is to be built between Phnom Penh and Arexa City. (according to a local consultant).

Table 6.7-1 Preliminary Scoping for the Requested Projects

Cat ego ry	No	Items	Before /during Constr uction	During Operati on	Reasons of Assessment
Pollution Control	1	Air Pollution	✓	✓	<p>During Construction:</p> <ul style="list-style-type: none"> • Construction work and operation of construction machinery generate exhaust gases. <p>During Operation:</p> <ul style="list-style-type: none"> • Air pollutants are expected to increase due to increased traffic on improved roads and automobile traffic on newly constructed bridge connecting roads. Alternatively, they are expected to decrease due to increased travel speeds.
	2	Water Quality	✓		<p>During Construction:</p> <ul style="list-style-type: none"> • During the construction of the bridge, wastewater from the construction work may flow into the Mekong River. <p>During Operation:</p> <ul style="list-style-type: none"> • Since the requested projects is a new road bridge and road improvement project, it will not cause deterioration of water quality at the time of service.
	3	Wastes	✓		<p>During Construction:</p> <ul style="list-style-type: none"> • Since the requested projects are a new road bridge and road improvement project, no significant amount of waste will be generated during construction. On the other hand, there is a possibility that waste may be generated due to removal of affected buildings. <p>During Operation:</p> <ul style="list-style-type: none"> • No waste is generated by the use of the road.
	4	Soil Contaminati on			<p>During Construction:</p> <ul style="list-style-type: none"> • The requested projects are a new road bridge and road improvement project, and there are no factors that would cause soil contamination. <p>During Operation:</p> <ul style="list-style-type: none"> • There are no factors that would cause soil contamination due to the operation of the projects.
	5	Noise and Vibration	✓	✓	<p>During Construction:</p> <ul style="list-style-type: none"> • Construction activities may cause noise impacts on the neighborhood. <p>During Operation:</p> <ul style="list-style-type: none"> • The road traffic noise may affect to the roadsides.
	6	Ground Subsidence			<p>During Construction:</p> <ul style="list-style-type: none"> • The requested projects are a new road bridge and road improvement project, and there are no factors that would cause land subsidence. <p>During Operation:</p> <ul style="list-style-type: none"> • The requested project are a typical road and will not generate extra loads that will cause land subsidence.
	7	Odor			<p>During Construction:</p> <ul style="list-style-type: none"> • Materials that generate offensive odors are not used in construction work. <p>During Operation:</p> <ul style="list-style-type: none"> • There are no projects that generate odors after being put into the operation.

Cat ego ry	No	Items	Before /during Constr uction	During Operati on	Reasons of Assessment
	8	Bottom Sediment			During Construction: <ul style="list-style-type: none"> • Since no dredging or other construction activities that would significantly disturb the bottom sediment are anticipated, no negative impacts on the bottom sediment is anticipated. During Operation: <ul style="list-style-type: none"> • The requested project is a general road and there are no factors affecting bottom quality.
Natural Environment	9	Protected Area			During Construction / During Operation: <ul style="list-style-type: none"> • There are no impacts because there are no protected areas in/around the project site.
	10	Ecosystem	✓	✓	During Construction: <ul style="list-style-type: none"> • The approach road of Areiy Ksatr City side will pass through around the KBA (Boeung Veal Samnap). The construction activities may affect the KBA's natural environment. During Operation: <ul style="list-style-type: none"> • The road traffic on the approach road may affect the KBA's natural environment.
	11	Hydrology	✓	✓	During Construction / During Operation: <ul style="list-style-type: none"> • The bridge structures of the project may affect the flow of the river.
	12	Geographica l features			During Construction: <ul style="list-style-type: none"> • The requested projects are a new road bridge and road improvement, and has no potential to affect topography and geology. During Operation: <ul style="list-style-type: none"> • The requested projects are a new road bridge and road improvement, and there will be no impact on topography and geology during the operation.
Social Environment	13	Land Acquisition and Involuntary Resettlement	✓		Before Construction: <ul style="list-style-type: none"> • Land acquisition and structure removal will be required, and the large-scale involuntary resettlement will likely occur. During Operation: <ul style="list-style-type: none"> • There is no additional land project which will cause land acquisition and resettlement.
	14	Poor	✓		Before Construction: <ul style="list-style-type: none"> • If affected residents include the poor, the negative impacts on the poor are expected. During Construction / During Operation: <ul style="list-style-type: none"> • Improved access through the requested project can provide economic benefits to the poor.
	15	Ethnic minorities and indigenous peoples			Before Construction / During Construction / During Operation: <ul style="list-style-type: none"> • There are no minority or indigenous peoples living in the project site.
	16	Local economies, such as employment, livelihood, etc.			During Construction: <ul style="list-style-type: none"> • Construction work can create new jobs in the region. During Operation: <ul style="list-style-type: none"> • Development of access routes and improved travel speeds will help improve the local economy.

Cat ego ry	No	Items	Before /during Constr uction	During Operati on	Reasons of Assessment
	17	Land use and utilization of local resources			During Construction / During Operation: <ul style="list-style-type: none"> The requested projects are a new road bridge and road improvement and will have no negative impacts on land use or local resource use.
	18	Water usage			During Construction / During Operation: <ul style="list-style-type: none"> The requested projects are a new road bridge and road improvement and will have no negative impacts on water use.
	19	Existing social infrastructures and services			During Construction / During Operation: <ul style="list-style-type: none"> The requested projects are a new road bridge and road improvement project and will have no impact on existing social infrastructure or social services.
	20	Social structure such as social capital and local decision making institutions			During Construction / During Operation: <ul style="list-style-type: none"> The requested projects are a new road bridge and road improvement and will have no negative impacts on social organizations, such as social-related capital and local decision-making bodies.
	21	Misdistribution of benefits and damages		✓	During Construction / During Operation: <ul style="list-style-type: none"> There is no potential for uneven distribution of damage and benefits during the implementation of the requested projects (new construction of road bridges and road improvements). While the bridge project will benefit ferry users crossing the Mekong River, it will have a significant negative impact on ferry operators.
	22	Local conflicts of interest			During Construction / During Operation: <ul style="list-style-type: none"> The requested projects are a new road bridge and road improvement projects, and there is no potential for conflicts of interest within the region.
	23	Cultural heritage	✓		During Construction / During Operation: <ul style="list-style-type: none"> This might affect temples along the NR1 that are considered cultural assets. During Operation: <ul style="list-style-type: none"> The requested projects are not expected to have any negative impacts on the cultural properties.
	24	Landscape	✓	✓	During Construction / During Operation: <ul style="list-style-type: none"> The construction of large bridges may affect the surrounding landscape.
	25	Gender			During Construction: <ul style="list-style-type: none"> The employment generated by construction work is expected to contribute to the economic activity of women. During Operation: <ul style="list-style-type: none"> The requested projects are a new road bridge and road improvement projects and is not expected to affect women's behavior.
	26	Children's rights			During Construction / During Operation: <ul style="list-style-type: none"> The requested projects are a new road bridge and road improvement projects, and is not expected to affect children's rights.

Cat ego ry	No	Items	Before /during Constr uction	During Operati on	Reasons of Assessment
	27	Infectious diseases such as HIV/AIDS	✓		During Construction: • There is a risk of HIV/AIDS transmission among construction workers and related local businesses. During Operation: • The requested projects are a new road bridge and road improvement projects, and there are no factors that would increase the number of infections.
	28	Working conditions	✓		During Construction: • Construction workers are at risk of occupational accidents. During Operation: • No significant negative impacts are anticipated in the maintenance work of the project.
Others	29	Accidents	✓	✓	During Construction: • Construction workers are at risk of occupational accidents. During Operation: • Increased vehicle travel speeds may increase the number of traffic accidents.
	30	Transboundary impacts or climate change	✓	✓	During Construction: • Construction work generates CO ₂ . During Operation: • CO ₂ emissions will increase due to the increased traffic volume resulting from the provision of new road bridges and improvement of existing roads. On the other hand, CO ₂ emissions will decrease as vehicle travel speeds increase.

Source: Survey Team

(4) Draft TOR of Survey for Environmental and Social Considerations

Survey items and measures of environmental and social considerations are shown on the table.

Table 6.7-2 Draft TOR for Environmental and Social Considerations

	Evaluation Items	Items of Survey	Measures
Pollution Control	Air Pollution	<ul style="list-style-type: none"> • Environmental Standards, Guidelines (Cambodia, IFC) • Baselines of air quality • Construction plan 	<ul style="list-style-type: none"> • Review of secondary materials • Field survey • Review of construction plan • Review of estimated traffic volume
	Water Quality	<ul style="list-style-type: none"> • Environmental Standards • Baselines of water quality around the project sites • Construction plan 	<ul style="list-style-type: none"> • Review of secondary materials • Field survey • Review of construction plan
	Wastes	<ul style="list-style-type: none"> • Regulations of water management • Estimated volume of wastes (demolition of existing buildings and construction activities) • Construction plan 	<ul style="list-style-type: none"> • Review of secondary materials • Field survey • Review of construction plan
	Noise and Vibration	<ul style="list-style-type: none"> • Environmental Standards, Guidelines (Cambodia, IFC) • Noise origins around the project sites • Vulnerable facilities including hospitals, school and religious facilities • Baselines of noise • Construction plan • Project plan 	<ul style="list-style-type: none"> • Review of secondary materials • Noise origins around the project sites • Review of maps • Field survey • Review of construction plan • Review of project plan

	Evaluation Items	Items of Survey	Measures
Natural Environment	Ecosystem	<ul style="list-style-type: none"> • Outlines of KBAs around the project sites • Living species 	<ul style="list-style-type: none"> • Review of websites of KBA and IBA • Field survey
	Hydrology	<ul style="list-style-type: none"> • Review for the existing project, • Review for similar bridge projects 	<ul style="list-style-type: none"> • Review for construction records of the Tsubasa Bridge, • Review for the contents of the project
Social Environment	Land Acquisition and Involuntary Resettlement	<ul style="list-style-type: none"> • Affected areas on the initial design • The number of affected persons and status of affected properties • Social status of affected persons • Opinions of affected persons 	<ul style="list-style-type: none"> • Review of affected areas • Socio-economic survey on RAP study • Consultation with stakeholders and interviews for individual
	Poor		
	Misdistribution of benefits and damages	<ul style="list-style-type: none"> • Current status of ferry operations around the project site. 	<ul style="list-style-type: none"> • Review for ferry operation areas • Consultation with stakeholders and interviews for individual
	Landscape Cultural heritage	<ul style="list-style-type: none"> • Temples along the NR1 (Wat Kien Svay Krau, Wat Dei Eth) • Policies of conservation for the temples 	<ul style="list-style-type: none"> • Collection of stakeholders' opinions • Collection of secondary materials • Interviews for relating agencies
	Infectious diseases such as HIV/AIDS	<ul style="list-style-type: none"> • Status of HIV/AIDS prevalence in Cambodia • Construction plan 	<ul style="list-style-type: none"> • Review of secondary materials • Review of construction plan
	Working conditions	<ul style="list-style-type: none"> • Estimated working conditions 	<ul style="list-style-type: none"> • Review of construction plan
Accidents	<ul style="list-style-type: none"> • Estimated working conditions • Safety plan in construction plan • Safety control in the project 	<ul style="list-style-type: none"> • Review of construction plan • Review of safety control plan in the project 	
Others	Transboundary impacts or climate change	<ul style="list-style-type: none"> • Cambodia's law systems of reduction of greenhouse gasses • Construction plan 	<ul style="list-style-type: none"> • Review of secondary materials • Review of construction plan • Confirmation of ROW and field survey • Prediction of reduction of greenhouse gasses due to the project

Source: Survey Team

(5) Issues on the Environmental and social considerations in the Preparatory Surveys, and Proposals for Survey Policies

The following are the issues on the environmental and social considerations in the preparatory surveys.

【Land acquisition and involuntary resettlement】

For the NR1 widening project, there is a history of land acquisition and resettlement in the previous grant projects supported by JICA. Therefore, the following points should be noted.

The RAPs and draft RAPs on JICA-supported road projects implemented in Cambodia in recent years provide for Entitlement as follows.

Table 6.7-3 Summary of Entitlements in the Existing JICA Projects or draft RAPs.

Subjects			Entitlements
Lands	Out of ROW		<ul style="list-style-type: none"> • Exchange for alternative land or cash compensation at replacement cost
	In ROW	Partial	<ul style="list-style-type: none"> • AHs must be removed entirely from PRW. • No cash compensation is available for affected land in ROW.

		<ul style="list-style-type: none"> No new permanent structures are permitted to be constructed in the ROW.
	Entirely	<ul style="list-style-type: none"> No cash compensation for affected land in ROW. Self relocation or group relocation with some supports.
Structures	Owners	<ul style="list-style-type: none"> Cash compensation at replacement cost.
	lessees	<ul style="list-style-type: none"> Allowances including transportation.

Source: Preparatory Survey for National Road No.5 Improvement Project/Middle Section: Draft Final Resettlement Planning

In existing projects, compensation shall be provided for lands outside the ROW as defined by the State. On the other hand, compensation shall not be provided for lands within the ROW, and the construction of permanent structures within the ROW is prohibited, and the building of permanent structures are requested to vacate in the PRW (the area necessary for the implementation of projects within the ROW). In principle, cash compensation at the replacement costs shall be provided for affected buildings and other structures.

For NR1, the land acquisition and resettlement in a certain road width (20-25 m on each side) has been carried out in the previous grant project, and it is considered to have been compensated for the affected persons. Therefore, it is highly likely that most of the affected buildings in the project have already been compensated in the previous grant project or buildings that were constructed after they were compensated for and removed from the previous grant project. Some residents have commented affirmatively on this. Cambodian national legislation considers unauthorized occupation of public lands to be illegal occupation and states that no compensation against illegal occupation of public land and penalties shall be imposed.¹³ In this survey, the implementing agency has stated that it will not compensate any affected persons who have already been compensated in the previous project.

As for the policy of entitlements in the project, it is considered appropriate to follow the entitlements in the existing projects in principle to comply with the laws and regulations of the Cambodia and also from the viewpoint of fairness. As most of the planned road widths of the Project are planned within the PRWs, which are considered to have been compensated in the previous grant projects, compensation for the lands and affected buildings will not, in principle, be paid. Residents who continue to occupy the lands despite having been compensated under the previous grant project, and residents who have taken up residence since then, are regarded as irregular occupants. It is necessary to urgently establish a compensation policy for this project, together with the intentions of JICA, and consult with the implementing agencies.

In RAP surveys, the achievements of the previous grant project in NR1 can provide valuable lessons. It is recommended that the actual conditions of relocation and compensation, and the actual living conditions of the relocated residents at the new sites, should be fully ascertained and the survey should be conducted based on this.

Many sections of the project require embankment of land. In sections where there is a large difference in elevation between the road surface and the ground along the road, the site areas for the slope may extend significantly. As the implementing agency of the project has indicated its intention to avoid new land acquisition and relocation of residents as much as possible, consideration should be given in the design to limit the extent of the land to the extent of land acquired in the previous project.

¹³ Land Law, Article 19, 34, 259



Source: Compiled by JICA Survey Team based on Google Earth and Google maps.

Figure 6.7-1 Status of Buildings on the Side of NR1 (around KP 13)

The figure above is a typical example of the status of buildings along NR1. The structures from ② to ⑥ all are crossing over into the ROW. However, the structures are roofs or simple structures that have been extended from the main building outside the ROW. Although they must be removed when the project is implemented, it is a minor removal and will not affect the main buildings itself. Most of the structures in the ROW along the road are in a similar situation. Most of the public buildings and larger structures such as ① (Wat Kien Svay Krau) are built outside the ROW across a buffer zone and will not be affected by the project implementation.

【Local Procedures of EIA】

There are no matters requiring special consideration for the EIA procedure for the project. However, the necessary procedures (type of procedures, lump sum or per project type) have not been identified at this stage when the target project has not yet been finalized. After the start of the preparatory survey, it is necessary to start preliminary consultations with the Ministry of Environment (the ministry with jurisdiction over EIA) as soon as possible to confirm the scheme and overall process for environmental and social considerations.

【Information about Environmental Category】

See 6.7 (1)

【Indivisible Projects and Estimated Derivative/Secondary Projects】

See 6.7 (2)

【Organization of Implementation Agency】

The MPWT, the project's implementing agency, does not have an organization specializing in environmental and social considerations. Since the MPWT has experience in implementing the improvement projects of NR1 and NR5, it is considered to have a certain understanding of environmental and social considerations related to JICA-supported projects. However, sufficient support in the preparatory surveys is desired in terms of the contents of the updated JICA Guidelines (January 2022) and discussions with MOE.

(6) Issues of Schedule of the Preparatory Survey

After the start of the preparatory survey, information collection, study of alternatives and the selection and contract with local consultants are carried out. As for the EIA procedure, an application for the EIA procedure is filed with the MOE according to the initial plan, and the procedure and study are initiated. In case that two season surveys (rainy and dry) are required for the field survey, survey schedule might take long time. The RAP survey may take a longer time for the census and socio-economic survey due to the large number of affected populations. Consideration should be given to shorten the survey process, for example, by allocating multiple survey parties of local consultants. The EIA/RAP reports are reviewed by the survey team, the implementing agency and JICA. After that the implementing agency submits the EIA report to MOE. It will take about 60 working days from MOE review to approval. Following submission of the EIA/RAP report from the implementing agency to the MOE, the EIA/RAP reports are disclosed on JICA's website.

In case that the project is classified as Category A, the scoping draft and DFR will be reviewed by the JICA Advisory Committee for the environmental and social considerations.

6.8 Draft Environmental Check List

For the requested projects, a draft environmental check list on the data collection survey is shown on the table.

Table 6.8-1 Draft Environmental Check List of the Requested Projects

Category	Items	Check Items	Yes: Y No: N	Environmental and Social Considerations (Reasons and basis of Yes/No, Mitigation measures)
I Approval • Consultation	(1) EIA and Environmental Approval	(a) Have EIA reports been already prepared in official process?	(a) N	(a), (b), (c), (d) An EIA report has not been prepared yet because there are no tangible project plans. On the next stage, Government of Cambodia (GOC) will prepare an EIA report based on tangible project plan.
		(b) Are documents including EIA reports prepared by official languages or widely used languages in the host country?	(b) N	
		(c) Have EIA reports been approved by authorities of the host country's government? (In case of unapproved, when is expected date of approval?)	(c) N	
		(d) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(d) N/A	
		(e) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(e) N	(e) For this project, other approvals are not required.
		(f) Are the requirements of GL Appendix 2 been satisfied?	(f) Y	(f) EIA reports which GOC requires almost satisfies the GL requirements. If it lacks the requirement, the EIA report will be complemented.
		(g) Have the environmental and social considerations carried out for the whole components of the project, cumulative, derivative and secondary impacts of the project, and impacts associated with indivisible projects?	(g) N	(g) As of now, there are likely no cumulative, derivative and secondary impacts of the project. In the preparatory survey, it will be conconfirmed again.
	(2) Explanation to the Local Stakeholders and Consultation	(a) Have local stakeholders of the project been appropriately identified and analyzed?	(a) N	(a), (b) (c) (d) Because current status of the project is the stage of basic study for project forming, information disclosure has not been conducted. On the next stage including EIA study, information disclosure will be appropriately conducted. And stakeholder's comments will be reflected to the
		(b) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(b) N	

Category	Items	Check Items	Yes: Y No: N	Environmental and Social Considerations (Reasons and basis of Yes/No, Mitigation measures)
		(c) Have records of consultations listing attributes including genders of participants been prepared?	(c) N	project appropriately.
		(d) Have the comments from the stakeholders (such as local residents) been reflected to the project design?	(d) N	
	(3) Examination of Alternatives	(a) Were the comparisons of alternatives conducted appropriately?	(a) Y	(a) In this survey, comparisons of alternatives were studied in the view of strategic environmental assessment, and the most prioritized project which solves the traffic issue of the NR1 was selected.
		(b) In the view of environmental and social items (as needed including reduction of GHG emission), have the technical, financial and environmental and social feasibilities of the alternatives been analyzed?	(b) Y	(b) In this survey, because multiple projects had been proposed, alternative study was done in the view of strategic environmental assessment.
		(c) Did the alternatives include “without project”?	(c) Y	(c) “Without project” plan was studied too.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country’s air quality standards?	(a) Y	(a), (b) Because the project is a road project, it may increase the volume of traffic and emission of air pollutants. Assessment will be conducted in the EIA study, and mitigation measures will be proposed as needed.
		(b) If air quality already exceeds country's standards near the route, is there a possibility that the project will make air pollution worse?	(b) -	
		(c) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?	(c) Y	
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas?	(a) Y	(a) The project involves embankment work. The soil runoff should be paid attention during the construction stage.
		(b) Can runoff of road surface contaminate surrounding water sources including underground water?	(b) N	(b) The runoff of road surface may contain highly turbid water. However, it is only instantaneous on the beginning of the rain, it will give no impacts against the underground water.
		(c) Can the project contaminate surrounding water sources such as a well?	(c) N	(c) The project is a bridge and road widening. There are no impacts against water sources.
		(d) Will the drainage from the parking or rest areas meet the standards for effluent discharge of the host country?	(d) N	(d) The project does not include the development of the parking or rest areas.
		(e) Is there possibility that the waste water degrades the water quality of public water areas below the standards?	(e) N	(e) As of now, major negative impacts due to the waste water are not expected. It should be studied on the preparatory survey.
		(f) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?	(f) Y	(f) There may be negative impacts due to construction work. It should be studied on the preparatory survey.
		(3) Wastes	(a) Are the maintenance on the operation carried out under the host country’s legal system? Are wastes of parking and rest area disposed legally? (b) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?	(a) N (b) Y

Category	Items	Check Items	Yes: Y No: N	Environmental and Social Considerations (Reasons and basis of Yes/No, Mitigation measures)
	(4) Noise and Vibration	<p>(a) Do noise and vibrations from the vehicle traffic comply with the country's standards?</p> <p>(b) If noise and vibration already exceed country's standards near the route, is there a possibility that the project will make noise/vibration worse?</p> <p>(c) Does low frequency noise generated by vehicles and/or railway satisfy country's standards?</p> <p>(d) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a) -</p> <p>(b) Y/N</p> <p>(c) -</p> <p>(d) Y</p>	<p>(a) It should be studied on the preparatory survey.</p> <p>(b) The increase of traffic volume will raise the road side noise/vibration, however the road widening will improve the roadside noise/vibration. It should be studied on the preparatory survey.</p> <p>(c) There are no country's standards of low frequency noise.</p> <p>(d) The construction activities of the project will generate noise. Impacts should be studied on the preparatory survey.</p>
3 Natural Environment	(1) Protected Areas	<p>(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions?</p> <p>(b) Is there a possibility that the project will affect the protected areas?</p> <p>(c) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N</p>	<p>(a) The project locates outside of the protected areas designated by the country's laws or international treaties and conventions.</p> <p>(b) (c) The site of the project is located from the protected areas over 60km. There is no possibility that the project will affected the procted areas.</p>
	(2) Biodiversity	<p>(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?</p> <p>(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?</p> <p>(c) Does the project involve significant conversion of significant degradation of critical habitats of critical forests, and significant negative impacts against biodiversity? In case of that, are appropriate mitigation measures taken?</p> <p>(d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock?</p> <p>(e) Is there a possibility that installation of the roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests?</p> <p>(f) In case that the road is developed in undeveloped area, are there possibilities that the natural environment is critically deteriorated?</p> <p>(g) In case that critical negative impacts against biodiversity are expected, are any mitigation measures taken?</p> <p>(h) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N</p> <p>(d) -</p> <p>(e) -</p> <p>(f) -</p> <p>(g) -</p> <p>(h) -</p>	<p>(a) (b) (c) (d) (e) (f) (g) (h)</p> <p>As of now, details of negative impacts due to the project implementation is unknown. Based on the findings of the preparatory survey, appropriate mitigation measures will be taken to conserve the biodiversity.</p>
	(3) Hydrology	<p>(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?</p>	<p>(a) N</p>	<p>(a) Because the project is improvement of the existing road and construction of a new bridge, it will give few negative impacts for surface water and groundwater flows.</p>

Category	Items	Check Items	Yes: Y No: N	Environmental and Social Considerations (Reasons and basis of Yes/No, Mitigation measures)
		(b) Can the installation of structures change hydrologic behavior and give negative impacts against the flow of surface/underground water?	(b) Y	(b) Piers of the bridge may affect the flow of Mekong river.
		(c) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?	(c) Y	(c) Ditto. The mitigation measures will be examined in the preparatory survey.
		(a) Are there any geologically vulnerable areas on the route? If yes, are appropriate technical actions taken?	(a) N	(a) The project site is flat land. There are no geologically vulnerable areas.
(4) Topography and Geology		(b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	(b) Y	(b) The road improvement will involve making embankment. Primitive construction plan will be examined in the preparatory survey.
		(c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(c) Y	(c) Detail will be examined in/after the preparatory survey.
		(d) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?	(d) -	(d) Primitive construction plan will be examined in the preparatory survey.
4 Social Environment	(1) Resettlement and land acquisition	<p>(a) Does project implementation cause involuntary resettlement? In case that the involuntary resettlement occurs, what is the scale of land acquisition and resettlement?</p> <p>(b) If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? Will other land acquisition and loss of livelihood occur?</p> <p>(c) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?</p> <p>(d) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?</p> <p>(e) Are the compensations going to be paid prior to the resettlement?</p> <p>(f) Are the compensation policies prepared in document?</p> <p>(g) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?</p> <p>(h) Are compensations stated in writing to the affected persons? Are agreements with the affected people obtained prior to resettlement?</p> <p>(i) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?</p> <p>(j) Are any plans developed to monitor the impacts of resettlement?</p> <p>(k) Is the grievance redress mechanism established?</p>	(a) Y (b) (c) (d) (e) (f) (g) (h) (i) (j) (k)	(a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) The project can cause land acquisition and large-scale involuntary resettlement. In the preparatory survey, RAP survey based on the JICA Guidelines will be prepared.

Category	Items	Check Items	Yes: Y No: N	Environmental and Social Considerations (Reasons and basis of Yes/No, Mitigation measures)
	(2) Living and Livelihood	<p>(a) Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts?</p> <p>(b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary?</p> <p>(c) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)?</p> <p>(d) Is there any possibility that project will impede the movement of inhabitants?</p> <p>(e) Is there any possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?</p> <p>(f) Does the project give negative impacts against ecosystem services (Provisioning services and Regulating services) and the public health and safety of communities (especially against indigenous peoples communities which depend on the ecosystem services, etc.)</p> <p>(g) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p> <p>(g)</p>	<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p> <p>(e)</p> <p>(f)</p> <p>(g)</p> <p>Same as (1) Resettlement and land acquisition</p>
	(3) Vulnerable	<p>(a) Does the project give appropriate considerations for the vulnerable including women, children, elders, poor, disables, refugees and minorities.</p> <p>(b) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a)</p> <p>(b)</p>	<p>(a)</p> <p>(b)</p> <p>Same as (1) Resettlement and land acquisition</p>
	(4) Heritage	<p>(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?</p> <p>(b) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a) N</p> <p>(b) N</p>	<p>(a) (b)</p> <p>There are archeological sites (temples) on the road side of NR1. Because the sites are out of ROW, no direct impacts are expected.</p>
	(5) Landscape	<p>(a) In case that there is landscape which requires special consideration, will the project give negative impacts against that?</p> <p>(b) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a) N</p> <p>(b) N</p>	<p>(a) (b)</p> <p>The bridge project may affect the landscape. However, there are no areas requiring special consideration around the project.</p>

Category	Items	Check Items	Yes: Y No: N	Environmental and Social Considerations (Reasons and basis of Yes/No, Mitigation measures)
4 Social Environment	(6) Ethnic Minorities and Indigenous Peoples	<p>(a) Are considerations given to reduce negative impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?</p> <p>(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to lands and resources respected?</p> <p>(c) If necessary, is an indigenous peoples plan developed and disclosed?</p> <p>(d) Is sufficient information provided to the ethnic minorities/indigenous peoples? Given this, does the project proponents make effort to get Free, Prior and Informed Consent (FPIC)?</p> <p>(e) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N</p> <p>(d) N</p> <p>(e) N</p>	<p>(a) (b) (c) (d) (e)</p> <p>The project is located on the urban area and outskirts of the urban. There are no residential areas of ethnic minorities / indigenous peoples.</p>
	(7) Working Conditions	<p>(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?</p> <p>(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?</p> <p>(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?</p>	<p>(a) Y</p> <p>(b) Y</p> <p>(c) Y</p>	<p>(a) (b) (c)</p> <p>The working conditions are formulated under Cambodian laws and JICA's provision. The details will be developed in D/D stage.</p>
	(8) Local public health and safety	<p>(a) Is there possibility that influx of workers of the project gives negative impacts against public health including outbreak of disease such as prevalence of HIV? In case of yes, are mitigation measures developed?</p> <p>(b) Is there possibility that influx of workers of the project gives negative impacts against security of local communities? In case of yes, are mitigation measures developed?</p> <p>(c) In case that the host country employs security staffs for the study or implementation of the project, does the project proponents take actions to avoid unnecessary exercise?</p> <p>(d) Are there possibilities that construction activities of the project give negative impacts? In case of that, are mitigation measures prepared?</p>	<p>(a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p>(a) (b) (c) (d)</p> <p>Same as (7) Working Conditions</p>

Category	Items	Check Items	Yes: Y No: N	Environmental and Social Considerations (Reasons and basis of Yes/No, Mitigation measures)
5 Others	(1) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Were the methodology and frequency of reports to competent authorities including results of monitoring stipulated? (e) Is grievance redress mechanism of the environmental and social considerations developed?	(a) Y (b) Y (c) Y (d) Y (e) Y	(a) A monitoring program will be developed in the EIA study. (b) Basically, quarterly report is required. (c) The contents of monitoring activities will be proposed in the EIA study. (d) Same as (a). (e) Grievance redress mechanism of the environmental and social considerations will be described in the EIA and RAP report.

CHAPTER 7 Priority Projects and Considerations for Project Implementation

7.1 Potentially applicable Japanese technologies

The technical needs required for the assumed road and bridge development projects are summarized below. Identify the technical needs for each project by organizing various conditions such as traffic, environment, adjacent structures, ground, rivers, etc., and the expected road structure.

Table 7.1-1 Conditions and Road structure of the proposed project

Project	Various Conditions		Road Structure
Construction of Viaduct	Traffic Conditions	It has four lanes with bike lanes on both sides, but traffic congestion occurs during peak hours in the mornings and evenings.	Viaduct Ramp-bridge Earthworks Retaining Wall
	Environment	The roadside is a commercial area where a large market is under construction.	
	Adjacent structures	There are shops along the R.O.W. The entire section is densely populated with commercial buildings.	
6-lane widening / 4-lane widening	Traffic Conditions	Future traffic is heavy to RR2 intersection. Traffic entering and exiting schools along the road, and pedestrians crossing the street are noticeable.	Earthwork Box culvert
	Environment	The roadside is mainly commercial and residential, with schools, hospitals, and pagodas.	
	Adjacent structures	The buildings are adjacent along the R.O.W. Some stores extend into the R.O.W.	
	Ground Conditions	The Mekong River is nearby, so there is a high possibility of dispersive soil.	
Mekong River Bridge	Traffic Conditions	Future traffic volume is equivalent to 6 lanes.	Viaduct Ramp-bridge Earthworks Retaining Wall
	Environment	There are shops and houses around the existing road on the Akreiy Ksatr side, while the bypass area is farmland.	
	Ground Conditions	The National Road side is likely dispersive soil. The reclaimed land on the Akreiy Ksatr side is good quality sand.	
	River Conditions	The main bridge is 660m long and six lanes wide. The Mekong River is deep, around 10m.	
Mekong River Tunnel	Traffic Conditions	A cross-river ferry currently operates. Future traffic volume is equivalent to 4 lanes.	Tunnel Box culvert Retaining Wall
	Environment	The Phnom Penh side is lined with high-rise buildings while the Akreiy Ksatr side is reclaimed land and farmland.	
	Ground Conditions	The soil near the tunnel entrance is mainly alluvial to sandy, with some parts possibly being soft ground.	
	River Conditions	The river width at the crossing point is 1.7 km, so there is a possibility that unexploded ordnance may be buried in the river.	

Source: JICA Survey Team

Table 7.1-2 Required Technical Needs of Project

Project	Required Technical Needs
Viaduct	<ul style="list-style-type: none"> • Construction of foundations in narrow areas to avoid traffic control as much as possible and decrease traffic impact. • A method of erection that minimizes the construction yard during construction, saves labor, and shortens the construction period. • Rapid construction method that takes into consideration traffic congestion and impact on the surrounding environment. • Structure shape for cost reduction. • Traffic control and traffic safety measures at signalized intersections under viaducts.
6 lane Widening / 4 lane Widening	<ul style="list-style-type: none"> • Effective, economical and feasible traffic safety measures. • Use of recycled materials contributes to a recycling-oriented society. Pavement construction that reduces waste. • Road slope construction using dispersive soil along the Mekong River. • Construction with precast products that reduce traffic impact and shorten construction period.
Mekong River Bridge	<ul style="list-style-type: none"> • Painting methods that reduce maintenance costs and lower LCC. • Superstructure with improved yield strength, excellent workability and weldability. • Streamlining of structures to improve durability and strength of bridges and reduce costs. • Foundation construction with excellent workability in deep water and soft ground conditions.
Mekong River Tunnel	<ul style="list-style-type: none"> • A tunnel structure that can be safely constructed under the deep Mekong River.

Source: JICA Survey Team

The Japanese technologies that are considered applicable to the bridge construction project of this survey are summarized below. Some of the technologies are not exclusive to Japan, but are included those that are used as standard in Japan and thus give Japanese companies an advantage, and those that are more effective in combination with Japan's meticulous quality control. In addition, we will also include options that are not particularly advantageous given the currently possible project conditions, but which may become more advantageous as design/construction conditions, etc. are finalized in the future.

In addition, while Cambodia is currently experiencing a period of rapid development and its infrastructure is being steadily improved, it is anticipated that in the future large-scale renewal will be required, just as in Japan, where the infrastructure developed intensively during the period of high economic growth is now all at once requiring maintenance and renewal. Therefore, rather than placing excessive emphasis on low initial costs, one of Japan's advantages is that we convey to the other party the importance of life cycle costs, including future maintenance efforts and costs, and make proposals to adopt technologies that lead to these costs.

Projects adopted under the JICA SDGs Business Supporting Survey (JICA Biz) shall be included as Japanese technologies that can be considered for this project. In particular, it is assumed that there is a high possibility of adaptation in the case of projects related to actual achievements in Cambodia and similar infrastructure development. For reference, Table 7.1-3 shows an excerpt of Cambodian infrastructure-related projects from the list of projects adopted by the JICA Biz.

Table 7.1-3 List of Projects Adopted by the JICA Biz

No.	Company Name	Sector	Address in Japan	Project Name	Implemented Country
1	SPEC Company Limited	Agriculture	Tokyo	Feasibility Survey for the Development of Irrigation and Agricultural Facilities by the STEIN Soil Harder	Cambodia

No.	Company Name	Sector	Address in Japan	Project Name	Implemented Country
2	Fuji Construction Work Co., Ltd.	Others	Tokushima	Feasibility Survey for the System to Ensure Safety of Traffic Dangerous Areas by Blinking Type LED Solar Light	Cambodia
3	Tanaka Co., Ltd.	Others	Osaka	Drainage sheet with a function to eliminate rainfall infiltration water causing existing road collapse in Cambodia road network	Cambodia
4	SkymatiX, Inc.	Infrastructure and Transportation	Tokyo	Introducing Infrastructure Measurement Survey with Remote Sensing Technology Using Drones in Cambodia	Cambodia
5	West Management Co., Ltd.	Infrastructure and Transportation	Fukuoka	Distribution and Utilization of Japanese Used Small Construction Machinery in Cambodia	Cambodia
6	Koua Shouji Co., Ltd.	Waste disposal	Aichi	Plastic Recycling System to Convert Waste to Eco-Product	Cambodia
7	OMURA Ceratec Co., Ltd.	Disaster prevention and countermeasures	Nagasaki	Project for Contribution to Flood Protection of City and Pedestrian Street by Utilizing the Characteristics of the Permeable Interlocking Block Pavement	Cambodia
8	IKEE Ltd.	Others	Ehime	Routine Road Maintenance with Pavement Repair Methods by Using Cold Mix Asphalt (EXCEL)	Cambodia
9	Fuji Construction Work Co., Ltd.	Infrastructure and Transportation	Tokushima	System to Ensure Safety of Traffic Dangerous Areas by Blinking Type LED Solar Light	Cambodia
10	SkymatiX, Inc.	Infrastructure and Transportation	Tokyo	Introducing DX Infrastructure Measurement Survey and Management with Remote Sensing Technology Using Drones in Cambodia	Cambodia
11	NICHIREKI Co., Ltd.	Transportation	Tokyo	In-place Base Course Stabilization System for Solid Pavement	Cambodia
12	ISO, Inc.	Others	Tokyo	Demining Robot Installation to Work Efficiently and Protect Safety of Deminers in Cambodia	Cambodia
13	Tanaka Co., Ltd.	Infrastructure and Transportation	Osaka	Installation of Drainage Sheet to Prevent Rainfall-Induced Road Collapse in Cambodia	Cambodia

With regard to DX, consider active use of digital technology in design and construction at the time of FS, such as ICT construction technology and ICT construction using unmanned aerial vehicles (UAVs), etc.

(1) Digitization of administrative procedures

Promote the digitalization of various procedures in the infrastructure sector by encouraging the use of web systems to enable remote procedures, reduce unnecessary paper submissions through paperless processes, and minimize contact through touchless solutions.

- Implement systems that allow necessary data display and actual applications to be processed immediately through digital procedures.
- Simplify unnecessarily complex processes, such as submitting documents to multiple departments for a single procedure, and enable centralized processing within the system.

(2) Advancement and Utilization of Information

Promote communication using 3D data that enables accurate and real-time information sharing among stakeholders.

- Encourage the use of 3D data (BIM/CIM), the adoption of XR technology, web conferencing systems, and the publication and utilization of infrastructure data.
- Use 3D visualizations to effectively communicate and disseminate information to the public.

(3) Remote, Automated, and Autonomous Operation of On-Site Work

Promote further development and social implementation of remote, automated, and autonomous technologies for various on-site tasks in the construction industry (e.g., construction work, progress

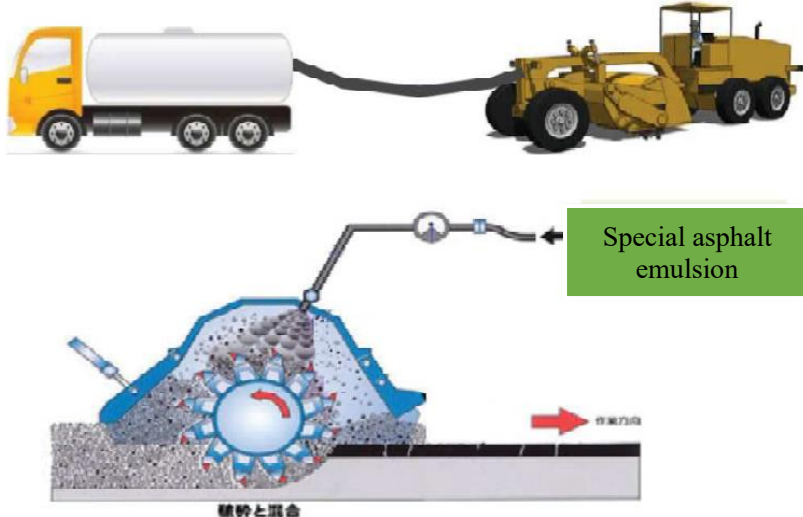
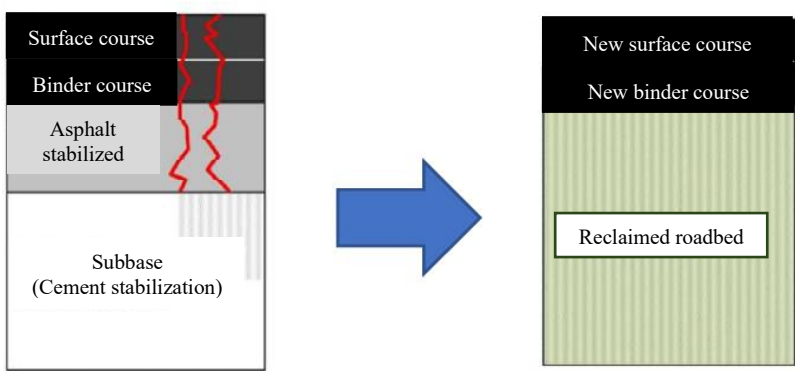
verification, disaster recovery, inspections).

- Standardize technical guidelines related to remote, automated, and autonomous operations.
- Develop infrastructure and platforms to support these advancements.

7.1.1 Road construction projects


Among the technical needs identified above, the Japanese technologies that can be used in road projects and their advantages are shown below.

(1) Reclaimed roadbed / Reclaimed asphalt

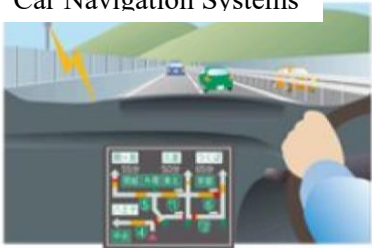



Name	Cement Foamed Asphalt
<p>Overview</p>	<p>Cement Foamed Asphalt is a technology developed in Japan, in which existing damaged asphalt pavement is crushed in-situ, and at the same time, cement, asphalt emulsion, additive materials, and existing roadbed materials are mixed and compacted to create a new roadbed with stabilized treatment. Waste plastics are used as additives to construct modified asphalt pavement.</p> 
<p>Characteristics</p>	<ul style="list-style-type: none"> • Compared to full replacement pavement, less pavement material is generated, construction speed is faster, and the construction period can be shortened, resulting in cost reduction. • The existing roadbed material is stabilized, so the pavement structure can be strengthened without raising the pavement. 
<p>Necessity</p>	<ul style="list-style-type: none"> • The establishment of a recycling-oriented society in Cambodia is an issue for the future, and MPWT is working to recycle asphalt, concrete, bricks, etc. • There are concerns about the depletion of aggregate procured

	<p>domestically in Cambodia, and construction costs are expected to increase if procured outside of the country.</p> <ul style="list-style-type: none"> • Since modified asphalt has a longer pavement life than regular asphalt and contributes to LCC reduction, demand is expected to increase for future national road rehabilitation projects. • The speed of construction is much faster than that of full surface replacement, and its introduction is particularly effective for widening in Phnom Penh's urban areas where traffic congestion is expected.
Feasibility and future prospects in Cambodia	MPWT and private companies in Japan have worked together to build a plant to recycle construction materials, and we expect that Japanese companies will continue to develop new businesses in Cambodia for maintenance, and operation and sales of their products.
Advantages of Japanese Companies	Cement Foamed asphalt is a Japanese technology and has been proven in Cambodia, there is no need to transport new construction equipment, which is an advantage.

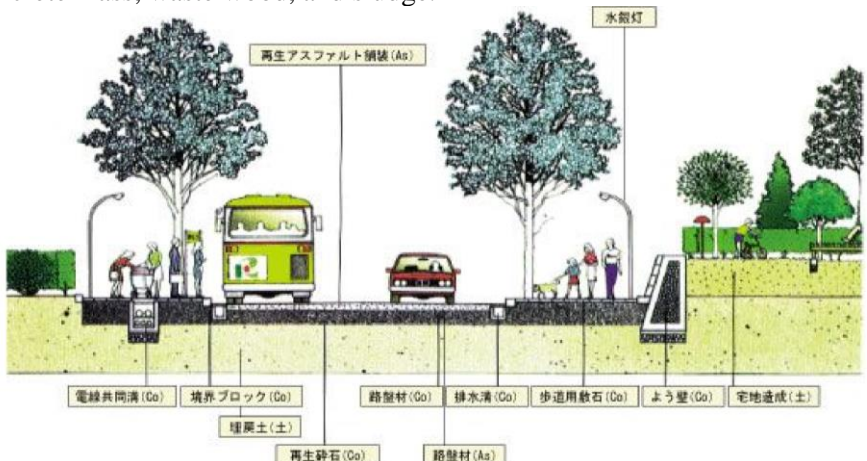
(2) Dragon Hole (Dispersive soil) measures

Name	Geostream
<p>Overview</p>	<p>In special soils that are prone to erosion, such as dispersive soils, soil erosion by rainfall infiltration can cause hollowing (dragon holes), and if erosion continues, slope failure is a possibility. Therefore, the soil is unsuitable for embankment materials.</p> <p>Geostream is a civil engineering drainage material with a structure of synthetic fibers of different permeability and strength woven into a nonwoven fabric, possessing separation, reinforcement, and drainage functions and requiring no maintenance. These are installed from the shoulder to the bottom of the embankment slope to prevent rainfall from infiltrating into the embankment and causing dragon holes.</p> 
<p>Characteristics</p>	<ul style="list-style-type: none"> • The drainage sheet combines the water collection effect of nonwoven fabric with the high strength of synthetic fibers, achieving both pressure resistance and water permeability. • Since no purchased soil is required for the embankment material, it leads to cost reduction. • Compared to other erosion control methods such as concrete framing, the construction is easier.
<p>Necessity</p>	<ul style="list-style-type: none"> • NR1 runs along the right bank of the Mekong River, and the locally generated soil is likely to be dispersive soil • The area around Phnom Penh is close to the Mekong River, making it difficult to secure high-quality embankment material. This contributes to the effective use of locally generated soil under such conditions.
<p>Feasibility and future prospects in Cambodia</p>	<p>Under JICA's support, a pilot test of the GeoStream is being conducted along NR1, and its effectiveness has been confirmed.</p>
<p>Advantages of Japanese Companies</p>	<p>Although it has little advantage as a drainage sheet, it is highly advantageous in that it has sufficient strength and drainage properties as a dragon hole measure, and the effectiveness of the measure can be proven.</p>



(3) ITS

Name	ITS (Intelligent Transport System)
Overview	<p>Advanced road traffic systems utilizing ICT, such as car navigation systems, VICS (Vehicle Information and Communication System), ETC (Electronic Toll Collection System), AHS (Automated Highway System), UTMS (Universal Traffic Management System), public transportation operation management systems, smart parking systems, and PICS (Pedestrian Information and Communication System), aim to solve road traffic problems such as accidents and congestion. By using cutting-edge information and communication technology to network people, roads, and vehicles through information, these systems strive to address traffic-related issues.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Car Navigation Systems</p>  </div> <div style="text-align: center;"> <p>Advanced driver-assistance systems</p>  </div> </div>
Characteristics	<ul style="list-style-type: none"> The overall plan for promoting ITS has been formulated in Japan, outlining nine areas of development for ITS, which are now being promoted as a national project. Pedestrian Information and Communication Systems provide signal information from traffic signals to smartphones and other devices, and have a green time extension function to enhance user convenience. <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Traffic Control</p>  </div> <div style="text-align: center;"> <p>PICS</p>  </div> </div>
Necessity	<ul style="list-style-type: none"> Since existing cross roads are continuous in the viaduct section, and if the viaduct is installed, there will be a series of flat intersections under the viaduct and an entrance/exit for the viaduct ramp, traffic guidance by providing information on traffic congestion, traffic control status, etc. through VICS, etc. will be effective. Since there are a series of signalized intersections, centralized signal control optimization can be expected by linking with the existing traffic control system. Signal intersections under viaducts affect pedestrian traffic due to poor visibility, longer pedestrian crossings, etc. Pedestrian Information and Communication systems provide optimal green time and improve safety by facilitating the movement of the visually impaired, elderly, etc.
Feasibility and future prospects in Cambodia	<p>With JICA support, a signal control system for major intersections in the Phnom Penh metropolitan area, including NR1, has been established, and it is expected to be even more effective in controlling traffic congestion when linked with the new traffic signals to be installed.</p>
Advantages of Japanese Companies	<p>VICS and traffic control systems have already been widely used in Japan, and there is sufficient experience and knowledge of these systems. There are also examples of pedestrian information and communication systems that are now in operation, and Japanese technology is highly competitive.</p>

(4) Recycling Technology for Construction By-Products

Name	Recycling Technology for Construction By-Products
<p>Overview</p>	<p>Recycling Technology for Construction By-Products is a generic term for technologies to recycle construction by-products such as concrete mass, asphalt concrete mass, waste wood, and sludge.</p>  <p>In Japan, the “ Construction Recycling Law” obliges construction companies to recycle materials. In FY 2018, the target recycling rate of 97% was achieved, and in the future, the quality of recycling must be improved by looking at how recycled materials are used. Efforts have also been launched to promote sorting and recycling of waste plastics, which are required to be addressed internationally, such as the SDGs.</p>
<p>Characteristics</p>	<ul style="list-style-type: none"> • Concrete masses, after crushing, sorting, and removal of mixed materials, are reused as roadbed material, building foundation material, concrete aggregate, etc. • Asphalt and concrete masses, after crushing, sorting, and removal of mixed materials, are reused as recycled asphalt and roadbed material. • Waste wood is crushed into small pieces and reused as boards, paper chips, solid fuel (RDF), or converted into cement fuel.
<p>Necessity</p>	<ul style="list-style-type: none"> • As the infrastructure resilience plan in the NSDP 2019-2023 progresses, the depletion of aggregates that can be procured domestically is a concern, and increasing construction costs through foreign procurement is a potential future challenge. • Building a recycling-based environment in Cambodia is an issue for the future, and MPWT is working to promote recycling of asphalt, concrete, bricks, and other materials. • It is necessary to manage and operate a construction material recycling plant that manufactures recycled aggregate, roadbed material, recycled asphalt mixture, and modified asphalt mixture (including modifier using waste plastic) using Japanese technology, aiming to build a recycling-based environment, reduce environmental burden, and lower life cycle costs.
<p>Feasibility and future prospects in Cambodia</p>	<p>Although there is an issue of low awareness of recycling among the Cambodian people, MPWT and Japanese companies have established a construction material recycling plant, and Japanese companies are expected to develop new businesses in Cambodia for maintenance, management, operation, and product sales in the future.</p>
<p>Advantages of Japanese Companies</p>	<p>Recycling Technology for Construction By-Products using Japanese technology is highly competitive in terms of the recycling rate achieved in Japan.</p>

(5) System to Ensure Safety of Traffic Dangerous Areas by Blinking Type LED Solar Light

Name	Pikalotto
Overview	<p>It is an LED-mounted concrete system that combines solar power generation and LED lights, which are recharged during the day and automatically turn on at night. It can be easily buried in curbs and roadways in traffic hazardous areas where no lighting or guide lights have been installed, and clearly indicates the traffic division as a guide light.</p> <div style="display: flex; justify-content: space-around;">   </div>
Characteristics	<ul style="list-style-type: none"> • It does not require a commercial power source, has low running costs for maintenance and utilities, and has a low risk of theft. • The system can clearly indicate road divisions at night and increase visibility of road to ensure traffic safety and prevent accidents. • Low illumination, rechargeable, and a wide temperature range of -20° to 60° for use, making it effective in a wide variety of locations.
Necessity	<ul style="list-style-type: none"> • In Cambodia, rapid economic growth has led to increased human mobility, and the dangers of road traffic are becoming more serious due to longer distances and longer hours of transportation and travel. • Many of the causes of traffic accidents are speeding, drunk driving, and fender-benders caused by reduced road visibility, and the installation of safety facilities can be expected to be effective. • Road lighting is effective in ensuring safety at night, but installation is difficult in Cambodia due to the lack of power sources, expensive commercial power, and maintenance management.
Feasibility and future prospects in Cambodia	<p>Fuji Construction Work Co., Ltd. is conducting a feasibility study in Cambodia, which was adopted by JICA's "JICA Biz." By continuing to demonstrate the effects of reducing production costs and traffic accidents, Japanese companies can be expected to develop their business in Cambodia.</p>
Advantages of Japanese Companies	<p>The project is effective as a traffic safety measure, and the ease of installation and the ability to prove the effectiveness of the measures are highly advantageous.</p>

7.1.2 Bridge construction projects




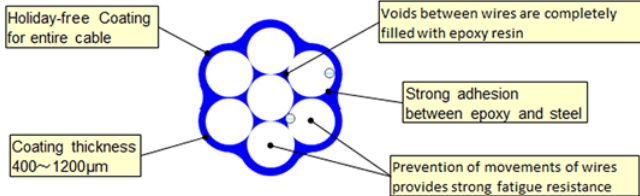
Among the technical needs identified above, the Japanese technologies that can be utilized in bridge projects and their advantages are shown below.

Target Bridge	Expected advantages	Japanese technologies
Viaduct (NR1 : 0 ~ 4km) (Including Bassac River crossing bridge)	Construction in narrow spaces	• Screw Pile (Foundation construction method that can be used on narrow space)
	Cost reduction	• Narrow box girder, Steel-concrete composite bridge deck
	Reduce maintenance costs and LCC	• ECF strand (Epoxy Coated and Filled strand) • Corrosion Resistance Steel for Painting Cycle Extension (CORSPACE) • Al-Mg Transfer Arc Plasma Spraying (Bearings, expansion joints etc.)
	Strengthening of	• Steels for Bridge High Performance Structure (SBHS)

Target Bridge	Expected advantages	Japanese technologies
	superstructure / Labor saving in construction	<ul style="list-style-type: none"> • UFC Road Bridge Deck (Ultra High Strength Fiber Reinforced Concrete)
	Labor saving / Shortening of construction period	<ul style="list-style-type: none"> • Precast segment (Span-by-span erection) • Accelerated Construction Method (Superstructure / Substructure)
Mekong River Bridge (RR2) (Including NR1 intersection flyover)	Rationalization of structure	<ul style="list-style-type: none"> • High strength PWS (Pre-fabricated Parallel Wire Strand)
	Cost reduction	<ul style="list-style-type: none"> • Narrow box girder, Steel-concrete composite bridge deck
	Reduce maintenance costs and LCC	<ul style="list-style-type: none"> • ECF strand (Epoxy Coated and Filled strand) • Corrosion Resistance Steel for Painting Cycle Extension (CORSPACE) • Al-Mg Transfer Arc Plasma Spraying (Shoe, expansion joint etc.)
	Strengthening of superstructure / Labor saving in construction	<ul style="list-style-type: none"> • Steels for Bridge High Performance Structure (SBHS) • UFC Road Bridge Deck (Ultra High Strength Fiber Reinforced Concrete)
	Labor saving / Shortening of construction period	<ul style="list-style-type: none"> • Accelerated Construction Method for Overpasses • Quick Bridge
	Labor saving	<ul style="list-style-type: none"> • Steel pipe sheet pile well foundations, which also serves as temporary cofferdam.
General	Improved maintenance and management accuracy	<ul style="list-style-type: none"> • SHMS (Structural Health Monitoring System)

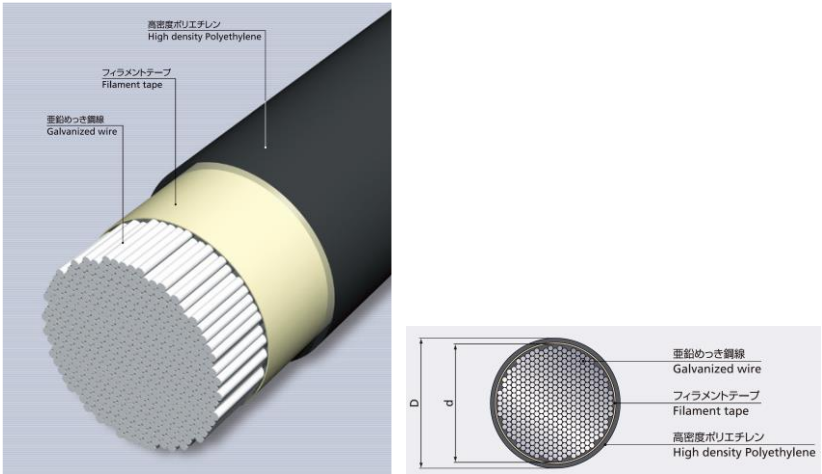
Among the above, those which are considered to have relatively high applicability are described in detail below.

(1) Exterior Cable for PC Bridge

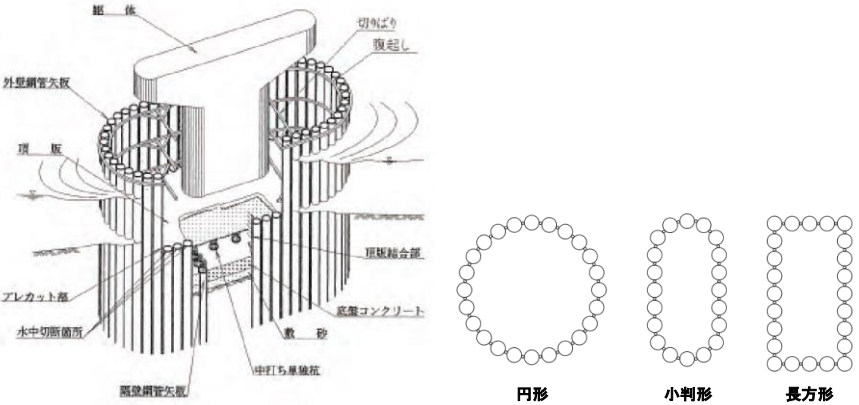
Name	ECF strand (Epoxy Coated and Filled strand)
Overview	<p>Special epoxy resin with excellent strength and extensibility properties is coated on the surface of strand for PC, and the gaps between the strands are also filled to improve corrosion resistance, durability, and fatigue resistance.</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>Single-layer anticorrosion (Standard Type, with Epoxy)</p> </div> <div style="text-align: center;">  <p>Double-layer anticorrosion (with Epoxy + PE)</p> </div> <div style="text-align: center;">  <p>Triple-layer anticorrosion (with Epoxy + PE + WAX)</p> </div> </div> <div style="text-align: center; margin-top: 10px;">  </div>
Characteristics	<ul style="list-style-type: none"> • The gaps between the strand for PC are filled with epoxy resin, which firmly adheres to the steel material and the epoxy resin, providing excellent corrosion resistance and durability. • Compared to conventional systems that use steel wire and grout filling, this system offers more reliable construction quality and higher corrosion resistance. The system also leads to easier inspection, reduction of inspection

	<p>cost, and lower LCC (Life Cycle Cost).</p> <ul style="list-style-type: none"> • No relative movement between wires, excellent fatigue resistance • As grouting after tensioning is not required, it also contributes to easier construction and shorter construction periods.
Necessity	<ul style="list-style-type: none"> • Cambodia is currently undergoing active infrastructure development and is expected to have a large stock of infrastructure in the future, so there is a need to further improve the durability and maintainability of structures.
Feasibility and future prospects in Cambodia	<p>There are several applications of ECF strands, including bridges, and they can be applied without any problems.</p>
Advantages of Japanese Companies	<p>ECF strands are the products of Japanese companies. They have been commonly applied in Japan, and Japanese companies that participate in bridge projects overseas have extensive construction experience.</p>

(2) Cable for Cable-supported Bridge


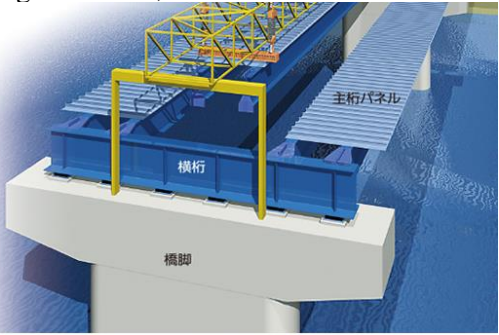
Name	High strength PWS (Pre-fabricated Parallel Wire Strand)
Overview	<p>The cable is composed of parallel strands of galvanized steel wire. Polyethylene coating is applied to the exterior to provide multiple corrosion protection.</p> 
Characteristics	<ul style="list-style-type: none"> • By bundling steel strands in parallel without twisting them, 100% of each wire strength can be utilized. • The outer diameter is smaller than that of a cable with the same capacity using stranded steel wires. • The size of the drum when the prefabricated cable is delivered to the site is also smaller, which is advantageous in terms of installation. • In the case of prefabricated cables, rust-proofing is performed at the factory in conjunction with assembly, eliminating the need for rust-proofing treatment on site.
Necessity	<ul style="list-style-type: none"> • Although the effect may not be so great for PC cable-stayed bridges of the size of the subject bridge, it is necessary to reduce the wind load on long-span bridges with cable-supported systems, where the effect of wind is significant. Smaller outer diameters reduce the area where the cables are exposed to wind, thus contributing to lowering wind loads.
Feasibility and future prospects in Cambodia	<p>There are several examples of application in Cambodia's neighboring countries, such as Vietnam, and hence the PWS can be applied in Cambodia without problems.</p>
Advantages of Japanese Companies	<p>PWS is a Japanese technology and has a high advantage.</p>

(3) Bridge foundation and Temporary cofferdam

Name	Steel Pipe Sheet Pile Foundations (SPSP Foundations)
<p>Overview</p>	<p>A structure in which steel pipe sheet piles placed in the form of a well are used as the bridge foundation. Steel pipe sheet piles are installed in a closed well (circular, rectangular, oval, etc.) and driven into the support layer. The joint pipes of the steel pipe sheet piles are filled with mortar and their heads are rigidly connected to the slab (footing) to form an integrated structure.</p> 
<p>Characteristics</p>	<ul style="list-style-type: none"> • Compared to installing a temporary cofferdam separately, the construction period can be shortened and construction costs can be reduced. • Higher safety during construction. • Construction is possible even in deep water, soft ground, and deep support layers. • Optimal shapes can be selected according to conditions (circular, oval, rectangular). • Occupied area can be reduced compared to pile foundations.
<p>Necessity</p>	<ul style="list-style-type: none"> • Based on the design conditions currently assumed and the trend of foundation types used in neighboring bridges, the necessity and superiority of the application of this technology are not high at the moment. As the study progresses in more detail, however, the applicability of this technology may increase if further conditions arise, such as necessity for large-scale temporary cofferdam due to topographic / geological conditions. • If the occupied area can be reduced, it will be advantageous for bridges on the Mekong River, where there are many vessels navigating.
<p>Feasibility and future prospects in Cambodia</p>	<p>There are several examples of application in Cambodia's neighboring countries, such as Vietnam, and there are no problems in applying the SPSP foundations in Cambodia.</p>
<p>Advantages of Japanese Companies</p>	<p>SPSP foundations is a Japanese technology and has a high advantage.</p>

(4) Composite Girder Bridge with Steel Plate-Concrete Composite Deck

Name	Panel Bridge
<p>Overview</p>	<p>A new type of assembled bridge consisting of main girder panels and intermediate slab panels, in which the composite deck slab and main girder are integrated to enable rapid and simple construction. The main girder and composite deck slab are integrated at the factory, simplifying on-site construction and enabling rapid construction.</p>

	
<p>Characteristics</p>	<ul style="list-style-type: none"> • Compared to PC bridges, the design force of the substructure can be reduced by about 20%, which means that the substructure can be made smaller. • Since there is no need to set up and remove suspended scaffolds and slab formwork, little or no work is required under the girders. • Construction can be done with minimal restrictions when crossing roads and railroads, thus reducing traffic congestion, noise, and other impacts on the surrounding environment. • Easy to use for straight sections, but difficult to use for curved sections. 
<p>Necessity</p>	<ul style="list-style-type: none"> • At intersections under viaducts, it is necessary to raise the roadway profile to ensure clearance. The low girder height of the panel bridge makes it possible to reduce costs by raising the road profile. • Because of the high traffic volume at the viaduct section, it is necessary to avoid traffic restrictions during traffic congestion as much as possible through rapid construction. • There are many commercial facilities adjacent to the viaduct section, and it is necessary to reduce the impact on the surrounding environment and stores as much as possible by shortening the construction period.
<p>Feasibility and future prospects in Cambodia</p>	<p>Although Panel Bridge has a large number of installations in Japan, the number of installations outside of Japan is still small. However, due to its high quality and performance, it is highly regarded in overseas markets and is considered to be internationally competitive, especially in the Asian region.</p>
<p>Advantages of Japanese Companies</p>	<p>Panel bridge is a Japanese technology and has a high advantage in terms of rapid construction.</p>

7.2 Proposal of high-priority projects

7.2.1 High-priority components and impact

(1) Selected high-priority project

As a result of reporting the survey of the requested projects (1) through (5) to the Cambodian side and holding discussions, projects (1) through (4) were selected as priority projects as candidates for yen loans. This result was based on the agreement up to the Secretary of State of the MPWT as well as discussions with the MEF, and reflects the intentions of the high-level decision-making authority on the Cambodian side.

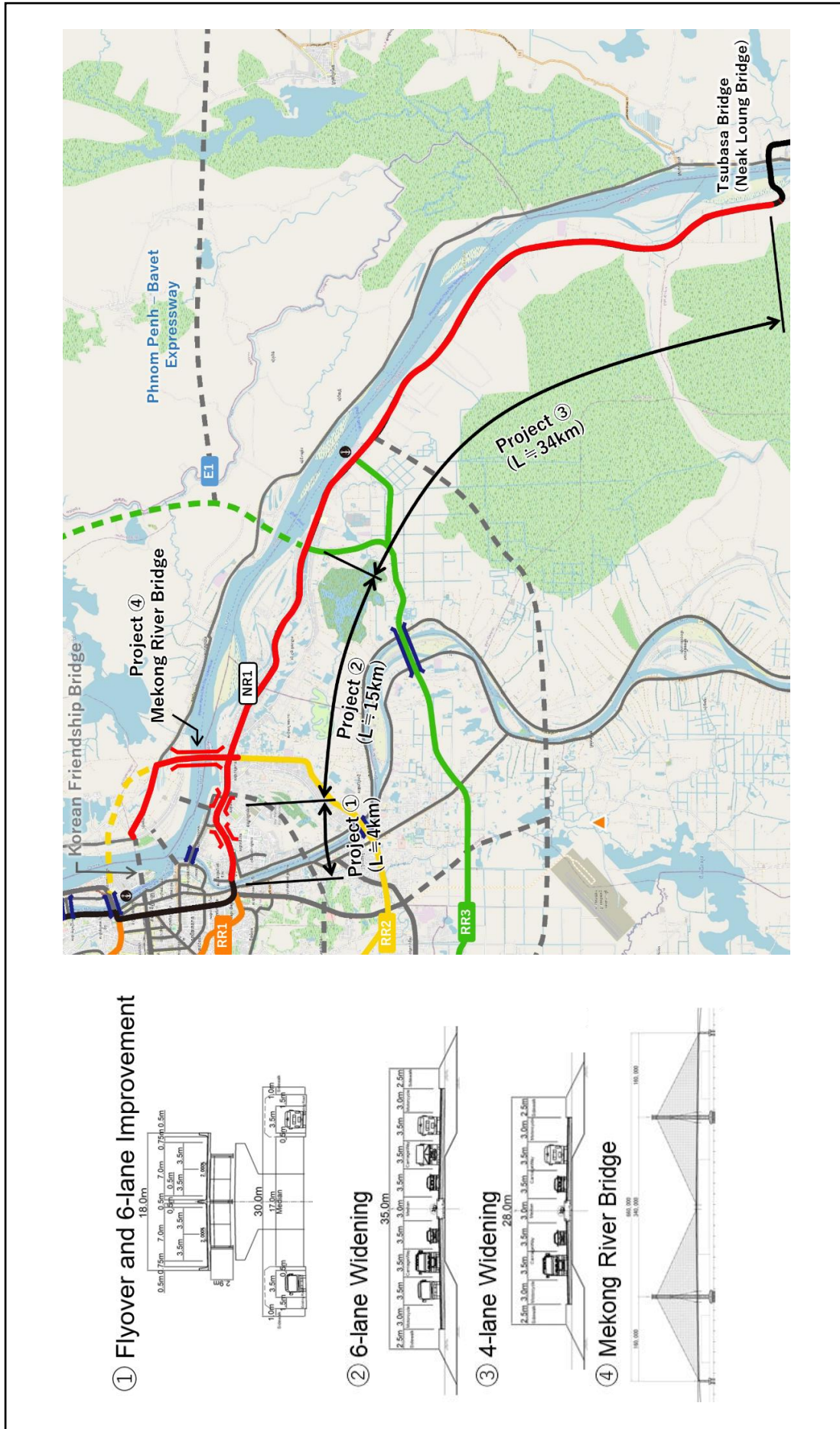


Figure 7.2-1 Selected high-priority project

(2) Components included in the priority projects

The priority project package will include the following components

Table 7.2-1 List of Included Project Components (NR1)

High-Priority Project	No.	Start	End	Component	Quantity	Billion JPY	
						Direct Cost	Assumed Loan Amount
Project 1	NR1-1	0+800	2+680	6 Lane Widening (Improvements within the width of the existing road)	1,880m	0.8	1.2
	NR1-2	2+680	3+790	Flyover	1,110m	10.4	15.1
	NR1-3	3+790	4+630	6 Lane Widening (Improvements within the width of the existing road)	840m	0.3	0.4
Project 2	NR1-4	4+630	5+180	6 Lane Widening	550m	0.3	0.4
	NR1-5	5+180	6+260	Flyover	1,080m	6.7	9.7
	NR1-6	6+260	19+800	6 Lane Widening	13,540m	8.1	11.7
Project 3	NR1-7	19+800	53+570	4 Lane Widening	33,770m	12.9	18.4

Table 7.2-2 List of Included Project Components (RR2 and AKC)

High-Priority Project	No.	Component	Quantity	Billion JPY	
				Direct Cost	Assumed Loan Amount
Project 4	RR2-1	Mekong River Bridge (Approach road included)	2,945m	47.7	68.6
	RR2-2	NR1-RR2 multi-level crossing	1	9.7	13.2
	RR2-3	AKC side road maintenance	4,500m	1.7	2.4

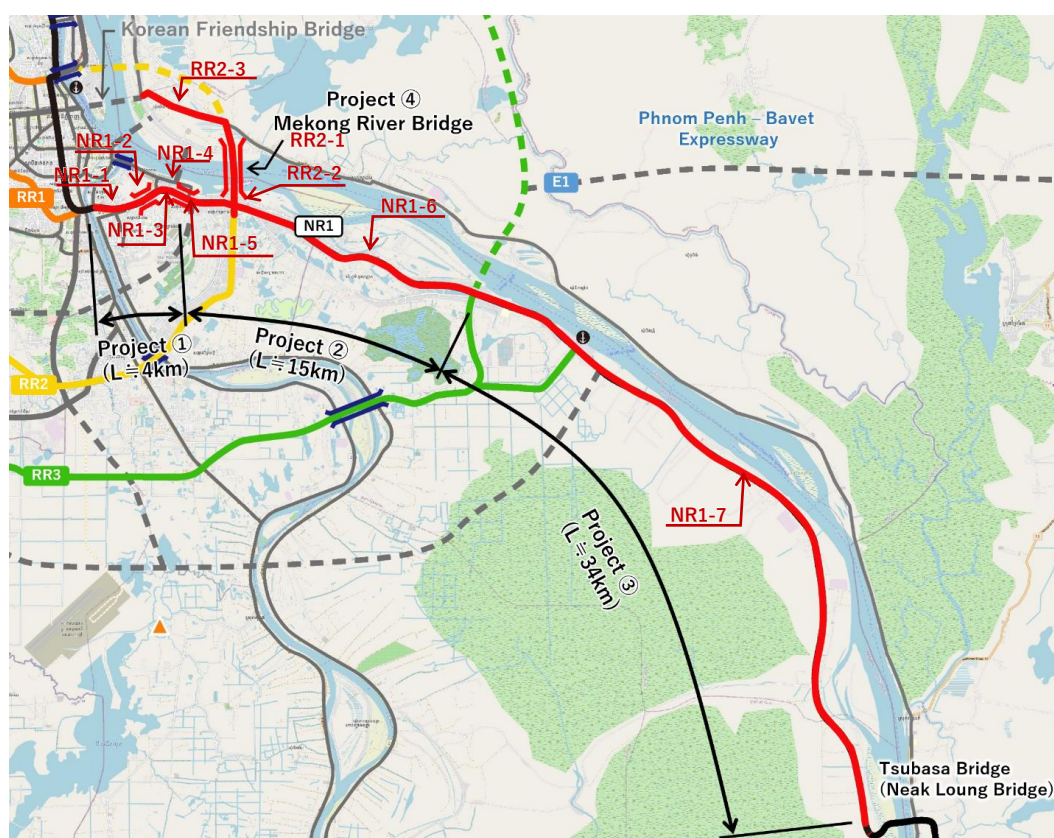


Figure 7.2-2 Location map of Included Project Components

Table 7.2-3 Overview of the Components

High-Priority Project	No.	Component	Quantity	Lanes Width	Bridge Length/ Design Criteria	Minimum Curvature	Maximum Gradient
Project 1	NR 1-1	6 Lane Widening (Improvements within the width of the existing road)	1,880m	6 Lanes 3.5m	0	950m	4.0%
	NR 1-2	Flyover	1,110m	4 Lanes 3.5m	1,110 m/ T44,L44,HLP240	1000m	4.0%
	NR 1-3	6 Lane Widening (Improvements within the width of the existing road)	840m	6 Lanes 3.5m	0	500m	4.0%
Project 2	NR 1-4	6 Lane Widening	550m	6 Lanes 3.5m	0	∞	4.0%
	NR 1-5	Flyover	1,080m	4 Lanes 3.5m	1,080 m/ T44,L44,HLP240	970m	4.0%
	NR 1-6	6 Lane Widening	13,540 m	6 Lanes 3.5m	0	300m	4.0%
Project 3	NR 1-7	4 Lane Widening	33,770 m	4 Lanes 3.5m	300 m/ T44,L44,HLP240	500m	4.0%
Project 4	RR 2-1	Mekong River Bridge (Approach road included)	2,945m	6 Lanes 3.5m	2,005 m/ T44,L44,HLP240	∞	4.0%
	RR 2-2	NR1-RR2 multi-level crossing	1 Location	6 Lanes 3.5m	850 m/ T44,L44,HLP240	∞	4.0%
	RR 2-3	AKC side road maintenance	4,500m	4 Lanes 3.5m	0	1500m	4.0%

(3) Estimated Project Costs and Project Schedule for Priority Packages

The estimated project cost for the total and each project is shown below.

Table 7.2-4 Estimated Project Cost

Item		Total		
		FC	LC	Total
A. JICA PORTION				
I)	Procurement / Construction	128,909	1	129,016
	Package 1 Alternative 3	98,100	0	98,172
	Base Cost for JICA Financing	98,100	0	98,172
	Price Escalation	19,090	0	19,116
	Physical Contingency	11,719	0	11,729
II)	Consulting Services	11,451	4	12,067
	Base Cost	9,361	3	9,810
	Price Escalation	1,544	1	1,683
	Physical Contingency	545	0	575
Total (I+II)		140,360	5	141,083
B. BORROWER PORTION				
a	Procurement / Construction	0	0	0
b	Land Acquisition	0	71	10,292
	Base Cost	0	55	7,934
	Price Escalation	0	10	1,422
	Physical Contingency	0	6	936
c	Administration Cost	0	52	7,569
d	Tax	0	146	21,126
	VAT	0	0	72
	Import Tax	0	145	21,054
	Other Taxes	0	0	0
Total (a+b+c+d)		0	269	38,987
TOTAL (A+B)		140,360	274	180,070
C. Interest during Construction (IDC)				
	Interest during Construction (Construction)	4,261	0	4,261
	Interest during Construction (Consultant)	4,255	0	4,255
	Interest during Construction (Consultant)	6	0	6
D. Front End Fee				
	Front End Fee	282	0	282
GRAND TOTAL (A+B+C+D)		144,903	274	184,613
E. JICA Finance Portion (A)				
	JICA Finance Portion (A)	140,360	5	141,083
F. Borrower Finance Portion (B+C+D)				
	Borrower Finance Portion (B+C+D)	4,543	269	43,530

* Calculation conditions

Base Year/Month for Cost Estimation:	Sep. 2024		FC,Total: million JPY
Exchange Rate:	USD = JPY	145	LC : million USD
	USD = USD	1	
	USD = JPY	145	
Price Escalation:	FC: 3.24%	LC: 5.65%	
Physical Contingency:	10.0%		
Physical Contingency for Consultant:	5.0%		

Table 7.2-5 Estimated Project Cost (By Projects)

Item	Project 1			Project 2			Project 3			Project 4		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. JICA PORTION												
D) Procurement / Construction	15,112	1	15,219	19,842	1	19,950	16,677	1	16,781	77,004	1	77,111
Package 1 Request project 1	11,500	0	11,572	15,100	0	15,172	12,900	0	12,972	58,600	0	58,672
Base Cost for JICA Financing	11,500	0	11,572	15,100	0	15,172	12,900	0	12,972	58,600	0	58,672
Price Escalation	2,238	0	2,264	2,938	0	2,964	2,261	0	2,284	11,403	0	11,429
Physical Contingency	1,374	0	1,384	1,804	0	1,814	1,516	0	1,526	7,000	0	7,010
II) Consulting Services	850	4	1,466	1,291	4	1,907	1,106	3	1,594	6,616	4	7,232
Base Cost	701	3	1,150	1,061	3	1,510	924	3	1,290	5,411	3	5,860
Price Escalation	108	1	246	168	1	306	129	1	228	889	1	1,027
Physical Contingency	40	0	70	61	0	91	53	0	76	315	0	344
Total (I+II)	15,962	5	16,685	21,133	5	21,856	17,782	4	18,375	83,619	5	84,343
B. BORROWER PORTION												
a) Procurement / Construction	0	0	0	0	0	0	0	0	0	0	0	0
b) Land Acquisition	0	0	0	0	0	0	0	0	0	0	71	10,292
Base Cost	0	0	0	0	0	0	0	0	0	0	55	7,934
Price Escalation	0	0	0	0	0	0	0	0	0	0	10	1,422
Physical Contingency	0	0	0	0	0	0	0	0	0	0	6	936
c) Administration Cost	0	6	834	0	8	1,093	0	6	919	0	33	4,732
d) Tax	0	17	2,467	0	22	3,242	0	19	2,727	0	87	12,615
VAT	0	0	72	0	0	72	0	0	59	0	0	72
Import Tax	0	17	2,394	0	22	3,170	0	18	2,667	0	87	12,543
Other Taxes	0	0	0	0	0	0	0	0	0	0	0	0
Total (a+b+c+d)	0	23	3,301	0	30	4,335	0	25	3,645	0	191	27,639
TOTAL (A+B)	15,962	28	19,986	21,133	35	26,192	17,782	29	22,020	83,619	196	111,981
C. Interest during Construction (IDC)												
Interest during Construction (Construction)	503	0	503	659	0	659	494	0	494	2,547	0	2,547
Interest during Construction (Consultant)	502	0	502	658	0	658	494	0	494	2,543	0	2,543
Interest during Construction (Construction)	1	0	1	1	0	1	1	0	1	4	0	4
Interest during Construction (Consultant)	33	0	33	44	0	44	37	0	37	169	0	169
GRAND TOTAL (A+B+C+D)	16,498	28	20,522	21,836	35	26,894	18,313	29	22,551	86,335	196	114,697
E. JICA Finance Portion (A)												
	15,962	5	16,685	21,133	5	21,856	17,782	4	18,375	83,619	5	84,343
F. Borrower Finance Portion (B+C+D)												
	556	23	3,837	703	30	5,038	531	25	4,176	2,715	191	30,354

Table 7.2-6 Project Schedule

	2025	2026	2027	2028	2029	2030	2031
Feasibility study							
Detail design							
Bidding							
Construction							

* The consultant selection period for Detail Design should be taken into account when considering the schedule in detail in the future.

The construction period (4 years) is assumed to be 4 years (= 48 months) based on the construction period of the Tsubasa Bridge below.

Reference case: Tsubasa Bridge construction (PC cable-stayed bridge, main span length: 330 m)

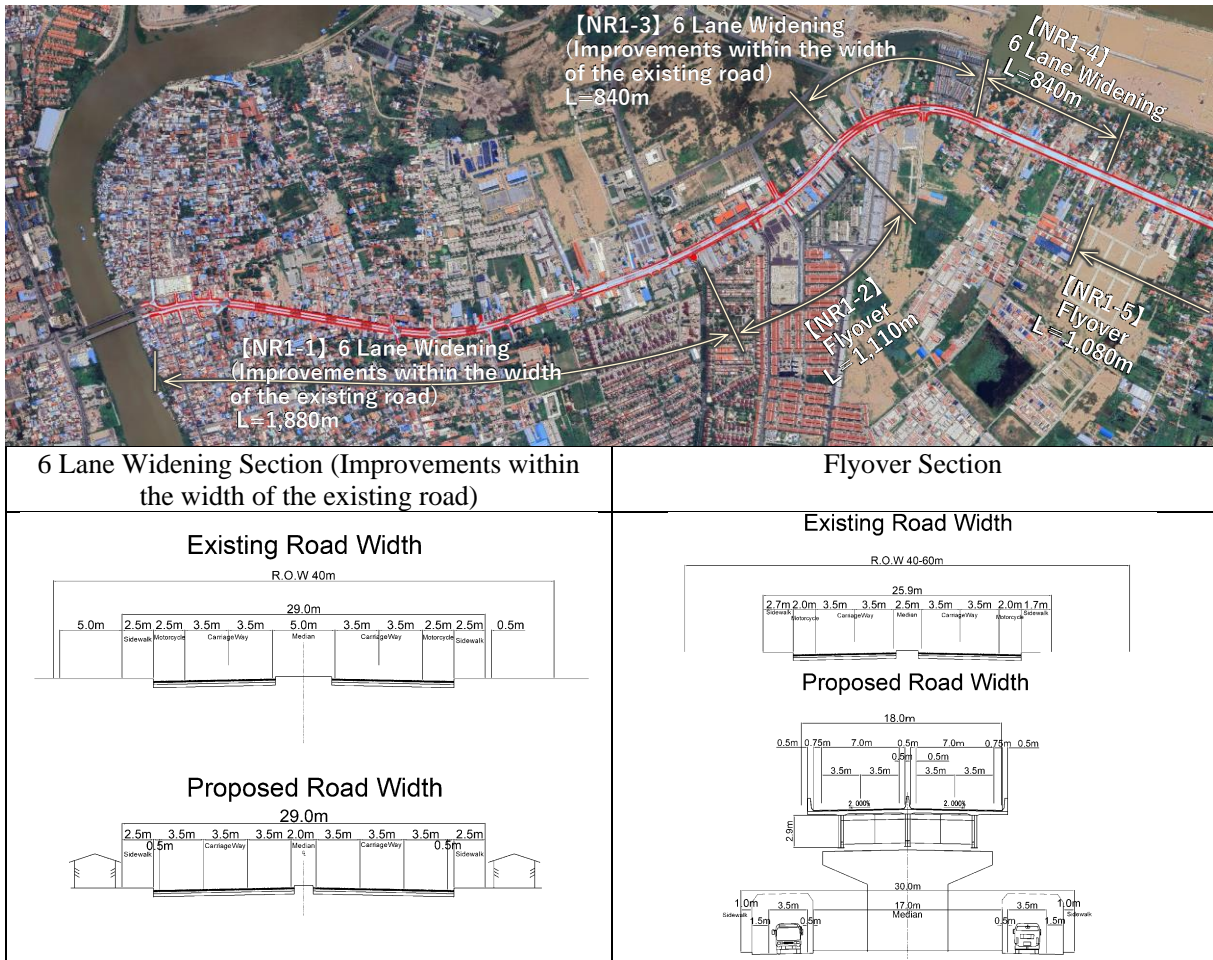
Construction period: 51 months for preparatory survey

51 months (December 20, 2010 - March 15, 2015) for implementation

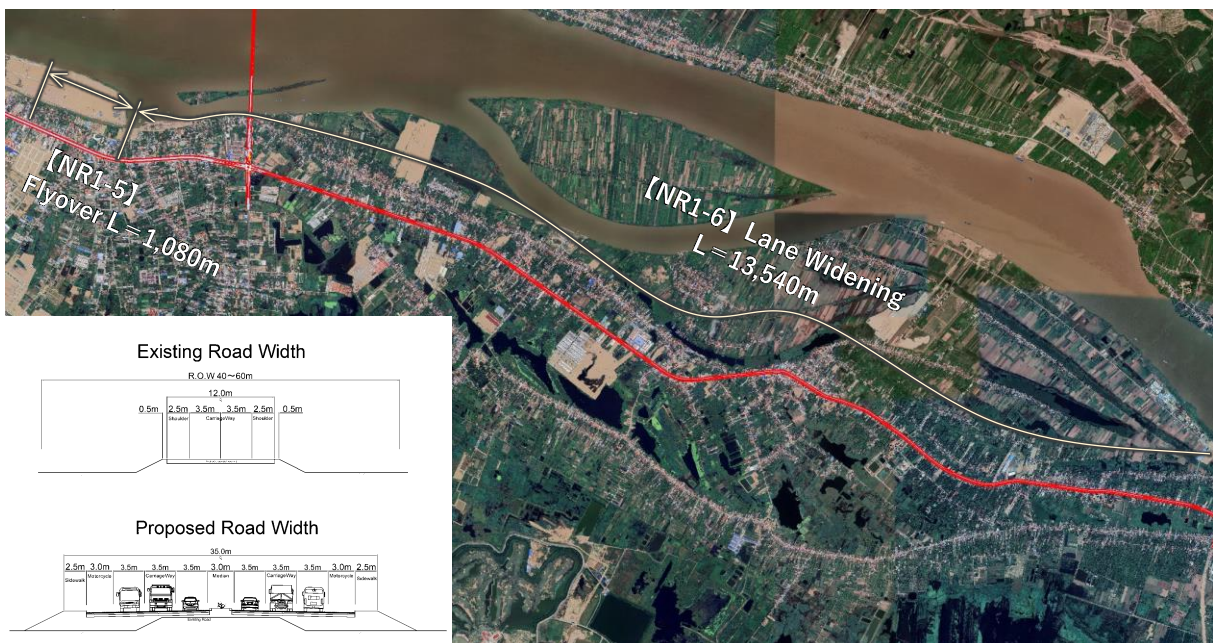
7.2.2 Outline of Each Component

Section of each component are shown below.

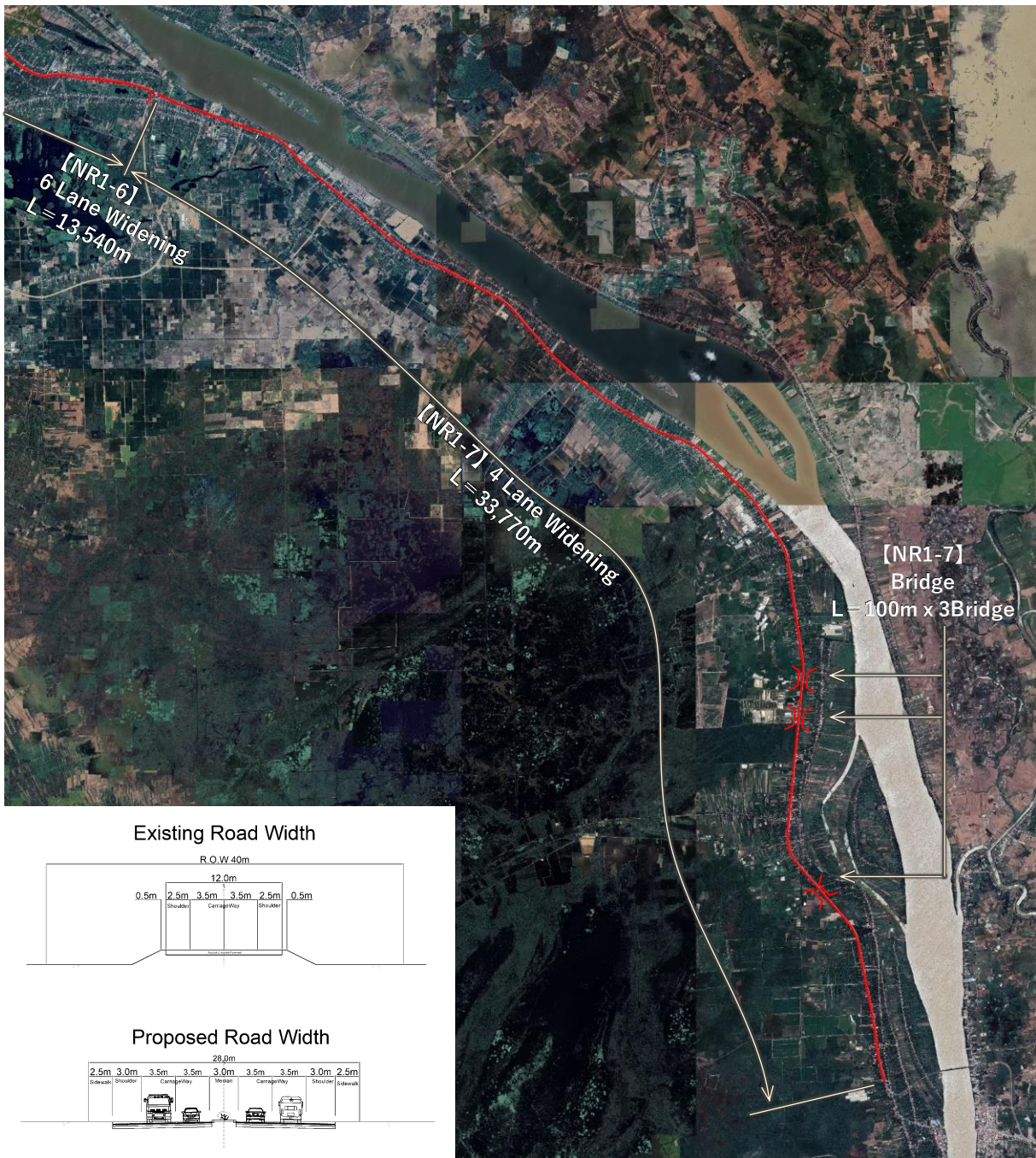
- (1) [NR1-1] 6 Lane Widening (Improvements within the width of the existing road) ~ [NR1-5] Flyover



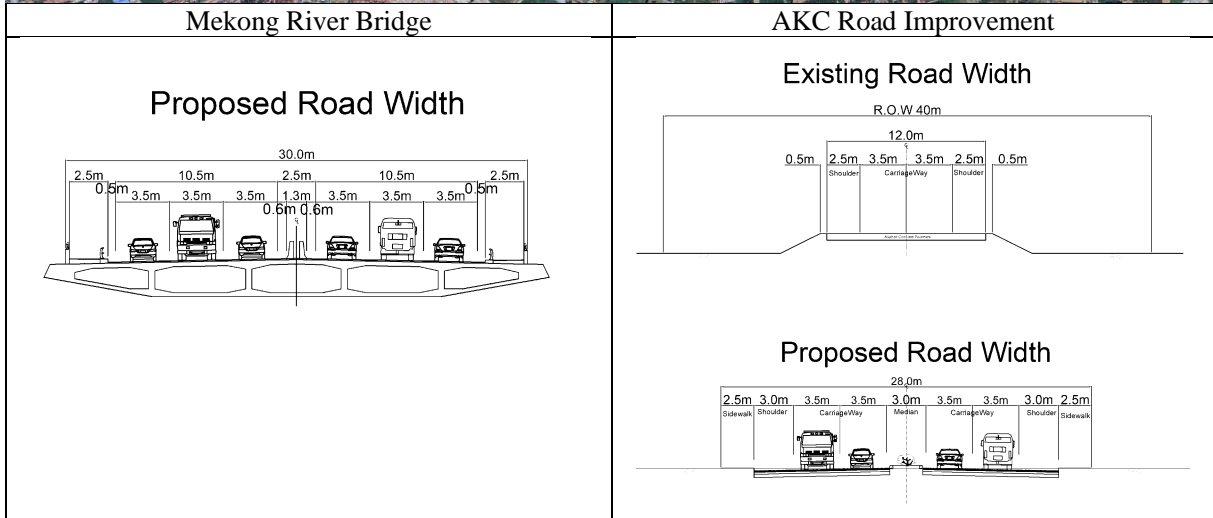
- (2) [NR1-5] Flyover ~ [NR1-6] 6 Lane Widening



(3) [NR1-6] 6 Lane Widening ~ [NR1-7] 4 Lane Widening



(4) [RR2-1] Mekong River Bridge ~ [RR2-3] AKC Road Improvement



7.2.3 Impact of the High-Priority Project

(1) Future Traffic Demand Forecast

Traffic demand forecast for 2035 and 2050 were conducted for both scenarios: with the high-priority project and without them. The future road network assumptions for each year are as follows:

Table 7.2-7 Future Road Network Assumptions

Year	Road Network Assumption		
	Classification of Projects	Without Case	With Case
2035	Requested projects	All projects are not implemented	Only the high-priority project is implemented
	Projects of CITL	All road projects listed in the project list that have a significant impact on the traffic of the target projects are reflected. However, the requested projects are excluded.	
	Projects of PPUTMP	Among the road projects list, all projects that significantly affect the traffic of the target projects are reflected.	
	Projects of land use plan in Akreiy Ksatr City	Road projects in the land-use plan that significantly impact the traffic of the target projects and for which project plans and donors are clearly identified are included.	
2050	All projects above	All of the above-mentioned projects are reflected	

*The details are described in the Appendix

The results of the traffic demand forecasts for year 2035 and 2050 are shown below. In all sections, the traffic volume in with-the-high-priority-project case exceeds the traffic volume in without-the-high-priority-project case.

Table 7.2-8 Future Traffic Volume by Case on NR1 and the Mekong River Bridge

Year	Future Traffic Volume (PCU/day)		
	High-Priority Project	Without Case	With Case
2035	Project 1 (NR1)	56,600	62,700
	Project 2 (NR1)	39,000	66,600
	Project 3 (NR1)	25,300	30,900
	Project 4 (The Mekong River Bridge)	---	77,700
2050	Project 1 (NR1)	66,900	76,000
	Project 2 (NR1)	45,100	87,400
	Project 3 (NR1)	30,900	38,200
	Project 4 (The Mekong River Bridge)	---	113,500

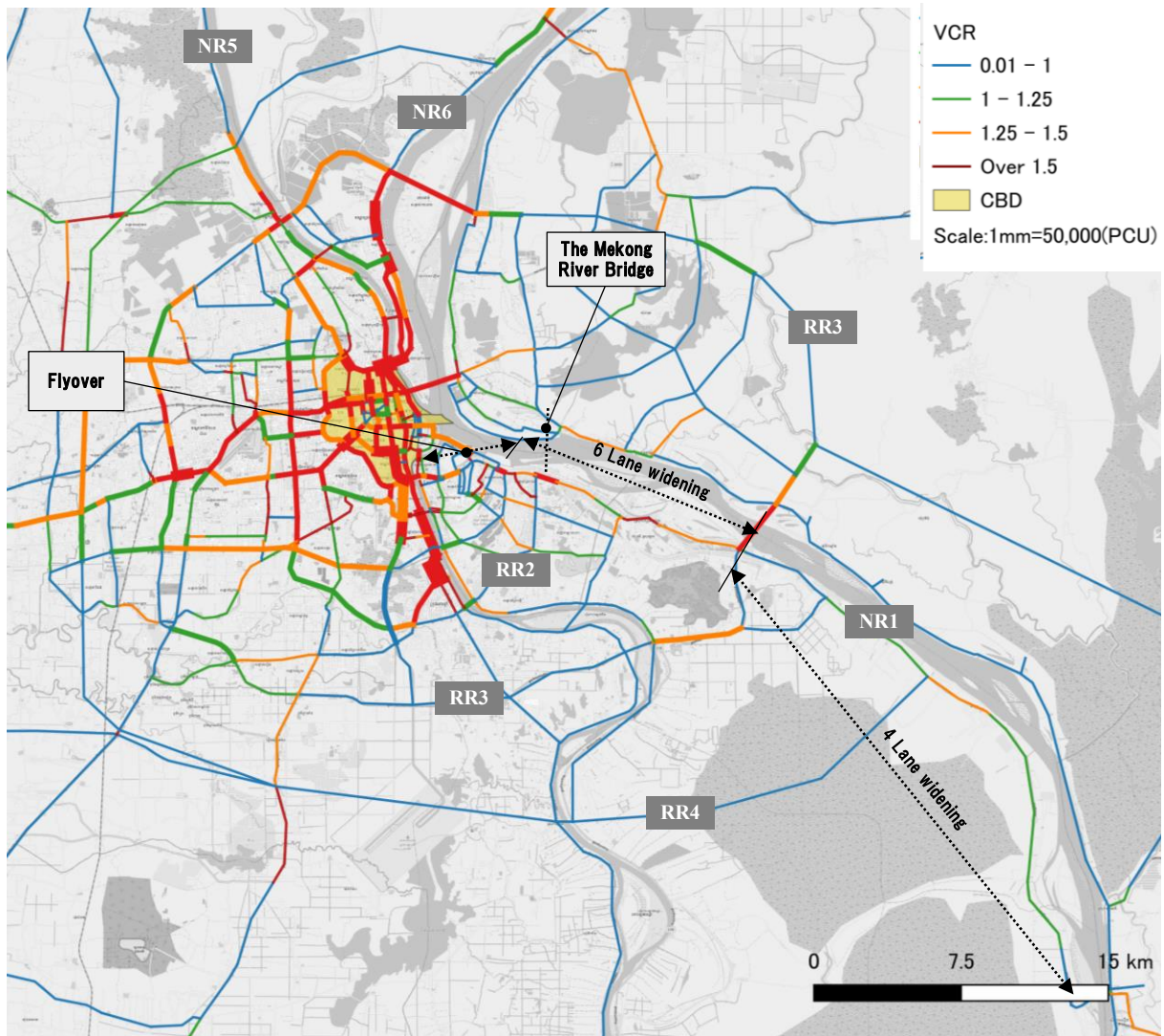


Figure 7.2-3 The Result of the Future Traffic Demand Forecast in 2035 (Without Case)

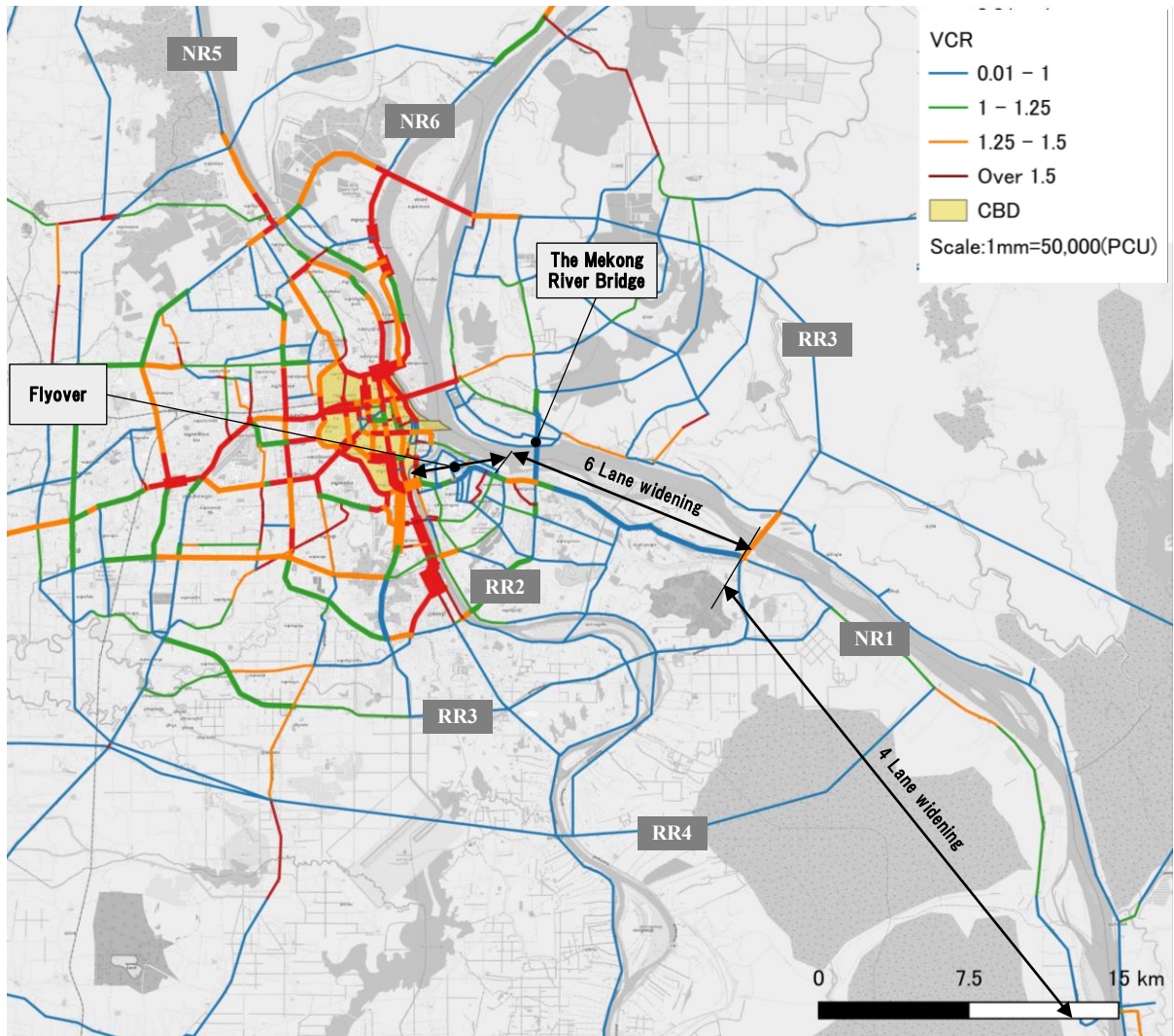


Figure 7.2-4 The Result of the Future Traffic Demand Forecast in 2035 (With Case)

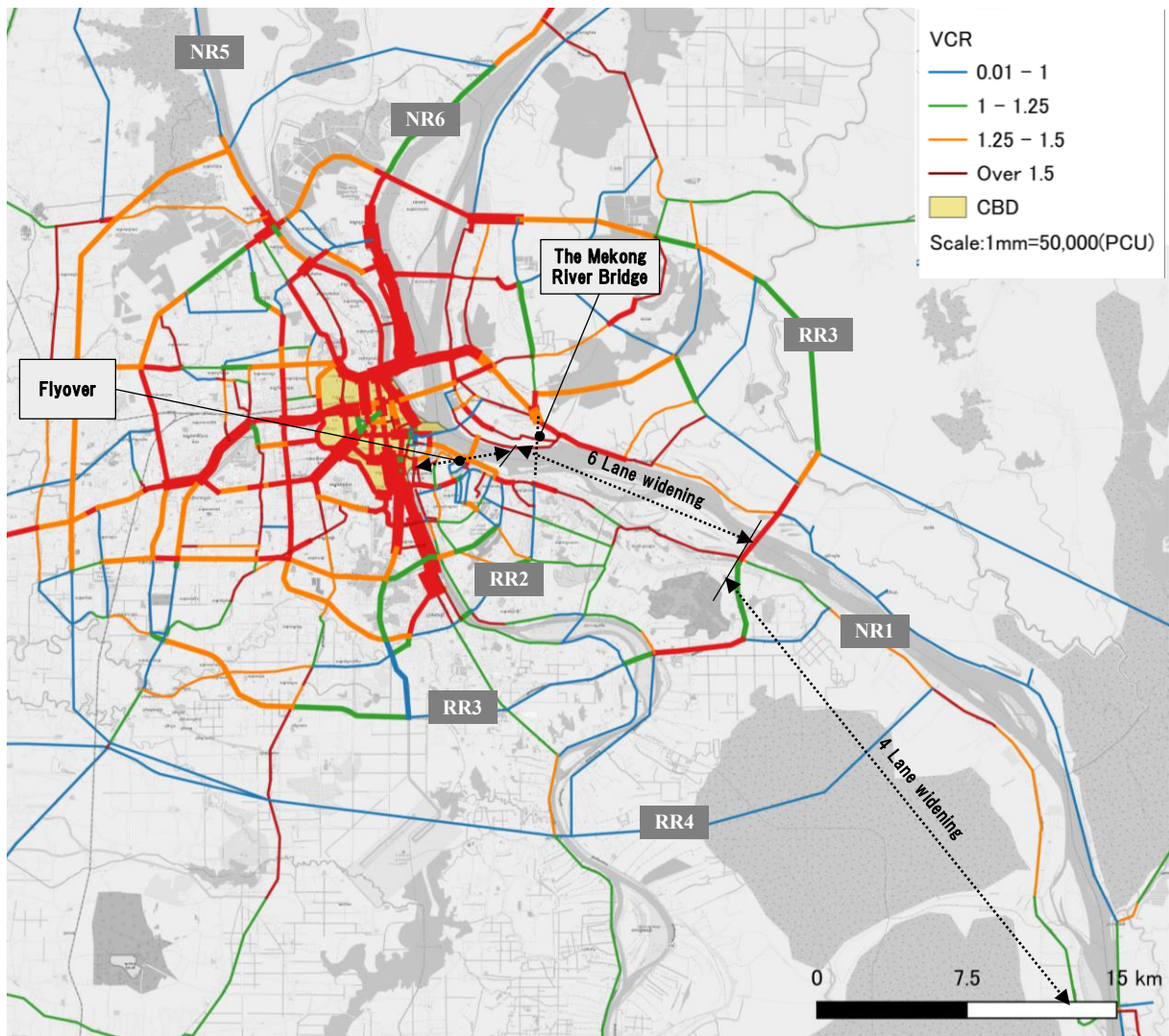


Figure 7.2-5 The Result of the Future Traffic Demand Forecast in 2050 (Without Case)

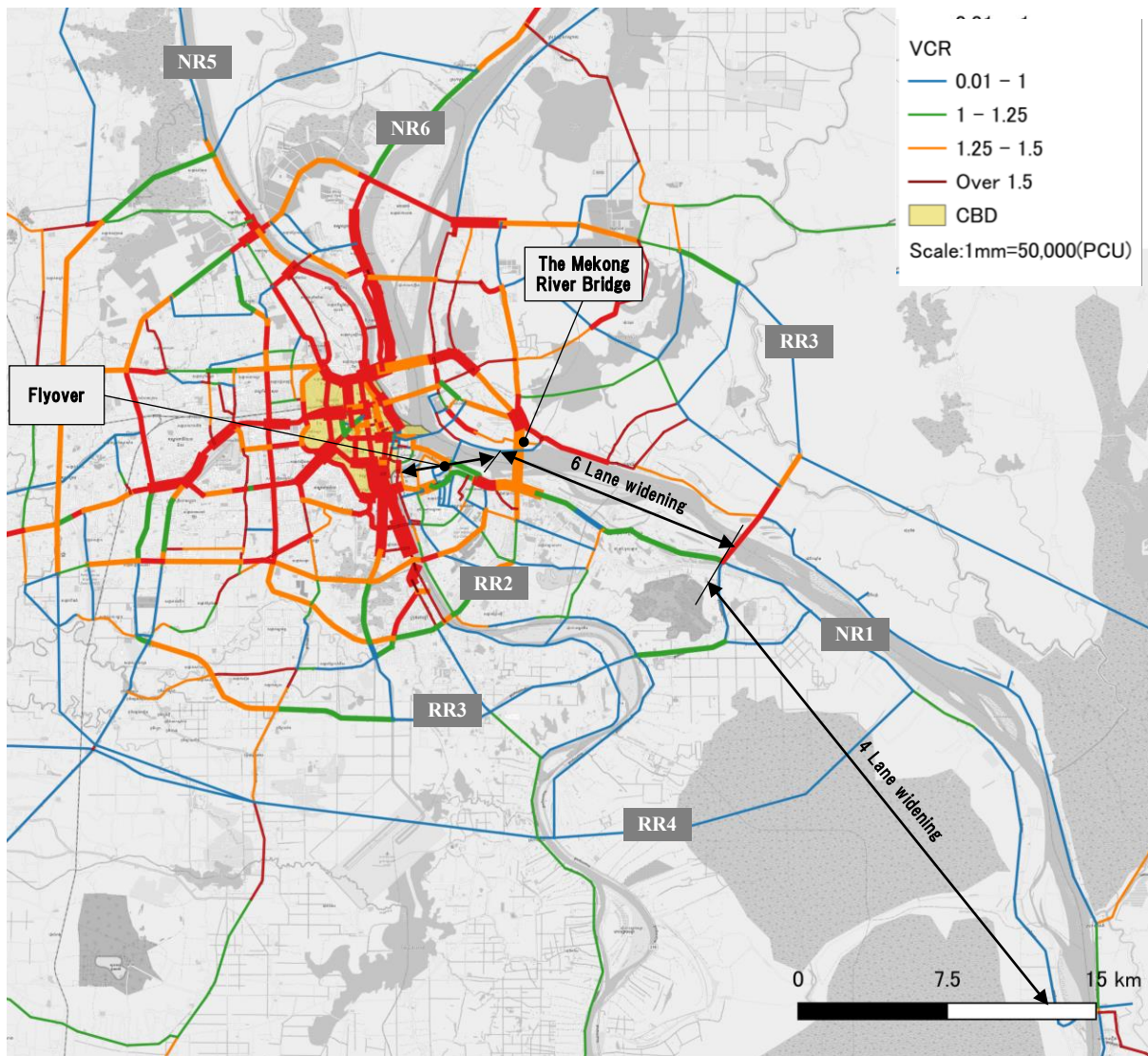


Figure 7.2-6 The Result of the Future Traffic Demand Forecast in 2050 (With Case)

(2) Effect of the High-Priority Project

The implementation of the high-priority project is expected to yield the following effects.

1) Smooth Traffic Flow in the Southern Economic Corridor

The improvements to NR1 are anticipated to expand traffic capacity and alleviate congestion. When the high-priority project is implemented, the average Volume/Capacity Ratio (VCR) on NR1 is expected to be approximately 1.0, resulting in a situation where smooth traffic flow is able to be maintained at all times. In 2050, an increase in traffic volume is anticipated, leading to a higher average VCR than in 2035; however, all sections are expected to remain below 1.25, thereby reducing the occurrence of continuous traffic congestion during off-peak hours.

Additionally, the travel time from Monivong Bridge to Tsubasa Bridge is considered to be reduced by approximately 15 minutes by 2035 and about 18 minutes by 2050 compared to the “without case”. As NR1 improves access to the city center of Phnom Penh, further acceleration of urban development along the NR1 is expected. Thus, the implementation of the high-priority project will enhance the efficiency of the Southern Economic Corridor, improving the convenience for daily life and industrial activities.

Table 7.2-9 Future Average VCR on NR1 and the Mekong River Bridge

Year	High-Priority Project	Without Case	With Case
2035	Project 1 (NR1)	1.18	1.01
	Project 2 (NR1)	1.44	0.92
	Project 3 (NR1)	1.05	0.74
	Project 4 (The Mekong River Bridge)	---	0.96
2050	Project 1 (NR1)	1.39	1.25
	Project 2 (NR1)	1.67	1.21
	Project 3 (NR1)	1.29	0.91
	Project 4 (The Mekong River Bridge)	---	1.40

Table 7.2-10 Future Travel Time from Monivong Bridge to Tsubasa Bridge

Year	Without Case	With Case
2035	89.5 min	74.7 min
2050	99.9 min	81.7 min

2) Mitigation of Through-Traffic into the City Center of Phnom Penh

The implementation of the high-priority project will enable traffic to bypass the city center of Phnom Penh. The Mekong River Bridge will function as a ring road for the city center area, allowing some of the traffic that starts and ends in the suburban areas to utilize this ring road.

In both 2035 and 2050, it is anticipated that the total traffic volume of “with case” on the southern screen line of the city center of Phnom Penh, which is shown on the Chapter 3, will decrease by approximately 10% compared to the total traffic volume of “without case”, contributing to the alleviation of traffic congestion in the city center.

Table 7.2-11 Future Traffic Volume and VCR on the Southern Screen Line of the City Center of Phnom Penh

Year	Item	Without-Case	With Case
2035	Total Traffic Volume on the Screen Line (PCU/day)	347,900	313,400
	VCR of the Screen Line	1.27	1.14
2050	Total Traffic Volume on the Screen Line (PCU/day)	414,600	374,300
	VCR of the Screen Line	1.51	1.37

3) Alleviation of Traffic Congestion on the Mekong River Crossing

The implementation of the high priority project will disperse traffic crossing the Mekong River, alleviating congestion at the Mekong River crossing. In 2035, the VCR on the Mekong River crossing is expected to be 1.27 in “with case”, compared to 1.51 in “without case”, indicating a reduction in chronic traffic congestion.

In 2050, although the total traffic volume on the Mekong River crossing is projected to increase to about 1.3 times that of the “without case”, the VCR is expected to decrease to 1.43, lower than that of “without case” of 1.48. However, the VCR for the Mekong River Bridge included in the priority project in 2050 is projected to be 1.40, indicating a high likelihood of continuous traffic congestion beyond peak hours. Therefore, efforts to promote the use of public transportation will be necessary to reduce reliance on private vehicles.

Table 7.2-12 Future Traffic Volume and VCR on the Mekong River Crossing

Year	Item		Without Case	With Case
2035	Total of the Mekong River Crossing	Traffic Volume	274,900	334,900
		VCR	1.51	1.27
	The Mekong River Bridge	Traffic Volume	---	77,700
		VCR	---	0.96
2050	Total of the Mekong River Crossing	Traffic Volume	389,100	493,300
		VCR	1.48	1.43
	The Mekong River Bridge	Traffic Volume	---	113,500
		VCR	---	1.40

4) Improvement of Accessibility to Akreiy Ksatr City and Promotion of Urbanization

It is anticipated that access from the urban area in the southern part of Phnom Penh to Akreiy Ksatr City will improve. For example, in “with case” in 2035, the travel time from Ta Khmau City to Akreiy Ksatr City is expected to be reduced by approximately 10 minutes, comparing to “Without case”. By improving access to Akreiy Ksatr City at an early stage, the implementation of the high priority project is also expected to contribute to the promotion of urbanization in Akreiy Ksatr City.

Furthermore, in 2050, a tunnel connecting the central urban area of Phnom Penh and Akreiy Ksatr City is scheduled to be put into operation. While the shortest route between Ta Khmau City and Akreiy Ksatr City will remain unchanged, the alleviation of congestion in the city center of Phnom Penh is expected to result in shorter travel time in “with case” than “without case”.

Table 7.2-13 Travel Time between Ta Khmau City to Akreiy Ksatr City by Case

Year	Without Case	With Case
2035	61.3 min	49.4 min
2050	57.3 min	56.1 min

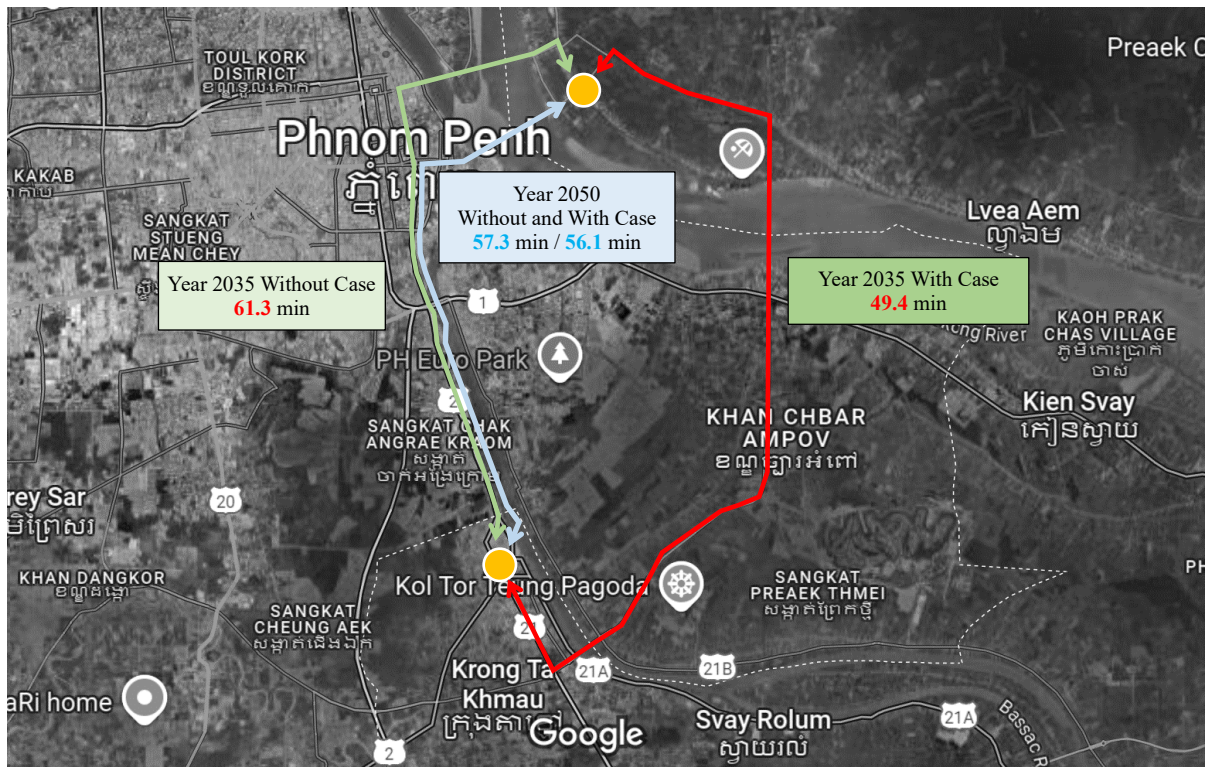


Figure 7.2-7 The Shortest Route between Ta Khmau City to Akreiy Ksatr City by Case

(3) Economic Analysis

The table below shows EIRR of the priority project package using the methodology shown in 5.2.2. EIRR is 29.1% and the project is efficient.

Table 7.2-14 Economic Analysis of Priority Project Package

Sections	Year 2035 (Million USD)			Year 2050 (Million USD)			EIRR
	VOC	TTC	Total	VOC	TTC	Total	
Priority Project Package	116.3	339.4	455.6	179.9	618.3	798.2	29.1%

(4) Operational/Effectiveness Indicator

The operational/effectiveness indicators were calculated two years after the development of the project package (2034). The results of the operational/effectiveness indicator calculations are shown below.

1) Annual Average Daily Traffic

Annual average daily traffic by location in 2034 is shown below.

Table 7.2-15 Operational/Effectiveness Indicator (Annual Average Daily Traffic)

Operational / Effective Indicator		Base Year (2024)	Target Year (2034) 2 years after the operation
Annual Average Daily Traffic Volume (PCU / day)	Nirouth Pagoda Intersection	61,600	84,500
	Korki Market	29,900	58,800
	Phnom Penh Autonomous Port	33,800	31,200
	The Mekong River Bridge	---	76,100

2) Travel Time from Monivong Bridge to Tsubasa Bridge

The travel time from Monivong Bridge to Tsubasa Bridge in 2034 is shown below.

Table 7.2-16 Operational/Effectiveness Indicator (NR1 Travel Time)

Operational / Effectiveness Indicator	Base Year (2024)	Target Year (2034) 2 years after the operation
Travel Time From Monivong Bridge to Tsubasa Bridge	103 min	75 min

3) Phnom Penh City Center Travel Time

The following table shows the travel times from NR1- RR2 intersection to NR5 in 2034 with and without the ODA loan package.

Table 7.2-17 Operational/Effectiveness Indicator (travel time From NR1-RR2 Intersection to NR5)

Item		The Mekong River Bridge	
		Without	With
NR1	Without	<u>52 min (Via NR1)</u> Not Connected (Via Akreiy Ksatr City)	<u>40 min (Via NR1 Route)</u> <u>18 min (Via Akreiy Ksatr City)</u>
	With	<u>43 min (NR1 Route)</u> Not Connected (Via Akreiy Ksatr City)	<u>34 min (NR1 Route)</u> <u>17min (Via Akreiy Ksatr City)</u>

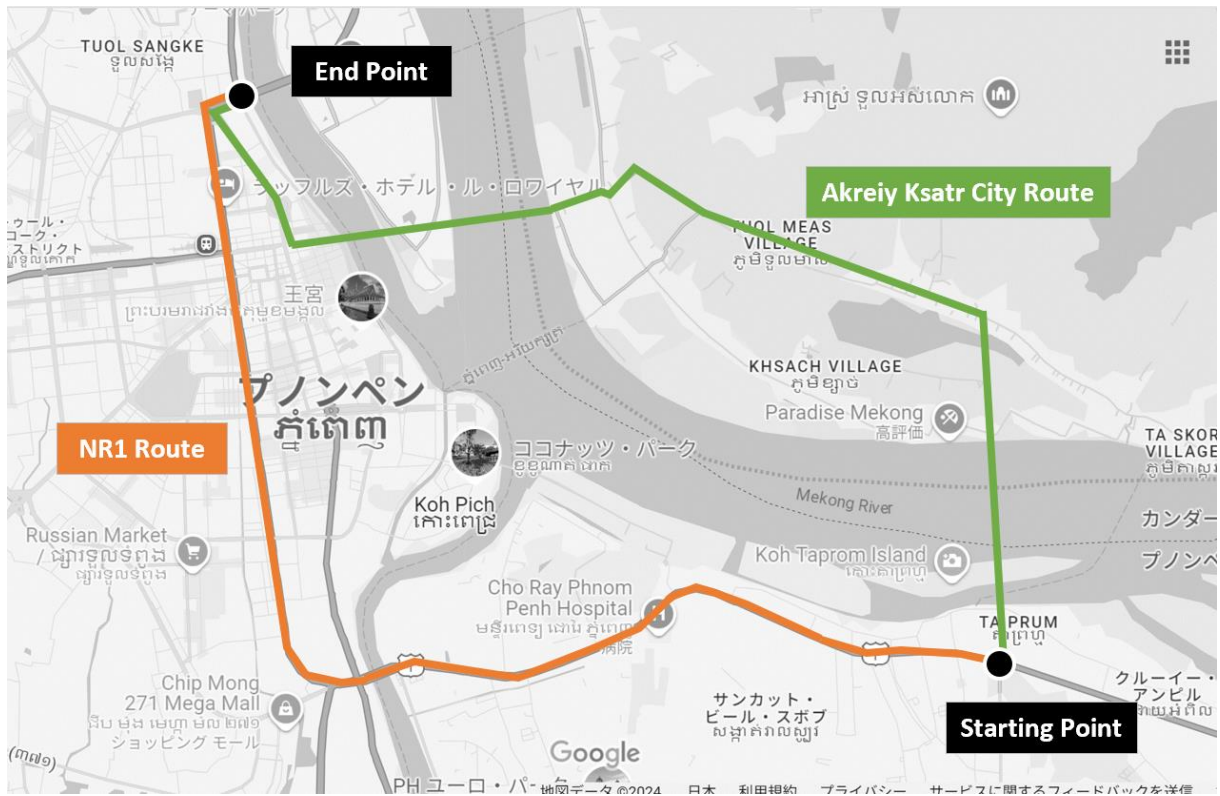


Figure 7.2-8 The Route via NR1 and via Akreiy Ksatr City

7.3 Information Gathering on Potential ODA Loan Projects

7.3.1 Procurement Plan

(1) Project Implementation Schedule

The following table shows the project implementation schedule for this project.

Table 7.3-1 Project Implementation Schedule

Item \ Year	2025	2026	2027	2028	2029	2030	2031	2032	2033
Feasibility study	■								
Detail design		■							
Bidding			■						
Land acquisition			■						
Construction									Defect inspection
Mekong River Bridge				■	■	■	■	■	■
NR 1 Flyover				■	■	■	■	■	■
NR1 Widening (6 lanes)				■	■	■	■	■	■
NR1 Widening (4 lanes)				■	■	■	■	■	■

Note) The consultant selection period for Detail Design needs to be taken into account when considering the schedule in detail.

(2) Selection Method for Consulting Services

The consulting services shall be of the following three types.

- 1) Detailed design (including preparation of bid documents)
- 2) Bidding assistance
- 3) Construction supervision

The following two types of orders/contracts for consulting services are assumed.

Case 1: Lump-sum order (all services from detailed design to construction supervision are ordered together)

Case 2: Separate order (detailed design (D.D.) and construction supervision (C.S.) are ordered separately)

D.D.: Detailed design (including preparation of bid documents)

C.S.: Construction supervision (including bidding assistance)

In the lump-sum ordering method, since the detailed design consultant and the construction supervision consultant are the same, the basic concept at the time of design is smoothly reflected in the construction supervision.

On the other hand, in the separate order method, the detailed design and construction supervision may be performed by different consultants, requiring a period of time for the construction supervision consultant to review the results of the detailed design. In addition, the selection of a consultant would have to be done twice, which would extend the project implementation schedule.

Cambodia has experience in both cases in the past projects.

- National Road No.5 Improvement Project: MPWT (Employer) adopted Case 2 (Separate order)
- Rural Road Connectivity Improvement Project: MRD (Employer) adopted Case 1 (Lump-sum order)

Since the Cambodian side wants the project to be completed as soon as possible, the lump-sum

order method is advantageous because it shortens the time until the start of construction, and the concept at the time of detailed design can be smoothly reflected in the construction supervision. Since this is a challenging construction project that includes a cable-stayed bridge with a large diameter, it is preferable to procure experienced consultants through international bidding instead of placing local orders for consultant services.

7.3.2 Implementation System and Operation and Maintenance System

(1) Maintenance management system

1) Roads and Bridges

The maintenance management system for roads and bridges is defined by the Law on Maintenance Management, and is implemented, supervised, and inspected by the organizations in charge as shown in Table 7.3-2 below.

Table 7.3-2 Roles of Department concerned

		Execution: General Department of Public Works	Planning/Supervising: General Department of Technique	Inspection: General Inspectorate
Chapter 21 <i>(New Construction, Reconstruction)</i>		DERR/DRRM DPWT/RCAF Private company	RID DPI DTPWT	PEAC /GI
Chapter 61	Routine	DPWT	RID	
	Periodic	DPWT/DERR/DRRM/ RCAF	RID/DPI/DIPWT	
	Emergency	Case by Case	RID	
Roles in design stage		<ol style="list-style-type: none"> 1. -Preparation of Basic Design 2. -Preparation of Preliminary Cost Estimate for Construction 3. -Preparation of Detailed Design 4. -Preparation of Cost Estimate for Construction 	<ol style="list-style-type: none"> 1. -Checking Basic Design 2. -Preparation of Preliminary Cost Estimate for Supervision 3. -Check and Sum of Preliminary Project Cost 4. -Checking Detailed Design 5. -Preparation of Cost Estimate for Supervision 6. -Check and Sum of Project Cost 	

Note :

- DERR : Department of Equipment and Roads Rehabilitation
- DRRM : Department of Roads, Repair and Maintenance
- RID : Road Infrastructure Department
- DPI : Department of Public Infrastructure
- DTPWT : Department of Technical Public Works and Transport
- DPWT : Provincial Department of Public Works and Transport
- RCAF : Royal Cambodian Army Force
- PEAC : Procurement Evaluation Award Committee
- GI : General Inspectorate

2) Long span bridges

The maintenance of long-span bridges is paid for from Chapter 61 of the Cambodian national budget and is divided into two categories: routine periodic maintenance and maintenance at regular intervals. Implementation, supervision, and inspection are handled by RID.

(2) Budget for maintenance

The actual maintenance and management of road bridges is carried out jointly by private companies

and the maintenance department under the MPWT. As shown in the table in the previous section, the MPWT budget is divided into two categories, with expenditures coming from Chapter 21 for new construction and rehabilitation and Chapter 61 for maintenance and management. The table below shows the evolution of the budget for road maintenance (Chapter 21) and maintenance (Chapter 61) in recent years.

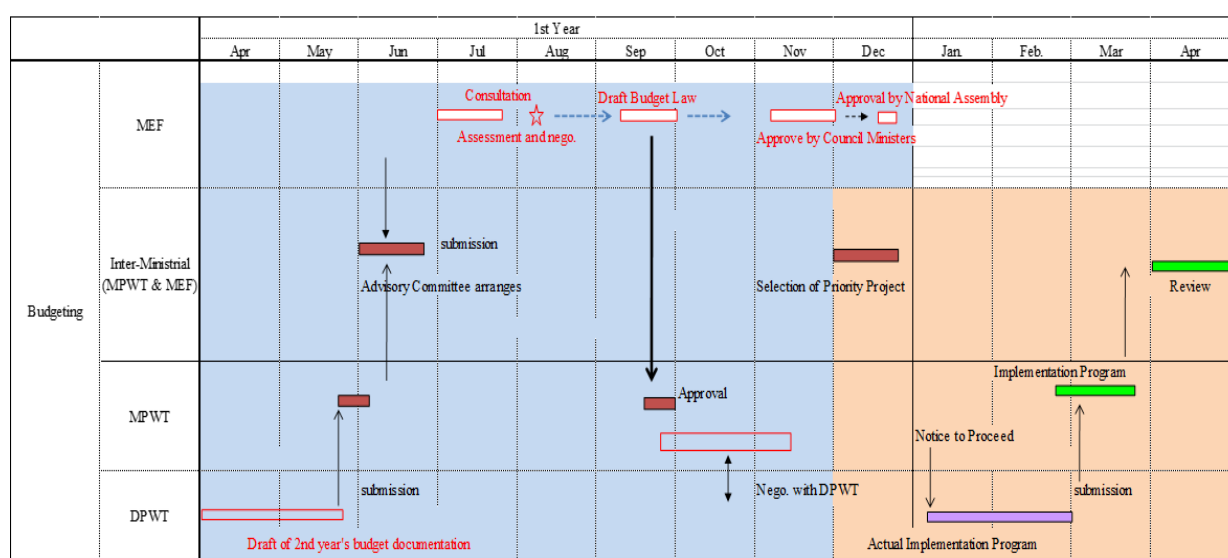
In 2022 and 2023, when COVID-19 compliance was required, the budget for road maintenance was reduced, but the budget for maintenance was maintained.

According to MPWT/RID, the maintenance budget is expected to gradually increase in allocation in the future as the improvement projects of single-digit and two-digit national roads progress.

Table 7.3-3 Transition of National Budget for Maintenance

No	Description	2018	2019	2020	2021	2022	2023
1	Chapter 21	155	131	244	278	106	116
2	Chapter 61	74	74	77	76	76	79
3	Total	229	205	321	354	182	195

million USD



Source : MPWT Annual Report and RID Deputy Director

Figure 7.3-1 National Budget Flow for Road Maintenance

Table 7.3-4 Transition of National Budget for Mega Bridge Maintenance

No	Description	2017	2018	2019	2020	2021	2022	2023	2024
1	Chapter 61	0.36	0.58	1.08	0.81	1.69	1.69	1.87	2.18
2	Total	0.36	0.58	1.08	0.81	1.69	1.69	1.87	2.18

million USD

7.3.3 Risk Assessment

Identify risks that may occur during each phase of the project and assess the impact of those risks on the project and the probability of their occurrence.

(1) Risk matrix

Risks	Preparatory survey		Detailed Design		Contractor Bidding		Construction	
	Impact	Probability	Impact	Probability	Impact	Probability	Impact	Probability

Delay in building consensus on project details	High	Med	High	Med	Med	Low	Low	Low
Increase in project costs	Med	Med	High	Med	High	High	High	High
Delays in resettlement and land acquisition	Low	Med	High	Med	High	Med	High	Med
Difficulty in securing borrow pits for embankment	Low	Med	High	Med	Med	Med	Med	Med
Delayed approval of urban plan/land use plan for AKC	High	Low	High	Med	Med	Low	Low	Low
Large-scale climate change	Low	Low	Med	Low	High	Med	High	Med
Impact of mines and unexploded ordnance	Med	Med	Med	Med	High	Med	High	Med
Complexity of traffic turnaround during construction and worsening of traffic congestion due to lane restrictions during construction.	Low	Low	Med	Low	High	Med	High	High
Lack of contractor's resources	Low	Low	Med	Low	High	Med	High	High

(2) Countermeasures

1) Delay in building consensus on project details

- **Preparatory survey:** Hold workshops and meetings involving stakeholders at an early stage to deepen common understanding.
- **Detailed Design:** Regular meetings are held to share the progress of the project and reflect opinions in the design process.
- **Contractor Bidding:** Clarify the agreement and reflect it in the overall schedule to avoid delays in consensus building.
- **Construction:** Ensure that an agreement has been reached, and check regularly to prevent problems from occurring.

2) Increase in project costs

- **Preparatory survey:** Set a flexible budget that anticipates cost risk.
- **Detailed Design:** Conduct market surveys and incorporate the latest price trends into the design.
- **Contractor Bidding:** Selecting the right contractor by thoroughly controlling costs at the time of bidding.
- **Construction:** Thoroughly manage the budget and minimize additional costs.

3) Delays in resettlement and land acquisition

- **Preparatory survey:** Communicate early with affected residents to clarify relocation plans.
 - **Detailed Design:** Detailed planning of site acquisition schedule and methods to minimize delays.
 - **Contractor Bidding:** Confirm that relocation and site acquisition are complete before proceeding with bidding.
 - **Construction:** Consult with all parties involved to resolve any outstanding issues as soon as possible.
- 4) **Difficulty in securing borrow pits for embankment**
- **Preparatory survey:** Select multiple candidate borrow pits and diversify risks.
 - **Detailed Design:** Conduct environmental impact assessment and determine appropriate borrow pits.
 - **Contractor Bidding:** Confirm the availability of the site and select a low-risk contractor.
 - **Construction:** Prepare alternative plans in the event that a borrow pit cannot be secured, and take action to avoid construction delays.
- 5) **Delayed approval of urban plan/land use plan for AKC**
- **Preparatory survey:** Coordinate with relevant agencies at an early stage to confirm the approval process of the urban plan.
 - **Detailed Design:** Minimize the risk of approval delays by proceeding with the design in accordance with the urban plan.
 - **Contractor Bidding:** Bidding is done after confirming that approvals have been obtained.
 - **Construction:** Develop a coordination plan in case of approval delays.
- 6) **Large-scale climate change**
- **Preparatory survey:** Predict impacts of climate change and incorporate into risk assessments.
 - **Detailed Design:** Adopt climate resilient design to mitigate risks.
 - **Contractor Bidding:** Prepare specifications that include measures to prepare for climate change during construction.
 - **Construction:** Prepare contingency plans for extreme weather events during construction.
- 7) **Impact of mines and unexploded ordnance**
- **Preparatory survey:** Survey the area for possible mines and UXOs and assess the risk.
 - **Detailed Design:** Plan necessary removal operations and prioritize safety assurance.
 - **Contractor Bidding:** After confirming safety, select an appropriate contractor.
 - **Construction:** Manage the removal work to ensure that it is performed properly and does not interfere with construction.
- 8) **Complexity of traffic turnaround during construction and worsening of traffic congestion due to lane restrictions during construction.**
- **Preparatory survey:** Preliminary assessment of traffic impact due to construction and consideration of alternative routes.
 - **Detailed Design:** Detailed traffic control planning and design to minimize impacts.
 - **Contractor Bidding:** Select a contractor experienced in traffic management.
 - **Construction:** Real-time monitoring of congestion impacts and adjusting traffic control as needed.

7.4 Gathering Information to Contribute to the Planning of Surveys for Preparatory Survey

7.4.1 Changes in natural conditions around the Mekong River

It was confirmed that reclamation development is underway on the north bank side of the river at the proposed location of the Mekong Bridge. After the reclamation development is completed, it is assumed that the north bank of the river will be protected and will not be eroded. Satellite images of the south bank of the river (NR1 side) were taken around 1985, in February 2020, and in July 2023, and a comparison of these images showed that the waterline was not receding, but rather was advancing toward the waterway. The above results indicate that the river channel is not likely to change significantly at the bridge location, and even if the river channel changes slightly, there will be no significant impact on the size of the bridge. The location and shape of the sandbar has changed over time and is expected to change in the future. In addition, it is necessary to continuously confirm the possibility of further artificial changes to the waterline due to reclamation/soil extraction, etc.

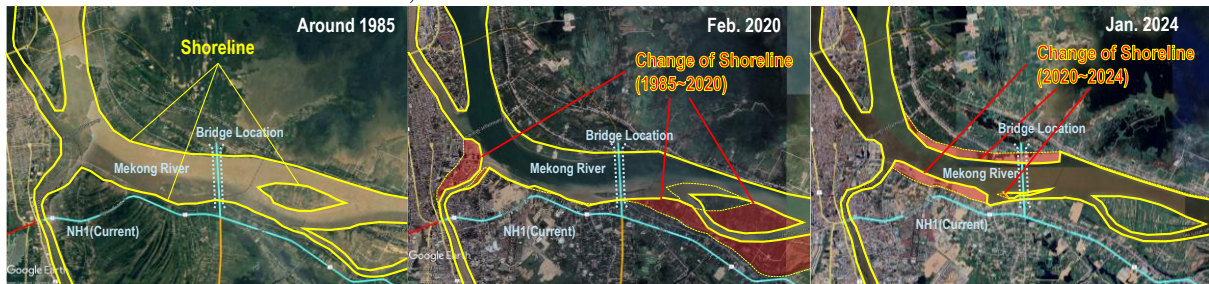


Figure 7.4-1 Changes in the Waterfront around the Mekong River Bridge Location

7.4.2 Conditions Required for Outline Design

(1) Design of Navigational Clearance

In the design on Mekong River Bridge, one main navigational channel for 3,000DWT vessels and two sub navigational channels for local coasters are considered in the planning, to take into account the navigational situation such as frequent vessel traffic at the site.

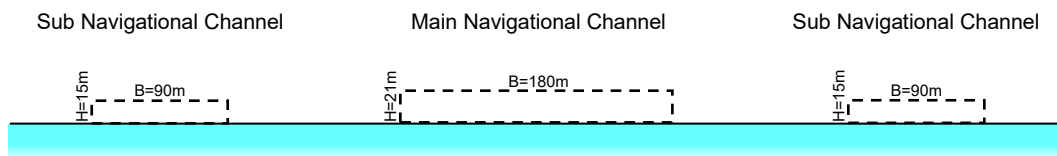


Figure 7.4-2 Navigational Clearance for the Mekong River Bridge

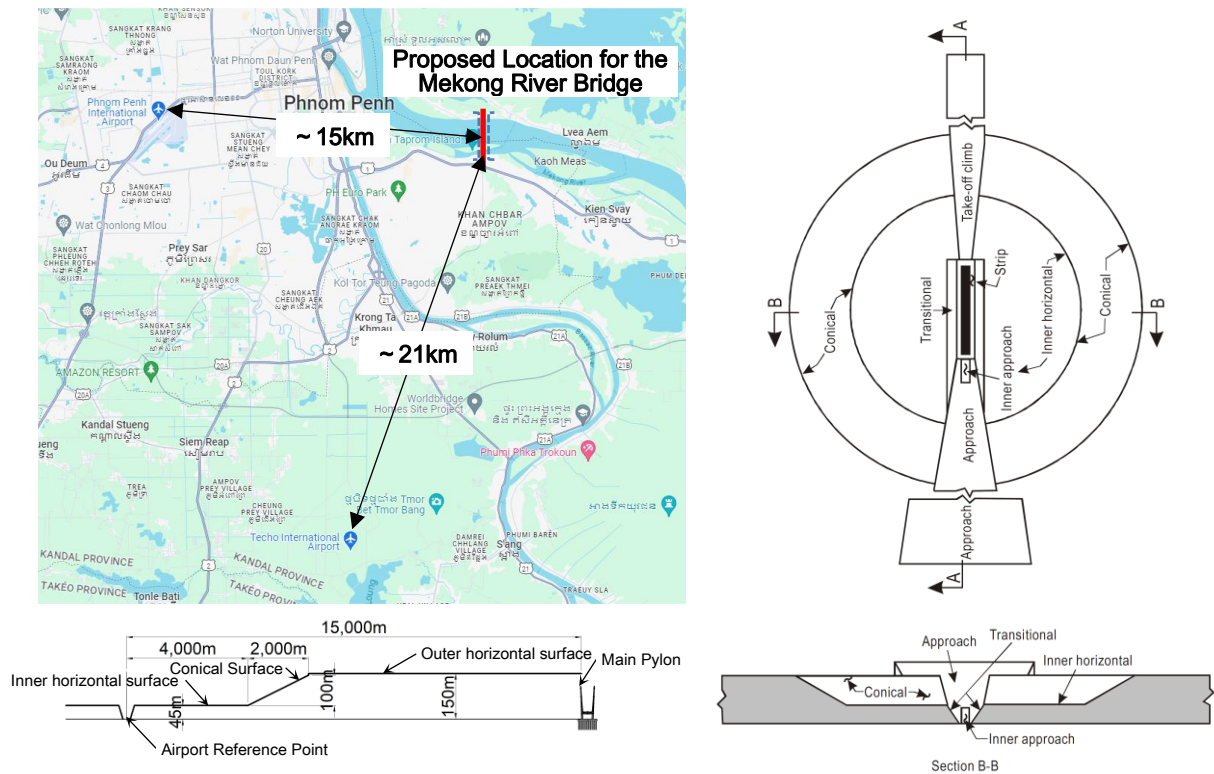
(2) Height restrictions at nearby airports

Regarding the height restrictions for aircraft takeoff and landing at the existing Phnom Penh International Airport and the new Takhmao Techo International Airport currently under construction, the relationship is confirmed between the distance from the airport to the Mekong River Bridge and the corresponding height of the obstacle limitation surfaces.

- Distance from New Takhmao Techo International Airport to the Mekong River Bridge is 21km.
- Distance from Existing Phnom Penh International Airport to the Mekong River Bridge is 15km.

Assuming a distance of 15 km from the Airport Reference Point, the minimum restricted surface height at the bridge location can be assumed to be 150 m (Outer Horizontal Surface).

The maximum height of the structure is 110-120 m above the ground surface (water surface) for the currently assumed bridge size and type for the Mekong River Bridge, so there should be no problem related to height restrictions associated with the nearby airport.



Source: JICA Survey Team (based on ICAO Annex 14 Vol. I [Aerodromes] and ICAO Airport Services Manual Part 6 [Control of Obstacles])

Figure 7.4-3 Obstacle Limitation Surfaces to the Two Phnom Penh Airports

(3) Scouring of bridge foundations and riverbank erosion

MPWT informed that the Prek Kdam Bridge over the Tonle Sap River on the upstream side of Phnom Penh has some erosion on the riverbank. However, MPWT recognized that this is not a major problem, and there were no particular cases of scouring around bridge foundations being a problem on other bridges. In the preparatory survey, it is necessary to reconfirm whether there are any cases of scouring or erosion problems around bridge foundations, especially for bridges crossing the Mekong River, and if necessary, to set the scour depth to be considered in the design of bridges over the Mekong River, which should be reflected in the design of foundation works.



Figure 7.4-4 Condition of River Bank around Prek Kdam Bridge

(4) UXO Detection and Removal

Regarding detection and removal of UXO (Unexploded Ordinance), the JICA survey team confirmed

the following to the MPWT.

- UXO detection and removal in the project site is the responsibility of the Cambodian side.
- The actual detection and removal will be carried out by CMAC (Cambodian Mine Action Centre).
- The detection and removal will be carried out in the detailed design phase.
- The implementation budget will be invoiced by MPWT to MEF (Ministry of Economy and Finance) and paid to CMAC.

The survey / investigation and clearance of UXO is also stipulated in the JICA Standard Safety Specification (JSSS), which will be incorporated as part of the construction contract documents, as an item to be borne by the counterpart government. In the preparatory survey, it is necessary to formally reconfirm the above to the Cambodian side and establish it as one of the prerequisites for the contractor's bid.

(5) Wind speed and other natural conditions

The following is the types of meteorological data available from the Department of Meteorology (DOM) of the Ministry of Water Resources and Meteorology (MOWRAM) for meteorological conditions.

- The data that DOM can provide are rainfall, humidity, wind speed, wind direction, and temperature.
- Wind speed is measured both manually (4 times/day, daily) and automatically (hourly).
- Wind speed data are available for purchase through the year 2020.

In the preparatory survey, these detailed data will be obtained and reflected as one of the design conditions.

(6) Traffic Safety Measures

1) Installation of Median Opening



Figure 7.4-5 Location Map of Important Facilities along NR1

In the vicinity of important facilities along NR1, consideration should be given to pedestrian crossings and traffic vehicles entering and exiting the facilities.

The locations of important facilities (schools, hospitals, and urban areas) along NR1 are shown in Figure 7.4-5(see Chapter 2, 2.1.3 for details). Appropriate safety measures should be taken near these locations, especially by installing median openings and pedestrian crossings.

In addition, standards for the installation of openings are defined in the “Standard Drawing of Median Opening of 4-Lane Carriageway 2022”.

With the widening of NR1, additional time will be required for crossing. Therefore, when installing traffic signals, careful consideration should be given to setting the green light duration. In areas with high pedestrian traffic, appropriate crossing facilities, such as pedestrian overpasses, should be considered. However, for pedestrian overpasses, careful judgment is essential in the installation process, as users may often choose to jaywalk rather than use stairs, making the addition of anti-crossing barriers advisable.

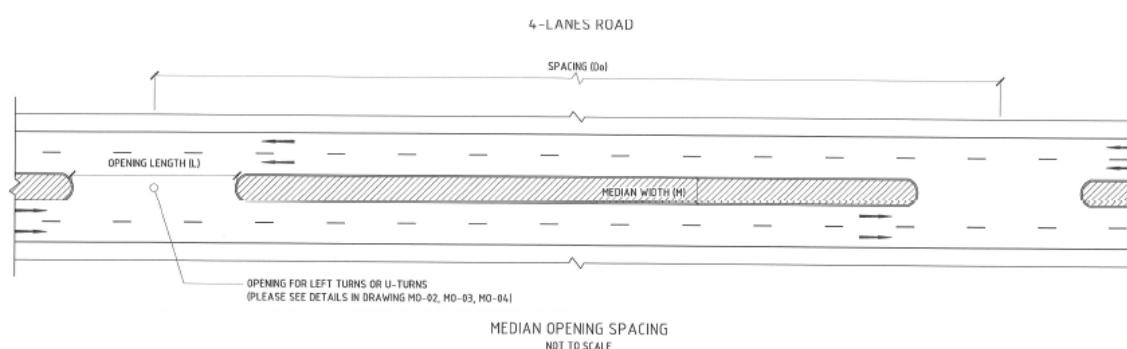


Table 7.4-1 Median Opening Interval

RURAL		URBAN	
STANDARD	EMERGENCY	STANDARD	EMERGENCY
2,000m	600m	1,000m	300m

Table 7.4-2 Minimum Median Opening for Turning Left

WIDTH OF MEDIAN (m)	MINIMUM LENGTH OF MEDIAN OPENING (m)	
	Designed Vehicle SU	Designed Vehicle WB-19
1.00-2.00	30.00	45.00
2.00-5.00	29.00	44.00
5.00-10.00	25.00	41.00
10.00-12.00	21.00	36.00
12.00	18.00	34.00

2) Collaboration with Project for Improvement of Road Traffic Safety

The “Project for Improvement of Road Traffic Safety on Trunk Roads in Cambodia” which has been implemented since 2020 with JICA's technical assistance under a loan agreement, is a project that verified traffic safety measures on National Highway No. 5, strengthened the organizational structure and human resource development related to traffic safety measures, and promoted educational activities. The traffic safety measures to be introduced on the trunk roads in Cambodia, which are derived from this project, should also be reflected on NR1. Table 7.4-3 shows the details of traffic safety facilities recommended by the project team for improvement of road traffic safety on trunk roads in Cambodia.

Table 7.4-3 Suggestions from Project for Improvement of Road Traffic Safety

Traffic Safety Facilities	Suggestion
Installation of traffic signals at intersections	Most traffic accidents occur at intersections without signals. Signals need to be installed.
Reduction of speed of vehicles entering the intersection	Because of the high speed of vehicles entering the intersection, traffic control needs to be strengthened and speed signs need to be installed.
Installation of median openings (U-turns)	When medians are located near schools, markets, facilities, etc., drivers who want to enter the opposite lane will drive in the opposite direction. This leads to more sidewalk driving by vehicles and dangerous road crossings by pedestrians.
Installation of sidewalks and side roads	Although there are not many pedestrians on NR5, it is important to install sidewalks and side streets to control access.

7.5 Recommendations and Issues

Based on the information obtained from the survey, the following is a list of important issues and discussion points that should be taken into account when considering how future surveys should be developed to contribute to the enhancement of connectivity in the Southern Economic Corridor.

(1) Detail Study on the Design

In the preparatory survey, a detailed study on the design is required to assess technical feasibility. In particular, the following points need to be confirmed regarding construction (design and construction of roads and bridges) in the selected project.

- ✓ Implementation of geotechnical survey: A detailed survey on the strength and stability of the ground required for embankment and bridge construction should be conducted.
- ✓ Securing borrow pits and environmental impact assessment: A study on the selection of borrow pits as a source of fill material should be conducted, and the plan should take environmental impact into consideration.
- ✓ Since some sections of NR1 function as an embankment road for the Mekong River, it is necessary to set up the longitudinal section considering the case where future climate change will affect the water level of the Mekong River. Since the current NR1 is constructed with embankment and some settlement is observed over time, it is necessary to confirm the height of the current road and to raise it appropriately.

(2) Cost Estimation

In the preparatory survey, it is necessary to calculate the project cost more specifically than in this survey. The following factors should be taken into account in the calculation.

- ✓ Review of fluctuation factors of construction cost: It is required to set reserve cost flexibly, considering the impact of material cost, labor cost, and price escalation.
- ✓ Consideration of the portion to be shared by Cambodia: Costs related to resettlement and landmine survey and removal, which will be shared by Cambodia side, should be examined to reach an agreement with Cambodia side.

(3) Coordination with Other Projects in Progress

Currently, many projects are underway in the Phnom Penh area, and their contents are being updated on a daily basis. There is a great possibility that the contents confirmed during this survey will be changed or the maturity of the plan will be improved during the preparatory survey, so it is necessary to confirm and coordinate with the relevant organizations during the preparatory survey. The following is a list of projects that have been confirmed at this time.

- ✓ Cambodia-Korea Friendship Bridge: In the Cambodia-Korea Friendship Bridge project, three

roads are proposed to be constructed from the landing point of the bridge on AKC side to the north, east, and south. The east side of these roads may overlap with AKC side of the project (4), which was reviewed in this survey, so coordination with the relevant parties is necessary.

(4) Land Acquisition and Resettlement Issues

Detailed studies and discussions on land acquisition and resettlement should be proceeded with in the preparatory study. Based on information provided by Cambodian side that land acquisition along NR1 was completed when the current road was constructed, this survey assumes that land acquisition along NR1 is not necessary. On the other hand, new land acquisition is required for the development of RR2, and the cost of land acquisition was calculated in this survey based on satellite images and interviews on current land prices.

Since land acquisition and resettlement planning can have a significant impact on the overall project schedule, it is important to conduct more detailed surveys and confirm them during the preparatory study.

- ✓ Discussion with residents and compensation plan: When a project involves resettlement, it is necessary to establish clear guidelines for compensation and promote a process to reach agreement with residents at an early stage.

(5) Relevant Laws, Regulations and Urban Planning Approvals

In conducting the preparatory survey, it is necessary to confirm whether relevant urban plans and land use plans have been approved. In particular, since it is informed that the urban plan for land use in AKC will be approved during this fiscal year, it is necessary to coordinate ROW and the project plan during the preparatory survey, and adjust the plan accordingly.

- ✓ Confirmation of the progress of urban planning: The status of urban planning, land use planning, and land registration in the relevant area should be confirmed and reflected in the alignment plan of the Project.

(6) UXO Impact Surveys

A challenge specific to Cambodia is the possibility that mines and UXOs in the proposed construction site may hinder the progress of the project. Preparatory surveys need to collect detailed information on UXO surveys to ensure safe construction planning.

- ✓ Cooperation with specialized agencies: It is necessary to cooperate with the Cambodia side to collect information on the survey and removal of mines and UXOs, and to plan to ensure a safe construction environment.

(7) Environmental Impact Assessment (EIA)

The impact of infrastructure development on the environment must be assessed in advance, and necessary environmental protection measures must be taken. In particular, specific measures to minimize the impact on rivers and the surrounding natural environment need to be considered. Since there have been cases in which environmental and social considerations have taken a very long time in projects that Japan has supported, careful preparation is considered necessary in the preparatory survey.

- ✓ Use of experience from the Mekong River Bridge: Appropriate measures should be taken by utilizing the experience from the Tsubasa Bridge (the Mekong River Crossing Bridge), which was implemented as a Japanese grant project.
- ✓ River water level and flood countermeasures: Countermeasures against rising river water levels and flood risks due to climate change will be considered during design.

(8) Study of Land Use and Development Regulations

The widening of NR1 and the construction of a new bridge over the Mekong River are expected to increase the demand for land use along NR1 and in the connected areas, and thus there is a need to introduce planned land use and development regulations.

- ✓ Referring to the “district planning” system in Japan, a detailed master plan will be developed in cooperation with Phnom Penh and Kandal Provincial to determine the future vision, land use, uses, floor area ratio, building-to-land ratio, and urban facilities such as roads, parks, and green areas in the targeted areas.
- ✓ The project will examine ways to improve the effectiveness of development regulations and guidance based on the detailed master plan.
- ✓ The possibility of Japanese private companies participating in urban development and real estate development and contributing to the development of Cambodian cities through cooperation between the Japanese public and private sectors will be considered, and a roadmap for the implementation of urban development through public-private partnerships will also be examined.

(9) Securement of Local Workforce

It is necessary to confirm at the preparatory survey stage that enough resources for local subcontractors and engineers have been secured. It should be noted that the scale of the priority projects selected in this survey is very large and that lack of resources may affect the progress of the project if multiple construction projects are to be carried out at the same time.

- ✓ Coordination of human resources and equipment: It is necessary to plan the order of project implementation and the year of implementation after confirming local construction resources and setting up a package that allows multiple construction projects to proceed at the same time. In addition, when considering the order of implementation, it is important to give consideration to maximizing the impact of the project.

(10) Response to Comments from the Cambodian Side

Regarding the comments on traffic demand forecast by MEF, it is necessary to update the forecast after considering their reflection in the latest road network plans and examining the conversion rates to the Phnom Penh-Bavet Expressway.

Additionally, regarding another point raised by MEF about land acquisition and providing information to the General Department of Resettlement (GDR), GDR was involved during the kickoff discussions within this project and is informed about the projects. Care will be taken to provide information appropriately during the feasibility survey.

- ✓ Further detailed examinations will be conducted during the feasibility study concerning demand forecasts. During this process, discussions and agreements will be made with the Cambodian side regarding the future road network before proceeding.

Appendix

The Kingdom of Cambodia Data Collection Survey on the Road and Bridge Sector in the Southern Economic Corridor

Appendix Traffic Demand Forecast

February 2025

Japan International Cooperation Agency (JICA)

**Katahira & Engineers International
Chodai Co., Ltd.
URLinkage Co., Ltd**

Appendix Traffic Demand Forecast

1.1 Flow of Traffic Demand Forecast

The traffic demand forecast for NR1 was conducted to the following flow.

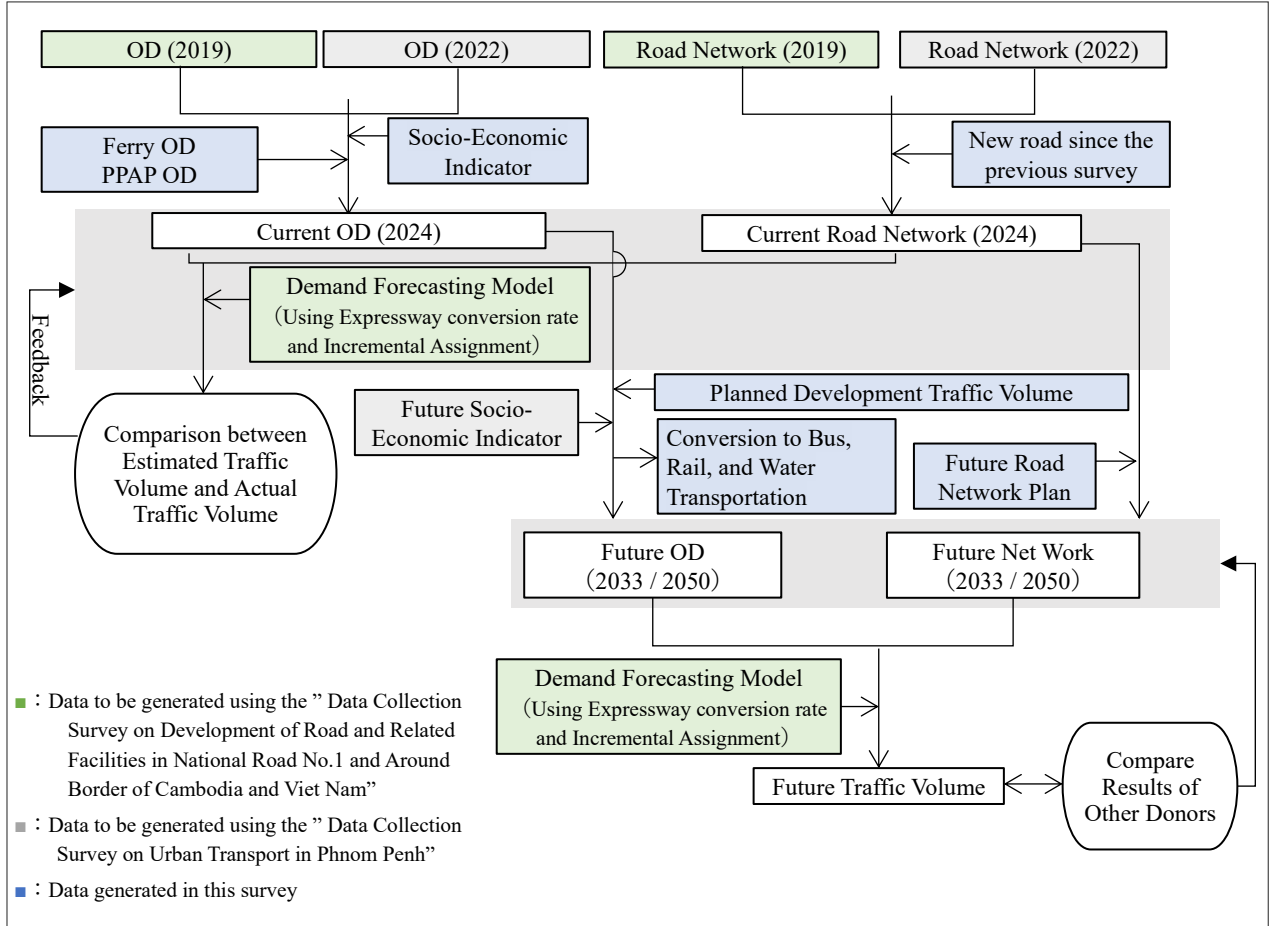


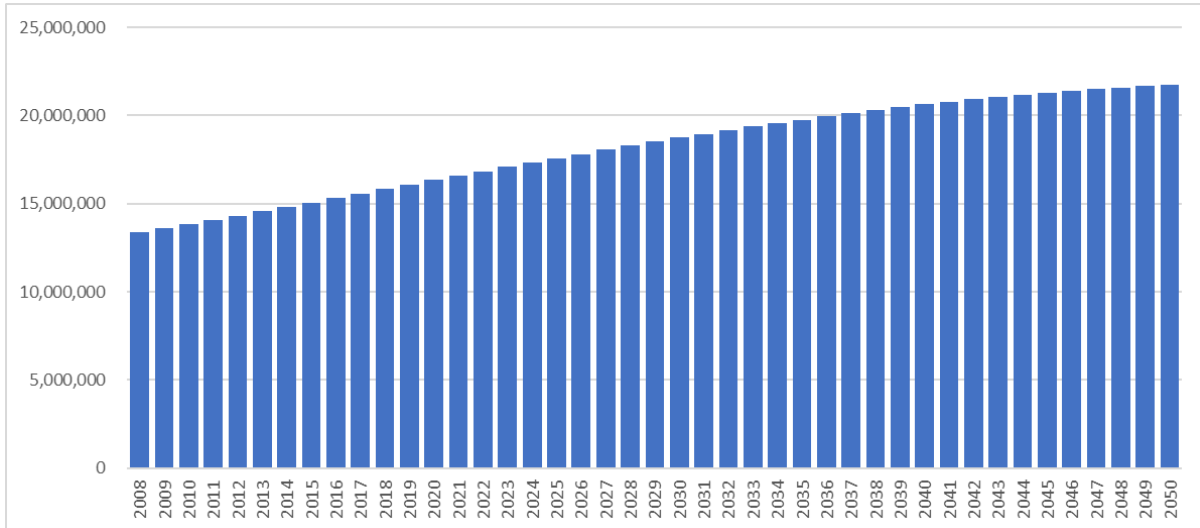
Figure 1.1-1 Flow of Traffic Demand Forecast

1.2 Socio-economic Indicator

1.2.1 Population

The population trend in Cambodia is shown below. A population census in Cambodia was conducted in 2019, and future population projections were made based on the result of population census.

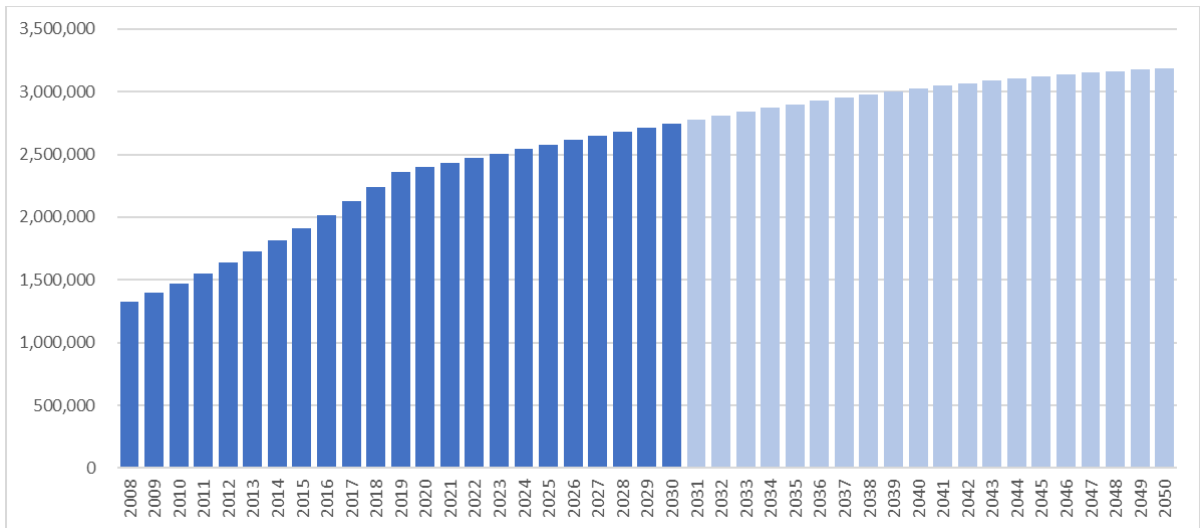
According to the General Population Census of Cambodia Series Thematic Report on Population Projection, Cambodia's population in 2050 is projected to be 21.73 million, with an average annual population growth rate of 1.0% from 2019 to 2050.



Source: General Population Census of Cambodia Series Thematic Report on Population Projection

Figure 1.2-1 Cambodia Future Population Projections

The population of Phnom Penh is projected to 2030. The population of Phnom Penh in 2030 is projected to be 2.75 million. Assuming that the population of the Phnom Penh grows at the same rate as that of Cambodia as a whole after 2030, it will reach 3.19 million in 2050.

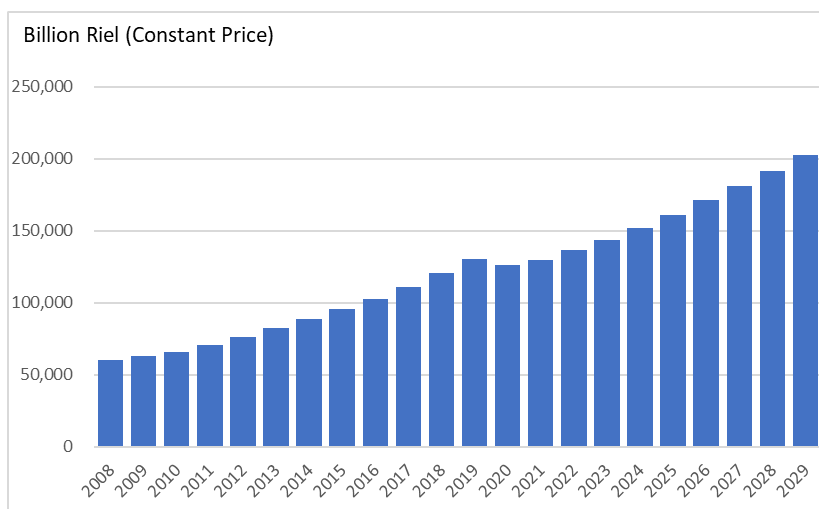


Source: Prepared by JST based on General Population Census of Cambodia Series Thematic Report on Population Projection

Figure 1.2-2 Projected Future Population of Phnom Penh

1.2.2 GDP

The following table shows the evolution of Cambodia's GDP in the World Economic Outlook Database, April 2024 (International Monetary Fund (IMF)). The GDP in 2020 decreased from the previous year's GDP due to the expansion of COVID19 infection, but the average annual growth rate from 2008 to 2021 exceeded 6%. 2022 and beyond are projected to continue at an average annual growth rate of around 6% until 2029.



Source : World Economic Outlook Database, April 2024 (IMF)

Figure 1.2-3 Cambodia GDP Trends and Projections

1.2.3 Number of Registered Automobiles

The following figure shows the number of registered automobiles. As of 2022, 5.87 million motorcycles, 0.75 million passenger cars, and 0.29 million heavy vehicles were registered in 2022. The main feature is that motorcycles account for more than 80% of the registered automobiles.

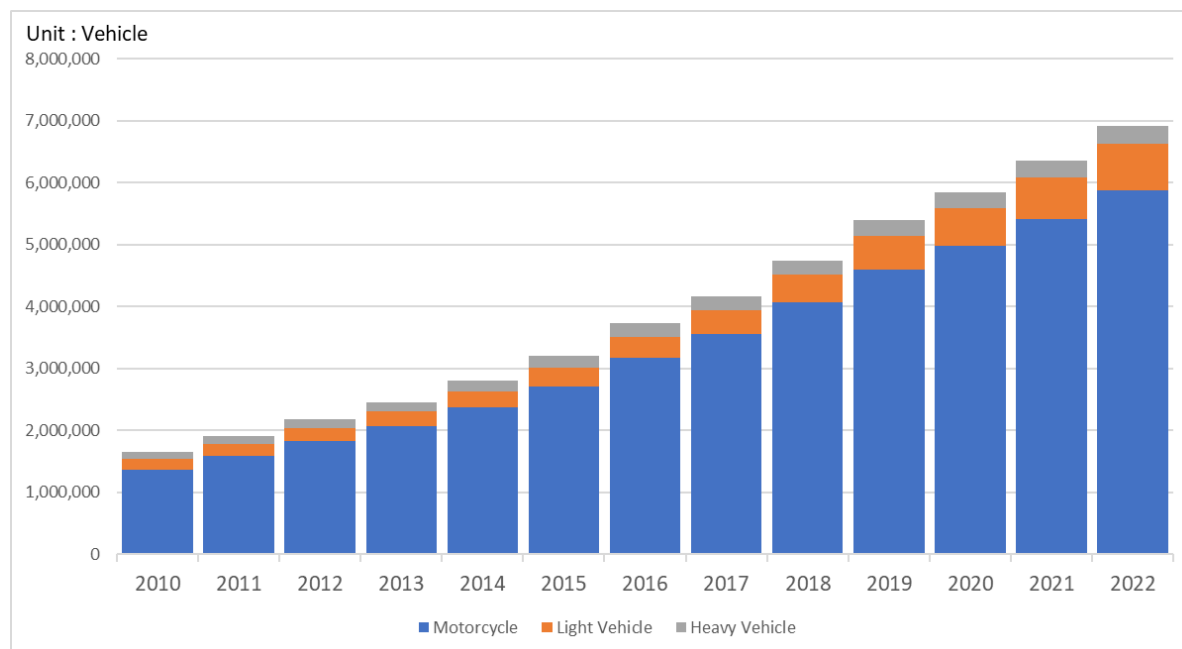


Figure 1.2-4 Cumulative Automobiles registrations in Cambodia

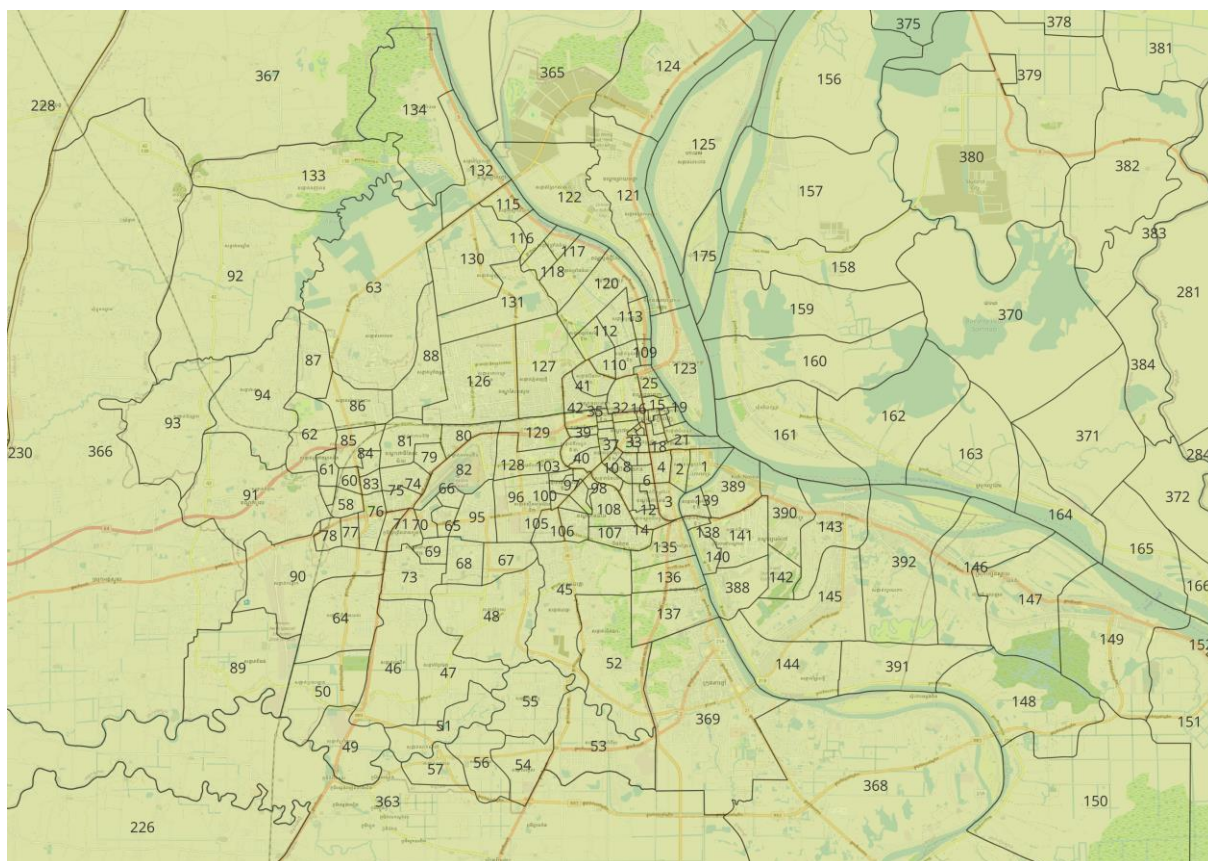


Figure 1.3-3 Zoning Map (Phnom Penh)

Table 1.3-1 Zoning Code Table

TAZ	Province name	District name	Commune/Sangkat Name	
1	Phnom Penh	Dangkao	Tonle Basak	
2			Tonle Basak	
3			Tonle Basak	
4			Boeng Keng Kang Muoy	
5			Boeng Keng Kang Pir	
6			Boeng Keng Kang Bei	
7			Olympic	
8			Tuol Svay Prey Ti M*	
9			Tuol Svay Prey Ti P*	
10			Tumnob Tuek	
11			Tuol Tumpung Ti Pir	
12			Tuol Tumpung Ti Muoy	
13			Boeng Trabaek	
14			Phsar Daeum Thkov	
15		Prampir Meakkakra	Phsar Thmei Ti Muoy	
16			Phsar Thmei Ti Pir	
17			Phsar Thmei Ti Bei	
18			Boeng Reang	
19			Phsar Kandal Ti Muoy	
20			Phsar Kandal Ti Pir	
21			Chakto Mukh	
22			Chey Chummeah	
23			Phsar Chas	
24			Srah Chak	
25			Srah Chak	
26			Voat Phnum	
27			Tuol Kouk	Ou Ruessei Ti Muoy
28				Ou Ruessei Ti Pir

TAZ	Province name	District name	Commune/Sangkat Name
29			Ou Ruessei Ti Bei
30			Ou Ruessei Ti Buon
31			Monourom
32			Mittapheap
33			Veal Vong
34			Boeng Proluet
35			Phsar Depou Ti Muoy
36			Phsar Depou Ti Pir
37			Phsar Depou Ti Bei
38			Tuek L'ak Ti Muoy
39			Tuek L'ak Ti Pir
40			Tuek L'ak Ti Bei
41			Boeng Kak Ti Muoy
42			Boeng Kak Ti Pir
43			Phsar Daeum Kor
44			Boeng Salang
45			Dangkao
46			Pong Tuek
47			Prey Veang
48			Prey Sa
49			Krang Pongro
50			Prateah Lang
51			Sak Sampov
52			Cheung Aek
53			Preaek Kampues
54			Roluos
55			Spean Thma
56			Tien
57			Kong Noy
58			Chaom Chau Ti3
59			Trapeang Krasang
60			Trapeang Krasang
61			Trapeang Krasang
62			Trapeang Krasang
63		Chbar Ampov	Kouk Roka
64			Phleung Chheh Roteh
65			Chaom Chau Ti2
66			Chaom Chau Ti2
67			Chaom Chau Ti1
68			Chaom Chau Ti1
69			Chaom Chau Ti2
70			Chaom Chau Ti2
71			Chaom Chau Ti2
72			Chaom Chau Ti3
73			Chaom Chau Ti2
74			Chaom Chau Ti3
75			Chaom Chau Ti3
76			Chaom Chau Ti3
77			Chaom Chau Ti3
78			Chaom Chau Ti3
79			Kakab Ti2
80			Kakab Ti1
81			Kakab Ti2
82			Kakab Ti1
83			Chaom Chau Ti3
84			Samraong Kraom
85			Samraong Kraom
86			Samraong Kraom
87			Samraong Kraom
88		Saensokh	Krang Thnong
89			Boeng Thum
90		Pur SenChey	Kantaok
91			Kamboul

TAZ	Province name	District name	Commune/Sangkat Name	
92		Chbar Ampov	Pongsang	
93		Pur SenChey	Ovlaok	
94			Snaor	
95			Chaom Chau	
96			Mean Chey	Stueng Mean chey TI3
97		Stueng Mean chey TI1		
98		Stueng Mean chey TI2		
99		Stueng Mean chey TI1		
100		Stueng Mean chey TI1		
101		Stueng Mean chey TI2		
102		Stueng Mean chey TI2		
103		Stueng Mean chey TI1		
104		Stueng Mean chey TI2		
105		Stueng Mean chey TI3		
106		Stueng Mean chey TI2		
107		Boeng Tumpum Ti2		
108		Boeng Tumpum Ti1		
109		Chamkar Mon		Tuol Sangke 1
110				Tuol Sangke 1
111				Tuol Sangke 1
112				Tuol Sangke 2
113			Ruessei Kaev	
114			Ruessei Kaev	
115			Svay Pak	
116			Svay Pak	
117			Chrang Chamreh Ti M*	
118			Chrang Chamreh Ti M*	
119		Chrang Chamreh Ti P*		
120		Kilomaetr Lekh Pram*		
121		Praek Pnov	Preaek Lieb	
122			Preaek Ta Sek	
123			Chrouy Changvar	
124			Bak Kaeng	
125			Kaoh Dach	
126		Saensokh	Kouk Khleang	
127			Phnom Penh Thmei	
128			Ou BaekK'am	
129			Tuek Thla	
130			Khmuonh	
131		Khmuonh		
132		Chbar Ampov	Preaek Phnov	
133			Ponhea Pon	
134			Samraong	
135		Mean Chey	Chak Angrae Leu	
136			Chak Angrae Kraom	
137	Chak Angrae Kraom			
138	Chraoy Chongvar	Chhbar Ampov Ti Muoy		
139		Chbar Ampov Ti Pir		
140		Preaek Pra		
141		Nirouth		
142		Veal Sbov		
143		Preaek Aeng		
144		Preaek Thmei		
145		Kbal Kaoh		
146		Kandal	Phum Thum	
147			Kokir	
148	Chheu Teal			
149	Dei Edth			
150	Kampong Svay			
151	Banteay Daek			
152	Phonn Penh Port			
153	Samraong Thum			
154	Kokir Thum			

TAZ	Province name	District name	Commune/Sangkat Name	
155		Leuk Daek	Kampong Phnum	
156		Khsach Kandal		Puk Ruessei
157				Preaek Ampil
158				Preaek Luong
159				Preaek Ta kov
160				Svay Chrum
161				Lvea Aem
162		Sarikakaev		
163		Peam Oknha Ong		
164		Kaoh Reah		
165		Thma Kor		
166		Tuek Khleang		
167		Boeng Krum		
168		Lvea Sar		
169		Kaoh Kaev		
170		Sambuor		
171		Prey Veng	Peam Ro	Peam Mean Chey
172	Peam Ro			
173	Preaek Khsay Ka			
174	Banlich Prasat			
175	Kandal	Khsach Kandal	Kaoh Oknha Tei	
176	Banteay MeanChey	Mongkol Borei		
177		Phnum Srok		
178		Preah Netr Preah		
179		Ou Chrov		
180		Serei Saophoan		
181		Thma Puok		
182		Svay Chek		
183		Malai		
184		Paoy Paet		
185	Battambang	Banan		
186		Thma Koul		
187		Battambang		
188		Bavel		
189		Aek Phnum		
190		Moung Ruessei		
191		Rotonak Mondol		
192		Sangkae		
193		Samlout		
194		Sampov Lun		
195		Phnum Proek		
196		Kamrieng		
197		Koas Krala		
198	Rukh Kiri			
199	Tboung Khmum	Dambae		
200		Krouch Chhmar		
201		Memot		
202		Ou Reang Ov		
203		Ponhea Kraek		
204		Tboung Khmum		
205		Suong		
206	Kampong Cham	Batheay		
207		Chamkar Leu		
208		Cheung Prey		
209		Kampong Cham		
210		Kampong Siem		
211		Kang Meas		
212		Kaoh Soutin		
213		Prey Chhor		
214		Srei Santhor		
215	Stueng Trang			
216	Kampong Chhnang	Baribour		
217		Chol Kiri		

TAZ	Province name	District name	Commune/Sangkat Name
218		Kampong Chhnang	
219		Kampong Leaeng	
220		Kampong Tralach	
221		Rolea B'ier	
222		Sameakki Mean Chey	
223		Tuek Phos	
224		Basedth	
225		Chbar Mon	
226		Kong Pisei	
227		Aoral	
228	Kampong Speu	Odongk	
229		Phnum Sruoch	
230		Samraong Tong	
231		Thpong	
232		Baray	
233		Kampong Svay	
234		Stueng Saen	
235		Prasat Ballangk	
236	Kampong Thom	Prasat Sambour	
237		Sandan	
238		Santuk	
239		Stoung	
240		Angkor Chey	
241		Banteay Meas	
242		Chhuk	
243		Chum Kiri	
244	Kampot	Dang Tong	
245		Kampong Trach	
246		Tuek Chhou	
247		Kampot	
248		Botum Sakor	
249		Kiri Sakor	
250		Kaoh Kong	
251	Koh Kong	Khemara Phoumin	
252		Mondol Seima	
253		Srae Ambel	
254		Thma Bang	
255		Chhloung	
256		Kracheh	
257		Prek Prasab	
258	Kratie	Sambour	
259		Snuol	
260		Chetr Borei	
261		Kaev Seima	
262		Kaoh Nheack	
263	Mondul Kiri	Ou Reang	
264		Pech Chreada	
265		Saen Monourom	
266		Chey Saen	
267		Chhaeb	
268		Choam Ksant	
269		Kuleaen	
270	Preah Vihear	Rovieng	
271		Sangkum Thmei	
272		Tbaeng Mean Chey	
273		Preah Vihear	
274		Ba Phnum	
275		Kamchay Mear	
276		Kampong Trabaek	
277	Prey Veng	Kanhchriech	
278		Me Sang	
279		Peam Chor	
280		Peam Ro	Neak Loang

TAZ	Province name	District name	Commune/Sangkat Name
281		Pea Reang	
282		Preah Sdach	
283		Prey Veng	
284		Pur Rieng	
285		Sithor Kandal	
286		Svay Antor	
287		Bakan	
288		Kandieng	
289	Pursat	Krakor	
290		Phnum Kravanh	
291		Pursat	
292		Veal Veang	
293		Andoung Meas	
294		Ban Lung	
295		Bar Kaev	
296		Koun Mom	
297	Ratanak Kiri	Lumphat	
298		Ou Chum	
299		Ou Ya Dav	
300		Ta Veang	
301		Veun Sai	
302		Angkor Chum	
303		Angkor Thum	
304		Banteay Srei	
305		Chi Kraeng	
306		Kralanh	
307		Puok	
308	Siem Reap	Prasat Bakong	
309		Siem Reap	
310		Soutr Nikom	
311		Srei Snam	
312		Svay Leu	
313		Varin	
314		Preah Sihanouk	
315	Preah Sihanouk	Prey Nob	
316		Stueng Hav	
317		Kampong Seila	
318		Sesan	
319		Siem Bouk	
320	Stung Treng	Siem Pang	
321		Stueng Traeng	
322		Thala Barivat	
323		Chantrea	
324		Kampong Rou	
325		Rumduol	
326	Svay Reang	Romeas Haek	
327		Svay Chrum	
328		Svay Rieng	
329		Svay Teab	
330		Bavet	
331		Angkor Borei	
332		Bati	
333		Borei Cholsar	
334		Kiri Vong	
335		Kaoh Andaet	
336	Takeo	Prey Kabbas	
337		Samraong	
338		Doun Kaev	
339		Tram Kak	
340		Treang	
341		Anlong Veang	
342	Odder Meanchey	Banteay Ampil	
343		Chong Kal	

TAZ	Province name	District name	Commune/Sangkat Name	
344		Samraong		
345		Trapeang Prasat		
346	Kep	Damnak Chang'aeur		
347		Kaeb		
348	Pailin	Pailin		
349	Pailin	Sala Krau		
350	Laos	NR7		
351	Thailand	NR5		
352		NR48		
353		NR57		
354		NR67		
355		NR68		
356	Vietnum	NR1		
357		NR2		
358		NR21		
359		NR33		
360		NR72		
361		NR76		
362		NR78		
363	Kandal	Kandal Stueng		
364		Kaoh Thum		
365		Mukh Kampul		
366		Angk Snuol		
367		Ponhea Lueu		
368		S'ang		
369		Ta Khmau		
370		Lvea Aem	Barong	
371			Preaek Kmeng	
372			Preaek Rey	
373			Phum Thum	
374			Preaek Ruessei	
375		Khsach Kandal	Preaek Ta Meak	
376			Ta Aek	
377			Preah Prasab	
378			Roka Chonlueng	
379			Sanlung	
380			Vihear Suork	
381			Chey Thum	
382			Sithor	
383	Kampong Chamlang			
384	Bak Dav			
385	Prey Veng	Peam Ro	Ba Baong	
386		Prey Kandieng		
387		Preaek Khsay Kha		
388	Phnom Penh	Chraoy Chongvar	Preaek Pra	
389			Nirouth	
390			Veal Sbov	
391			Preaek Thmei	
392			Kbal Kaoh	

(3) Expansion Rate

The OD tables prepared in the “Data Collection Survey on Urban Transport in Phnom Penh” were developed based on the results of the most recent survey conducted in 2022. In order to ensure consistency with the estimates in that study, the traffic demand expansion rates were calculated by linearly supplementing the current and future total traffic demand in this study. The following table shows the expansion rate of traffic demand for OD pairs in the Phnom Penh.

Table 1.3-2 Expansion Rate

Period	Expansion Rate		
	Motorcycle	Light Vehicle	Heavy Vehicle
2024/2022	1.01	1.08	1.01

In the “Data Collection Survey on Development of Road and Related Facilities in National Road No.1 and Around Border of Cambodia and Viet Nam”, future traffic demand was projected using the GDP growth rate at that time. Therefore, it is necessary to revise the growth rate in this study.

The growth rate of automobile registrations by vehicle type, which has a correlation with traffic demand. In this study, the growth rate of automobile registrations by vehicle type was set as the growth rate of traffic demand. Based on past trends in automobile registrations by vehicle type and socioeconomic indicators, a regression equation was calculated to predict the automobile registrations by vehicle type, and the future forecast results of socioeconomic indicators were used to predict the future growth rate of automobile registrations by vehicle type.

Below are regression equations calculated from the total number of automobile registrations by vehicle type, population, and GDP (2010-2022). Since the coefficient of determination was closer to 1.0 in the regression equation with population for all vehicle types, the future growth rate of automobile registrations by vehicle type was projected from the regression equation calculated using population.

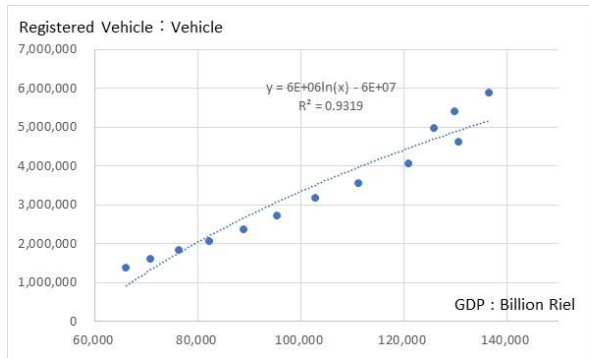


Figure 1.3-4 Regression Equation for Motorcycle Registrations and GDP

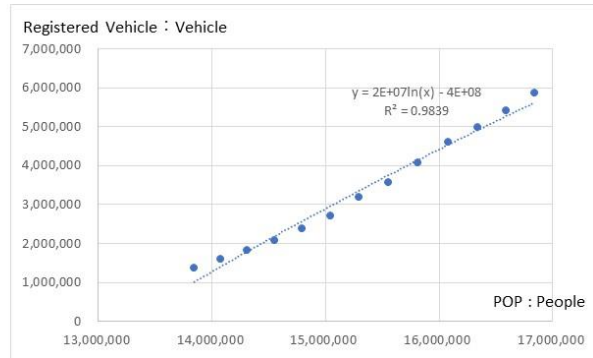


Figure 1.3-5 Regression Equation for Motorcycle Registrations and population

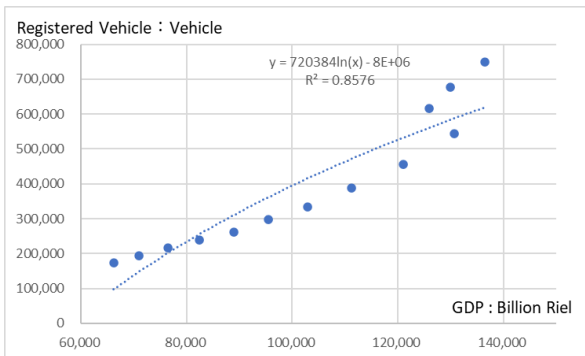


Figure 1.3-6 Regression Equation for Passenger Car Registrations and GDP

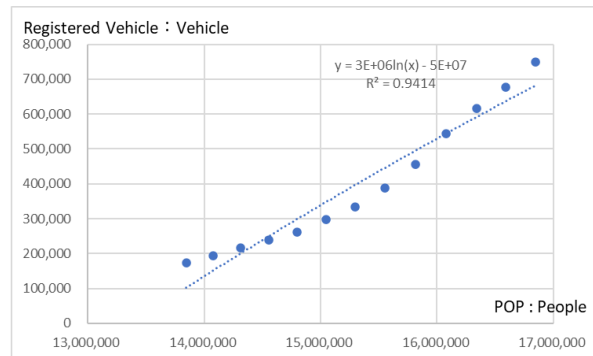


Figure 1.3-7 Regression Equation for Passenger Car Registrations and Population

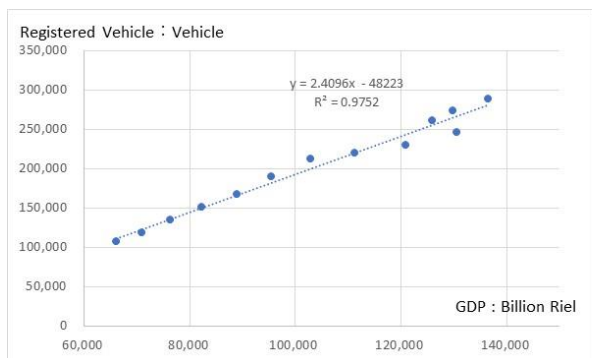


Figure 1.3-8 Regression Equation for Heavy Vehicle Registrations and GDP

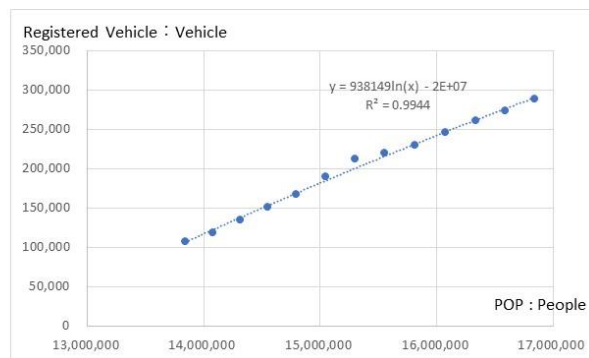


Figure 1.3-9 Regression Equation for Heavy Vehicle Registrations and Population

The following figure shows the number of automobile registrations by vehicle type and the expansion rate.

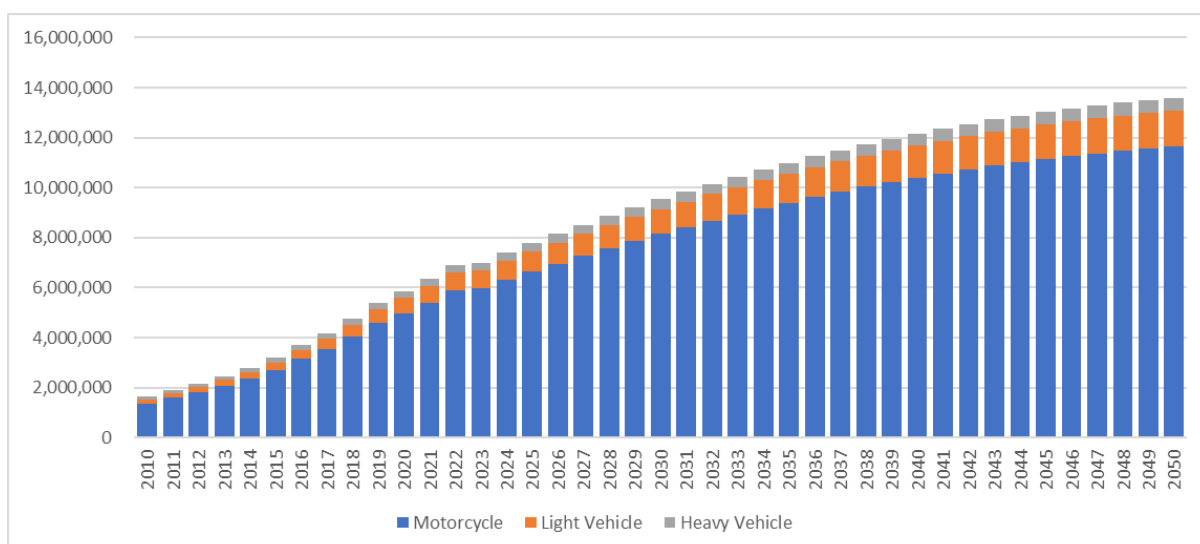


Figure 1.3-10 Forecast of Number of Automobile Registrations by Vehicle Type

Table 1.3-3 Traffic Demand Expansion Rate Calculated based on Automobile Registrations by Vehicle Type

Period	Expansion Rate		
	Motorcycle	Light Vehicle	Heavy Vehicle
2024/2019	1.37	1.41	1.29

(4) Update of OD table on the results of traffic survey

For PPAP, a major logistics hub along the NR1, a port-related current OD table was prepared based on the results of the traffic survey, and the data was updated to match the traffic situation in 2024.

For the ferry crossings in Kandal, the current ferry OD table was prepared based on the results of the traffic survey, and the data was updated to match the traffic situation in 2024.

(5) Desire Line

The following figure is desire line of the 2024 OD table developed in this study.

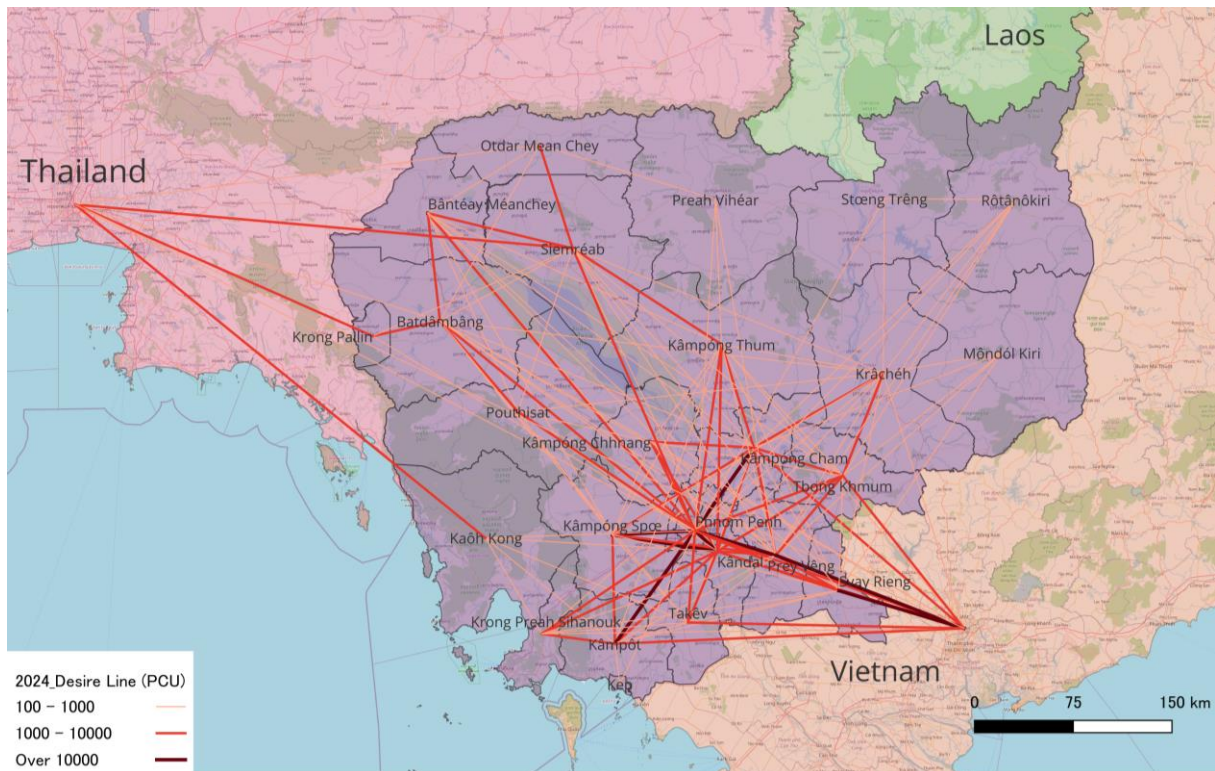


Figure 1.3-11 Desire Line in Cambodia (2024)

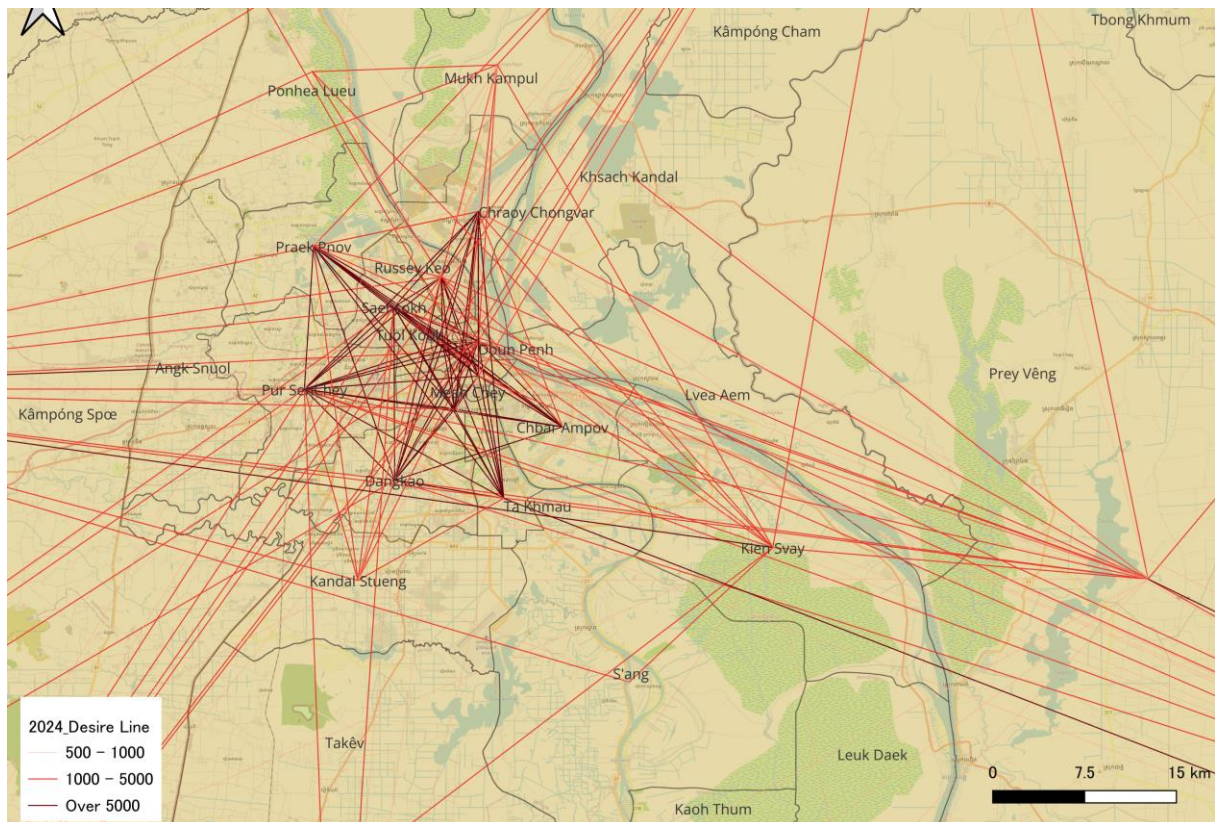


Figure 1.3-12 Desire Line in Study Area (2024)

1.3.2 Future OD Table

(1) Outline

The OD pairs for the Phnom Penh are based on the 2035 future OD table prepared by the “Data Collection Survey on Urban Transport in Phnom Penh” and the other OD pairs are based on the 2019 Current OD Table prepared by the “Data Collection Survey on Development of Road and Related Facilities in National Road No.1 and Around Border of Cambodia and Viet Nam”. The future OD table base for 2035 and 2050 was created by multiplying the growth rate of traffic demand by the 2019. The future OD table was finalized by taking into account development-related OD such as urban development in Akreiy Ksatr City and along the NR1.

The zones along Route 1, the target of the survey, were re-divided from the zoning of the previous survey to reproduce more detailed traffic conditions.

(2) Expansion Rate

“Data Collection Survey on Urban Transport in Phnom Penh” was preparing the future OD table for the year 2035. Therefore, the OD pair in Phnom Penh was utilized. The expansion rate of traffic demand between 2035 and 2050 were calculated by supplementing the current and future total traffic demand with a logarithmic approximation curve. The following table shows the expansion rate of traffic demand for OD pairs in the Phnom Penh.

Table 1.3-4 Future Traffic Demand Expansion Rate Calculated based on Automobile Registrations by Vehicle Type 1

Period	Expansion Rate		
	Motorcycle	Light Vehicle	Heavy Vehicle
2050/2035	1.08	1.43	1.08

The OD table based on the “Data Collection Survey on Development of Road and Related Facilities in National Road No.1 and Around Border of Cambodia and Viet Nam” was expanded based on the number of automobile registrations by vehicle type, as the case with current OD table. The expansion rate for 2024-2035 and 2035-2050 are shown below.

Table 1.3-5 Future Traffic Demand Expansion Rate Calculated based on Automobile Registrations by Vehicle Type 2

Period	Expansion Rate		
	Motorcycle	Light Vehicle	Heavy Vehicle
2035/2024	1.49	1.50	1.39
2050/2035	1.24	1.24	1.20

(3) Urban Development OD

1) Urban Development of Akreiy Ksatr City

Land Use Master Plan is currently being developed for the City of Akreiy Ksatr City with a target year of 2040. Population of Akreiy Ksatr City is still considering. It is not possible to estimate the total generation on a population basis. Therefore, estimated the amount of total generation per unit area of Akreiy Ksatr City and multiplying it by the area planned to be urbanized.

The assumptions used to calculate the total generation per unit area as follows.

- The urbanization of Akreiy Ksatr City will progress to the same level as the current suburban area of Phnom Penh by 2050.
- The degree of urbanization is assumed to be as follows based on the current status of urban development in Phnom Penh.

- In the case of ING City by ING Holdings, an urban development company in Cambodia, the residential land utilization rate was approximately 30% at the end of 10 years (2023) after the start of operations in 2013.
- When residential land utilization exceeds 50%, the speed of land utilization generally tends to accelerate quickly.
- Based on the above, assuming that urban development will progress at a rate of 3%/year from the first year to the 15th year of operations (about 45% of the total in the 15th year), and at a rate of 5%/year from the 16th year onward. To sum up, assume that urban development will progress to 33% as of 2035.

Table 1.3-6 Total Future Generation in Akreiy Ksatr City

Items	Value
Y 2024 total generation in suburban areas of Phnom Penh	1,942,900 PCU / Day
Suburban area of Phnom Penh	65,500 ha
Total generation per hectare in the suburban area of Phnom Penh	29.6 PCU / ha
Land use area of Akreiy Ksatr City	21,470 ha
Total future generation in Akreiy Ksatr City by urban development (Y 2050)	636,400 PCU / Day (App. 270,000 persons)
Total future generation in Akreiy Ksatr City by urban development (Y 2035)	210,000 PCU / Day (App. 89,000 persons)

※1 Average number of trips per person: 2.68 trips / day, modal share of car : 87.8% (Data Collection Survey on Urban Transport in Phnom Penh).

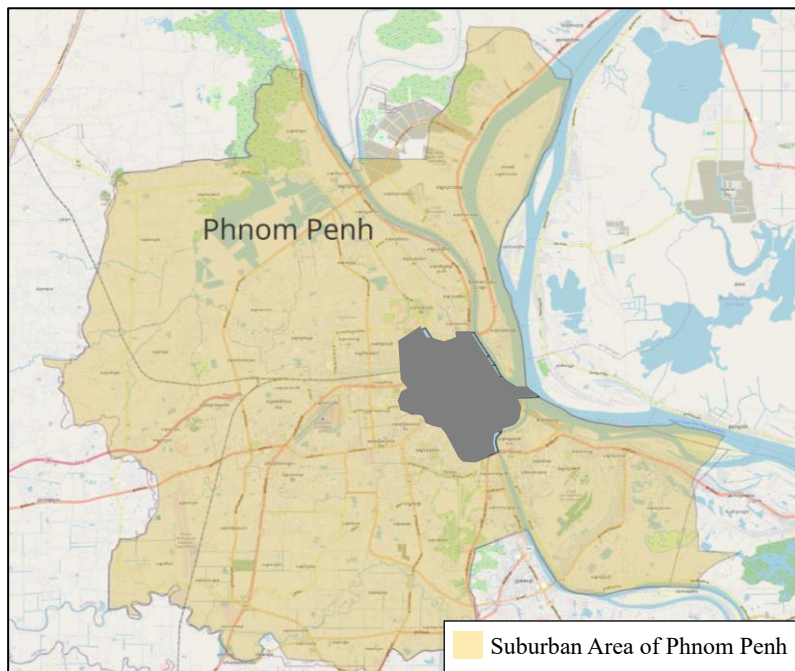


Figure 1.3-13 Desire Line in Study Area (2024)

The OD table was created using the distribution pattern of zones (TAZ 123 and 141) with similar characteristics to the urban development of Akreiy Ksatr City based on the total generation.

Figure 1.3-14 Desire Line in Cambodia (Y 2035)

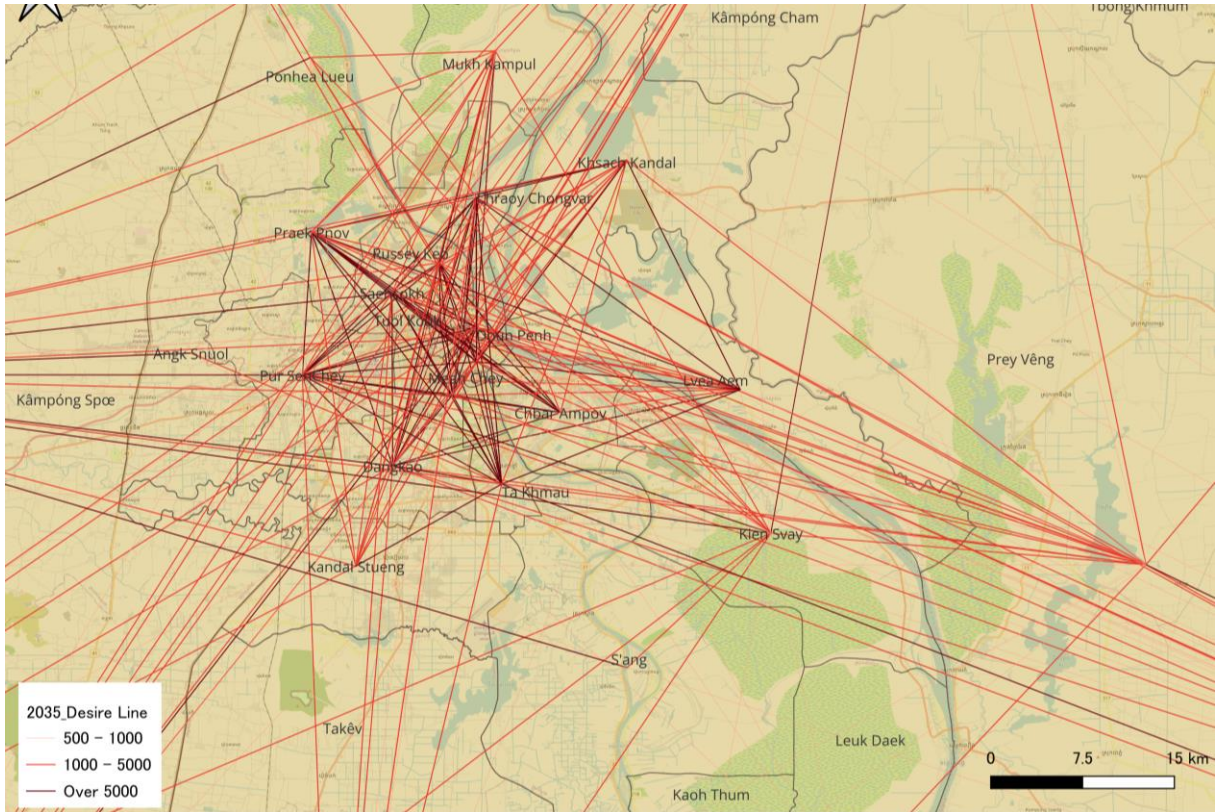


Figure 1.3-15 Desire Line in Study Area (Y 2035)

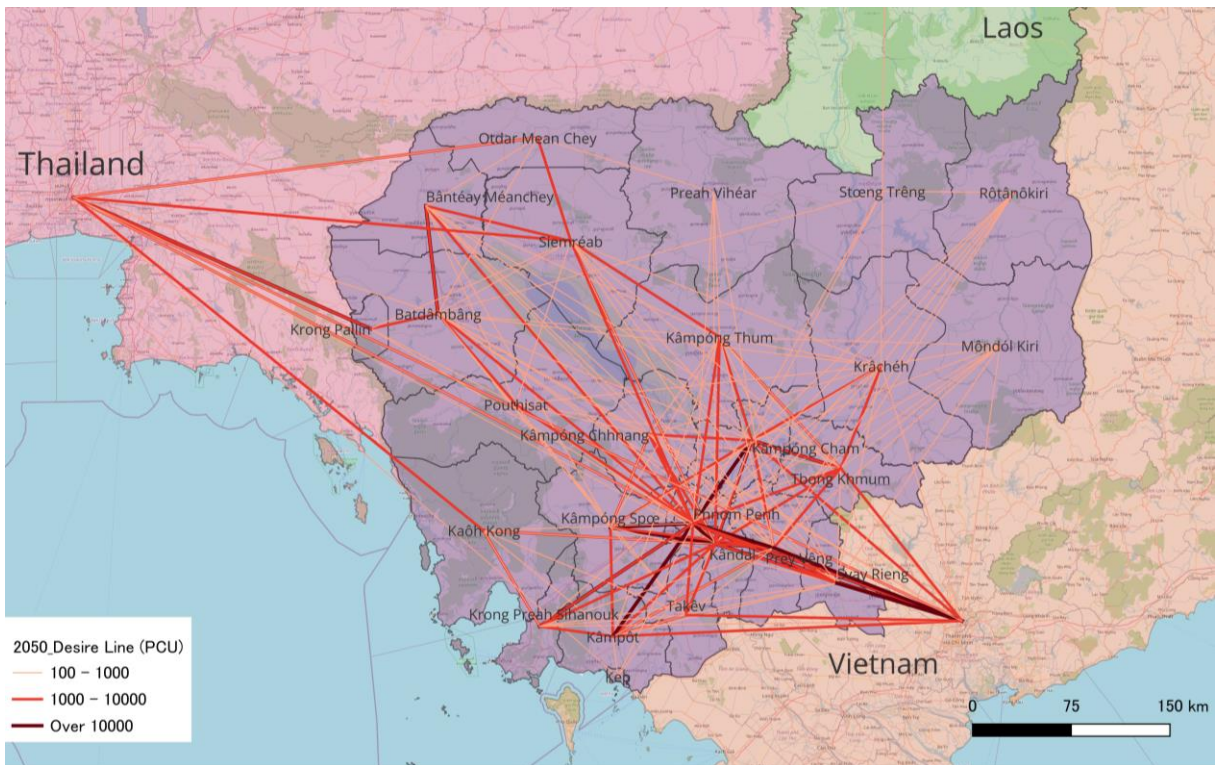


Figure 1.3-16 Desire Line in Cambodia (Y 2050)

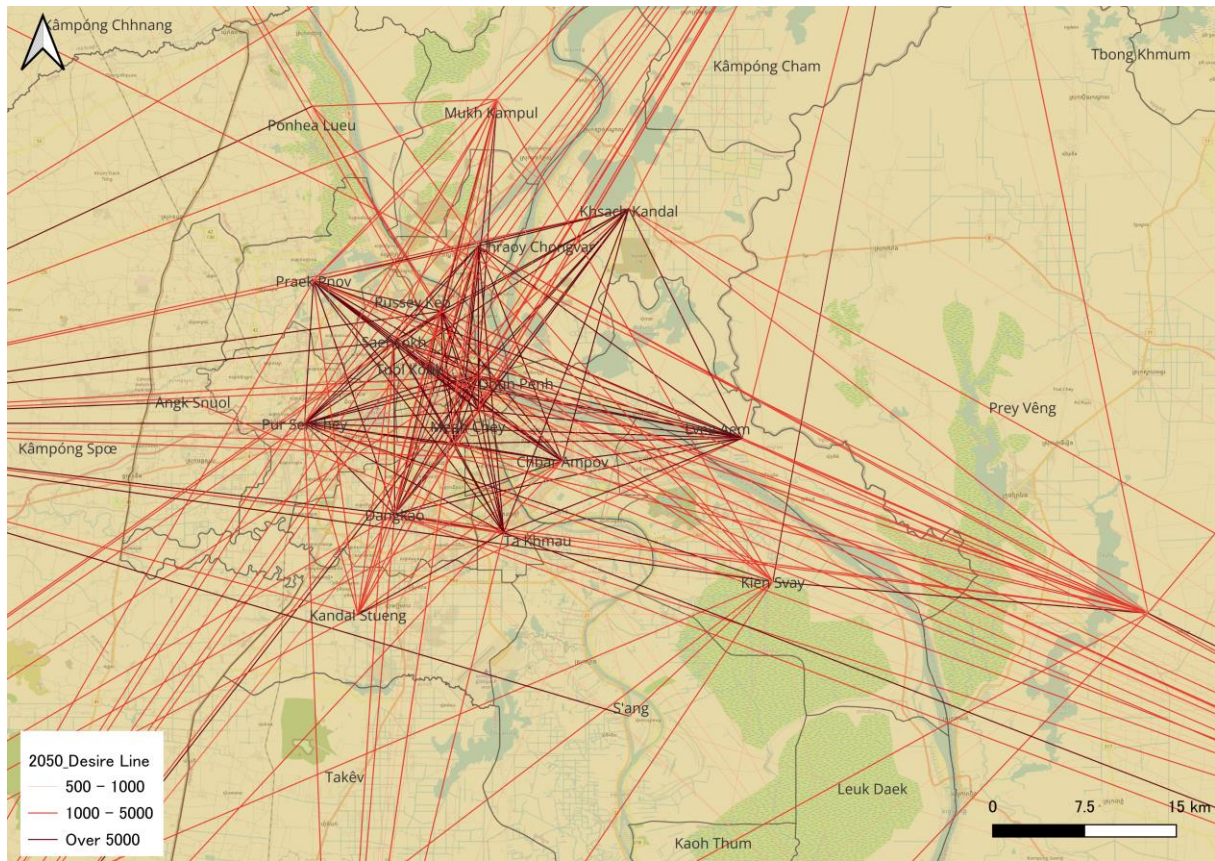


Figure 1.3-17 Desire Line in Study Area (Y 2050)

1.4 Road Network

1.4.1 Current Road Network

Based on the road network used in the traffic demand forecasts for the “Data Collection Survey on Urban Transport in Phnom Penh” and the “Data Collection Survey on Development of Road and Related Facilities in National Road No.1 and Around Border of Cambodia and Viet Nam” the major roads in operation by 2024 were added and created the current road network. The following figure shows the current road network in 2024.



Figure 1.4-1 Road Network in 2024

1.4.2 Future Road Network

The future road network was prepared based on the “Comprehensive Intermodal Transport and Logistics System Master Plan”, “Comprehensive Urban Transport Plan in Phnom Penh Capital City”, and “Land Use Master Plan in Akrei Ksatr City”, as well as additional future road networks that are expected to have a significant impact on traffic through interviews with related organizations. The future road network maps for 2035 and 2050 are shown below.



Figure 1.4-2 Future Road Network in 2035



Figure 1.4-3 Future Road Network in 2050

Table 1.4-1 Road Network Added by High-Level Plans

Year	Road Network Assumption		
	Classification	Without	With
2035	Requested project	All not in service	Priority project packages
	CITL	<p>The list of projects reflects road projects located in Phnom Penh and Kandal Province that have a significant impact on traffic flow on the target roads. The road projects added are listed below.</p> <ul style="list-style-type: none"> • PP-Bavet Expressway • Third Ring Road Construction project at East bank of Mekong River phase 1(2 bridge crossing Koh Dach Island and Road 30km) • Third Ring Road Construction project at East bank of Mekong River phase 2(2 bridge crossing Mekong River and Road 3km) • Second Ring Road construction project connected from Cambodia-Korea friendship bridge (Night Market -Akreyi Ksatr) to PP-Bavet Expressway • Tunnel from Samdach Songe Choun Nath- Akreyi Ksatr (Requested Proejct) • Kdey Ta Kouy crossing river bridge project (requested project) 	

Year	Road Network Assumption	
	Classification	Without With
		<ul style="list-style-type: none"> • Cambodia-Korea friendship constructed bridge project • Fourth Ring Road <p>*The Mekong River Tunnel project, which was not extracted as a priority project package, was not added to the network.</p>
	PPUTMP	<p>The project list reflects arterial road projects that have a significant impact on traffic flow on the target road and collector road projects in the southern urban area of Phnom Penh. The following is a list of road projects that were added.</p> <ul style="list-style-type: none"> • Boeng Kok Road • New E-W Arterial Road (NR1-Cheng Aek Road) • New E-W Arterial Road (Cheng Aek-RRe) • New and widening of RR2 (NR2-NR5) • Extension of RR2 (NR5-NR6) • RR4 (NR1-NR6) • Widening of NR2 (junction with NR21-RR3) • Widening of NR3 (Junction with RR3-RR4) • Chaban Ampov area Development Road package • New E-W Arterial in Sen Sok (Toul Kok-RR4) • Mean Chey District Urban Development Road package • Mean Chey – Diamond Island Connection Rd package • AZ Green City Development Road package
	Akreiy Ksatr city land use plan	<p>Of the project shown the road plan map, those projects with a road width of 30 m or more that have a significant impact on traffic flow were reflected. For the Mekong River Bridge, projects with circled in red, for which details of the plan could not be confirmed, were excluded.</p>
2050	All project	<p>In addition to the road projects mentioned above, four additional projects, circled in red in , were added.</p>

1.5.1 Verification of current OD

Traffic assignment was conducted using the current OD tables and current road network, and validated the accuracy by comparing it with the results of traffic survey data. The correlation between the traffic assignment and traffic survey data was verified, and the correlation coefficient exceeded 0.9, indicating that there is a strong correlation.

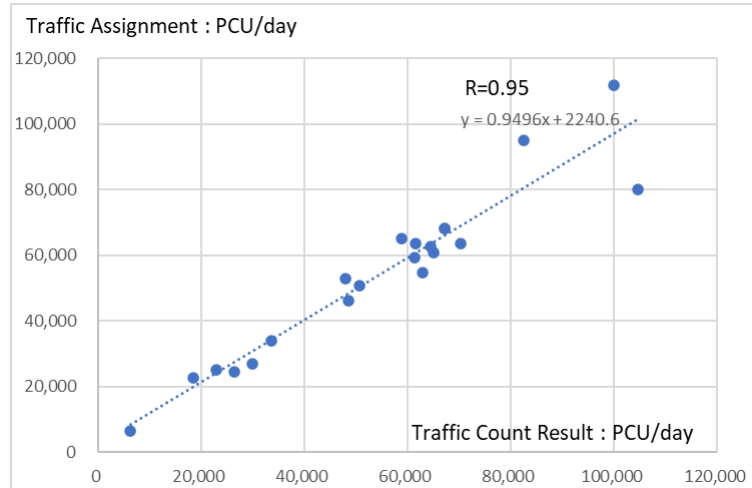


Figure 1.5-1 Correlation Coefficient Between Traffic Volume Estimation Results and Traffic Survey Data

The result of traffic survey and traffic assignment were generally less than $\pm 2,000$ PCU/day or $\pm 20\%$, ensuring adequate verification of the current situation. These results confirm that the data used for traffic assignment result is reliable enough for future traffic volume.

Table 1.5-1 The Range of Traffic Survey Data and Traffic Assignment Results

Road Name / Location		A. The result of the survey PCU / day	B. Traffic assignment PCU / day	Judge	B/A	A-B
NR1	IC2	104,757	80,100	△	0.76	24,657
		99,997	111,700	○	1.12	-11,703
	IC3	65,081	60,700	◎	0.93	4,381
		58,951	65,100	○	1.10	-6,149
	IC4	61,580	63,600	◎	1.03	-2,020
		64,492	62,500	◎	0.97	1,992
	IC5	67,211	68,000	◎	1.01	-789
		70,315	63,600	◎	0.90	6,715
	IC6	61,357	59,200	◎	0.96	2,157
		67,211	68,000	◎	1.01	-789
	IC8	62,916	54,600	○	0.87	8,316
		48,696	46,200	◎	0.95	2,496
	IC9	48,026	52,800	◎	1.10	-4,774
		50,743	50,700	◎	1.00	43
IC10	33,761	33,900	◎	1.00	-139	
	26,424	24,400	◎	0.92	2,024	
SC1	29,938	26,800	○	0.90	3,138	
Norodom St		82,707	95,100	○	1.15	-12,393
RR2		18,475	22,600	△	1.22	-4,125
PPAP		6,407	6,500	◎	1.01	-93
RR3		23,044	25,000	◎	1.08	-1,956

- * ◎ : $0.90 \leq B/A \leq 1.10$, or, $-1,000PCU \leq A-B \leq 1,000PCU$
○ : $0.80 \leq B/A \leq 1.20$, or, $-2,000PCU \leq A-B \leq 2,000PCU$
△ : $0.75 \leq B/A \leq 1.25$, or, $-3,000PCU \leq A-B \leq 3,000PCU$
× : $B/A < 0.75$ or $B/A > 1.25$, or, $B/A < -3,000$ or $B/A > 1.25$

1.5.2 Future Traffic Volume

(1) Case of Future Traffic Volumes

Future traffic volumes were estimated in 17 cases as shown in the table below.

Table 1.5-2 Future Traffic Volumes (19 Cases)

Case	Year	No. of Case
With All Requested Project (NR1 Section 0-4 km: Flyover)	2035	Case 01_2035
	2050	Case 01_2050
With All Requested Project (NR1 Section 0-4 km: Viaduct)	2035	Case 02_2035
	2050	Case 02_2050
Without Requested Project of NR1 Section 0-4km (With the other requested projects)	2035	Case 03_2035
	2050	Case 03_2050
Without Requested Project of NR1 Section 4-20km (With the other requested projects)	2035	Case 04_2035
	2050	Case 04_2050
Without Requested Project of NR1 Section 20-54km (With the other requested projects)	2035	Case 05_2035
	2050	Case 05_2050
Without Requested Project of the Mekong River Bridge (With the other requested projects)	2035	Case 06_2035
	2050	Case 06_2050
Without Requested Project of the Mekong River Tunnel (With the other requested projects)	2035	Case 07_2035
	2050	Case 07_2050
Without All Requested Projects	2035	Case 08_2035
With Requested Project of NR1 Section 0-4km: Flyover + NR1 4-20km 6-lane widening +20-54km 4-lane+ The Mekong River Bridge (Without the other requested projects)	2035	Case 09_2035
With Requested Project of NR1 Section NR1 4-20km 6-lane widening +20-54km 4-lane (Without the other requested projects)	2050	Case 10_2035

(2) Case 01_2035

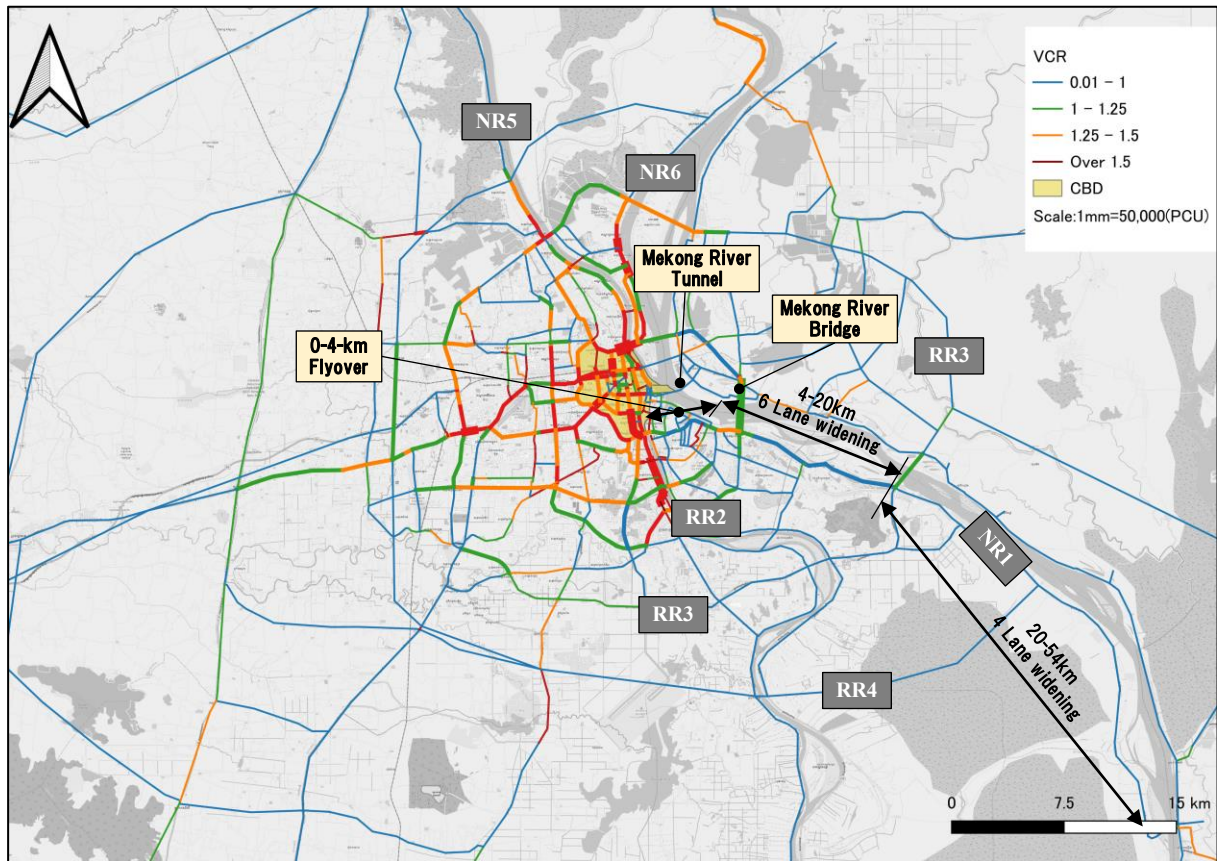


Figure 1.5-2 Case01_2035 With All Requested Project (NR1 Section 0-4 km: Flyover)

(3) Case 01_2050

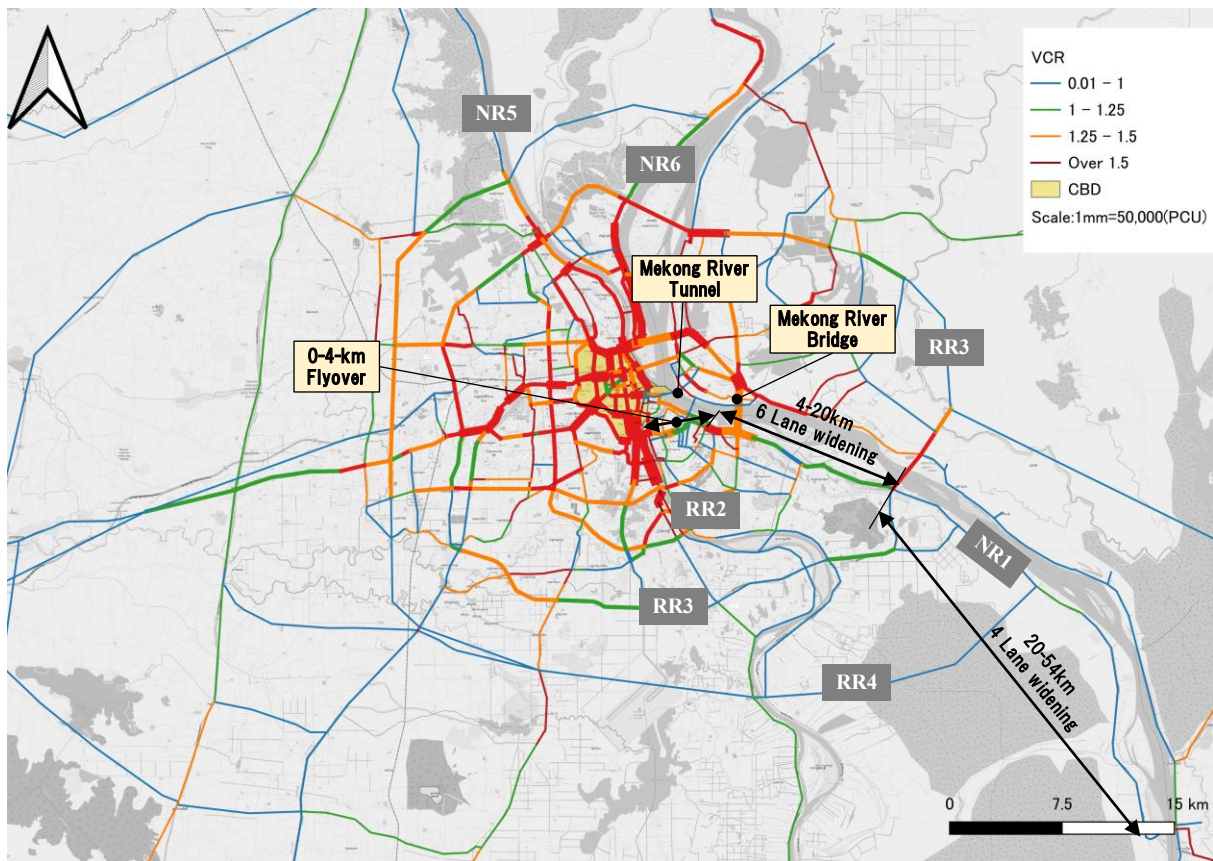


Figure 1.5-3 Case01_2050 With All Requested Project (NR1 Section 0-4 km: Flyover)

(4) Case 02_2035

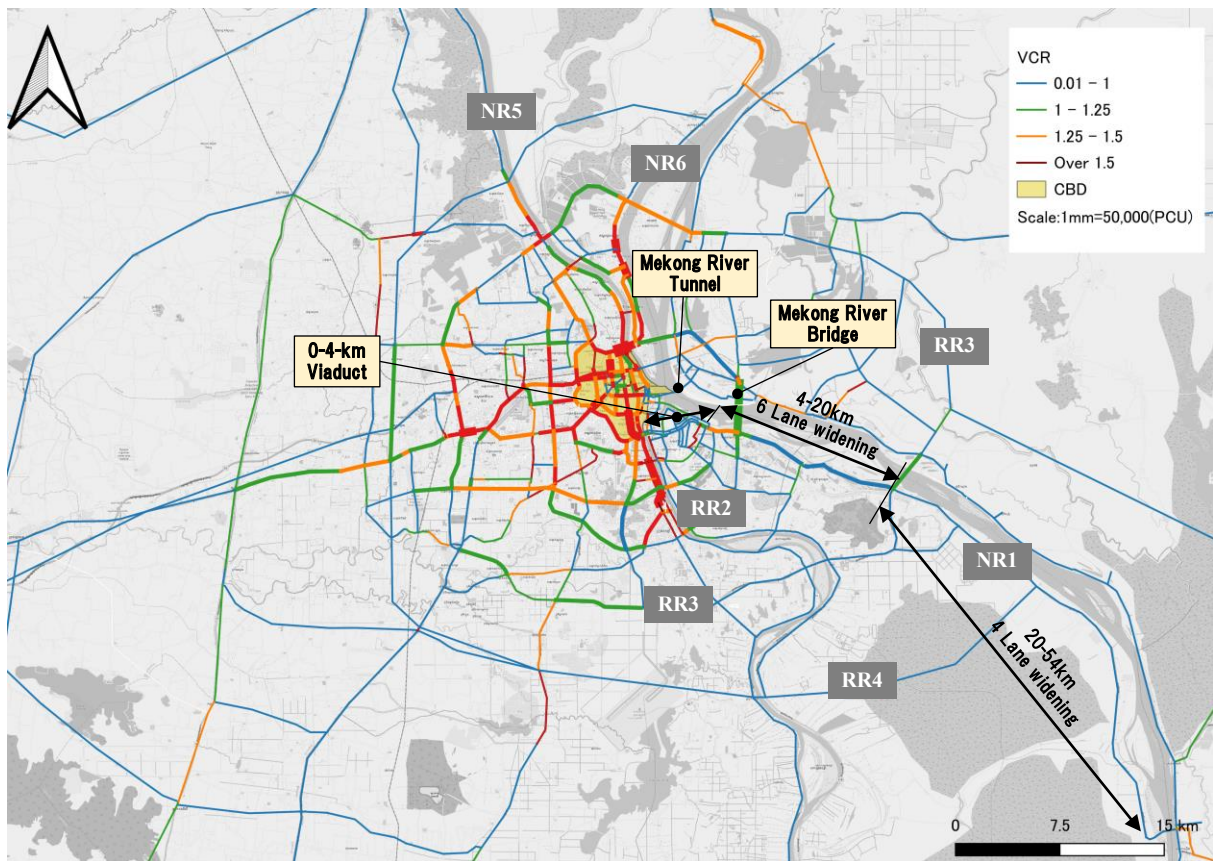


Figure 1.5-4 Case02_2035 With All Requested Project (NR1 Section 0-4 km: Viaduct)

(5) Case 02_2050

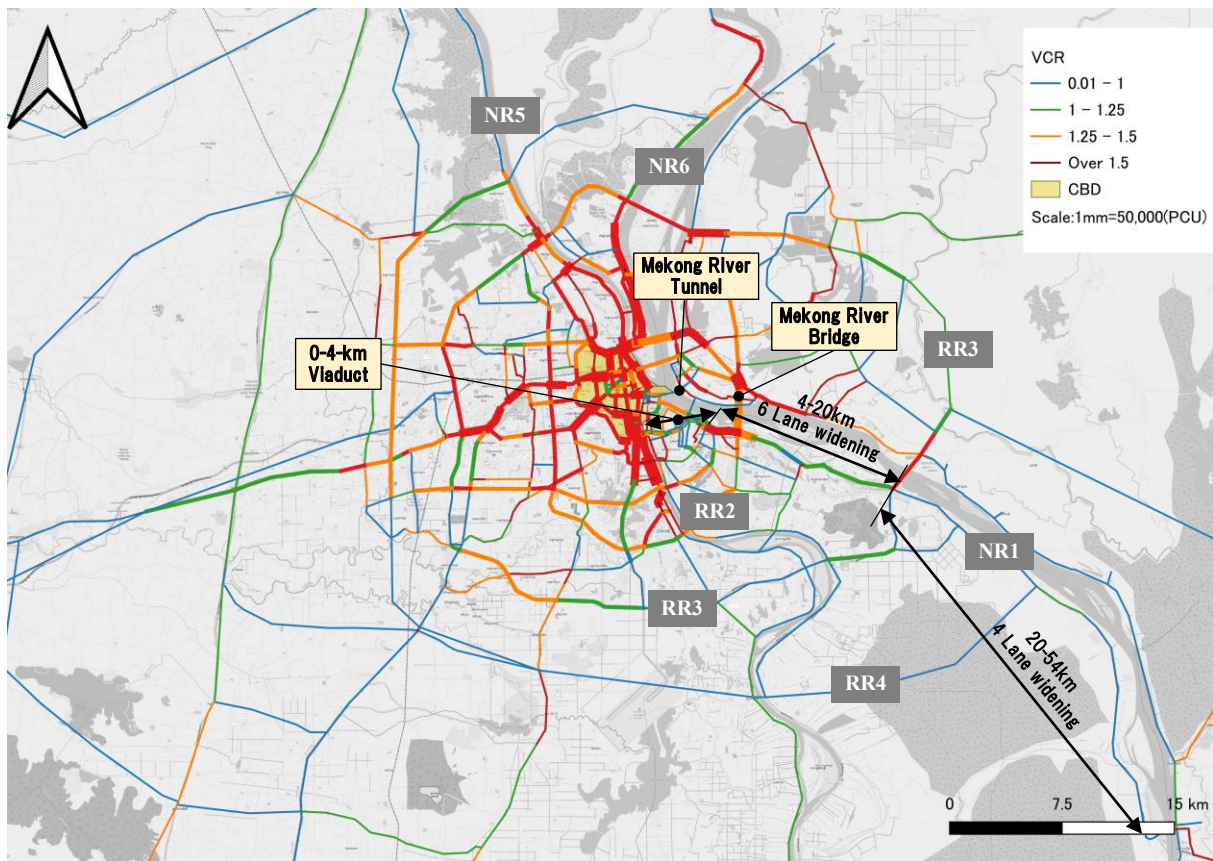


Figure 1.5-5 Case02_2050 With All Requested Project (NR1 Section 0-4 km: Viaduct)

(6) Case 03_2035

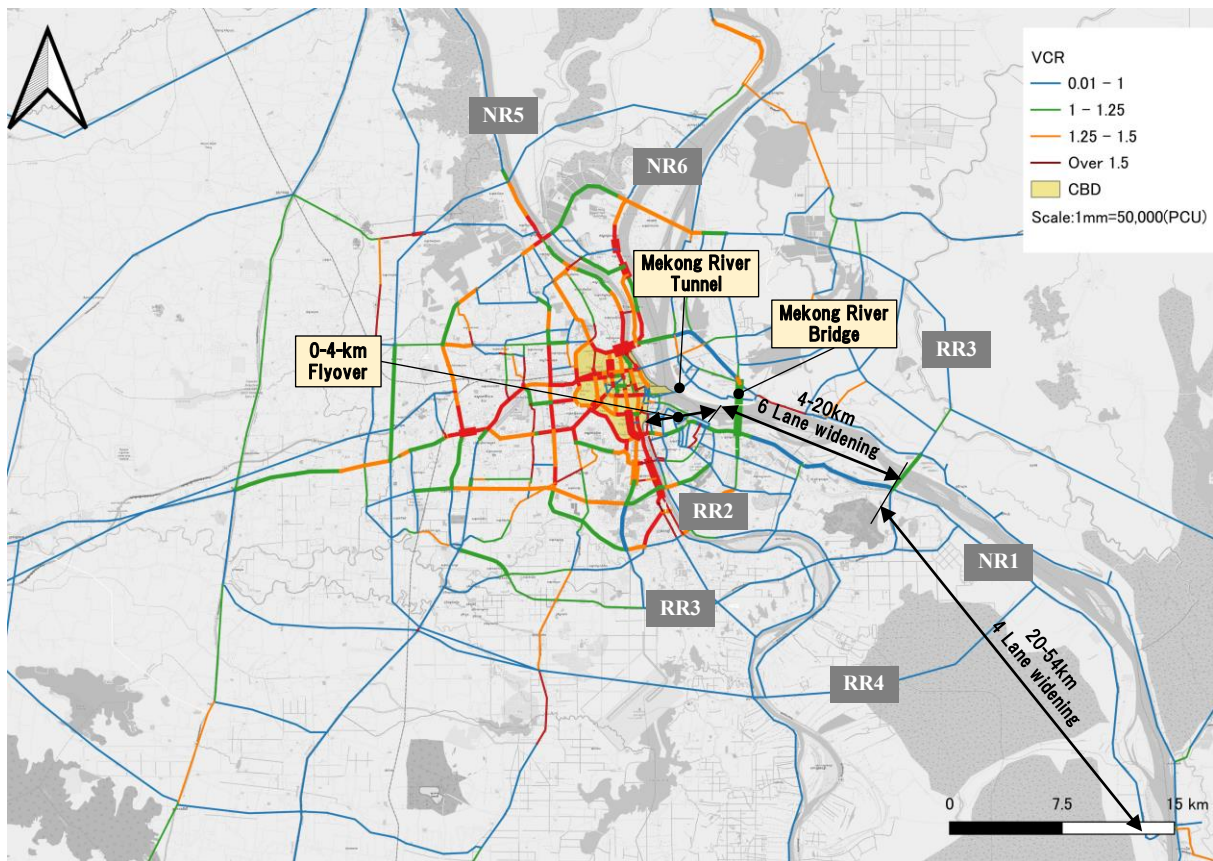


Figure 1.5-6 Case03_2050 Without Requested Project of NR1 Section 0-4km (With the other requested projects)

(7) Case 03_2050

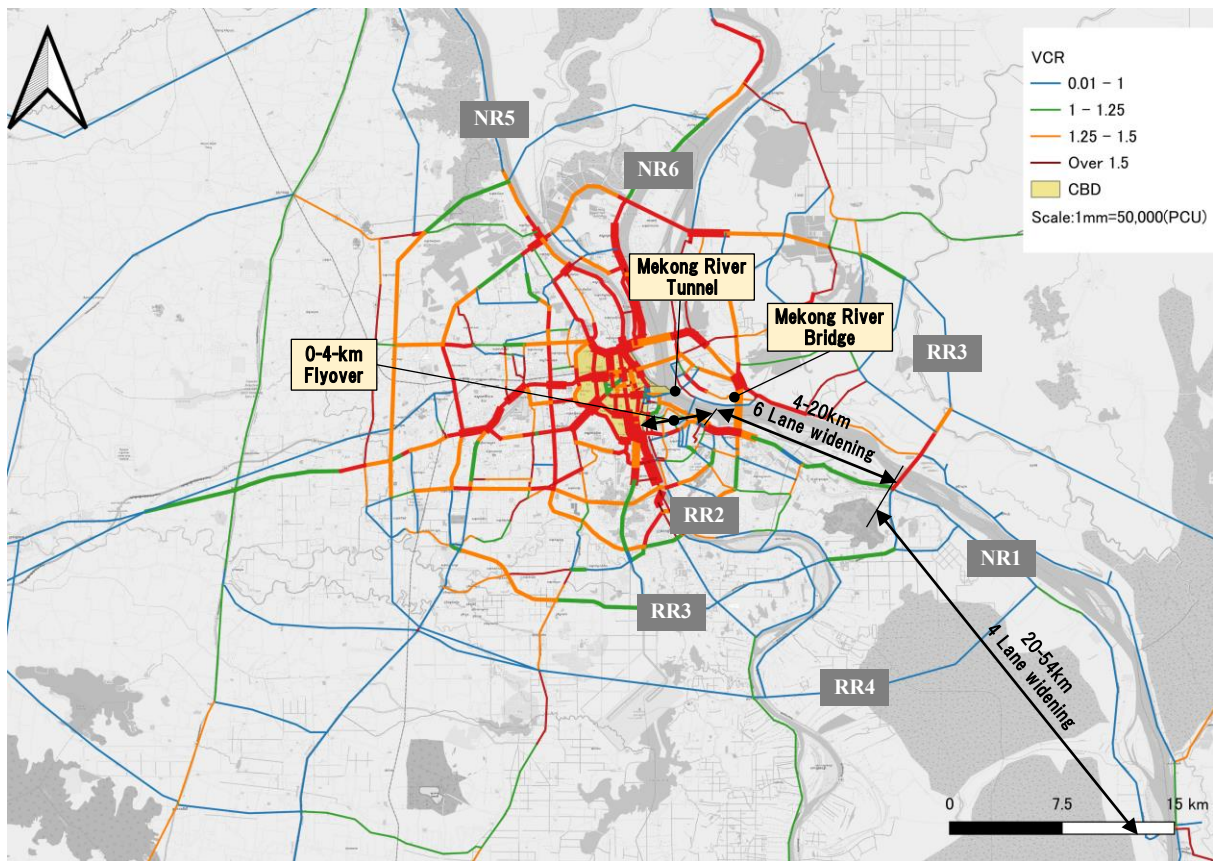


Figure 1.5-7 Case03_2050 Without Requested Project of NR1 Section 0-4km (With the other requested projects)

(8) Case 04_2035

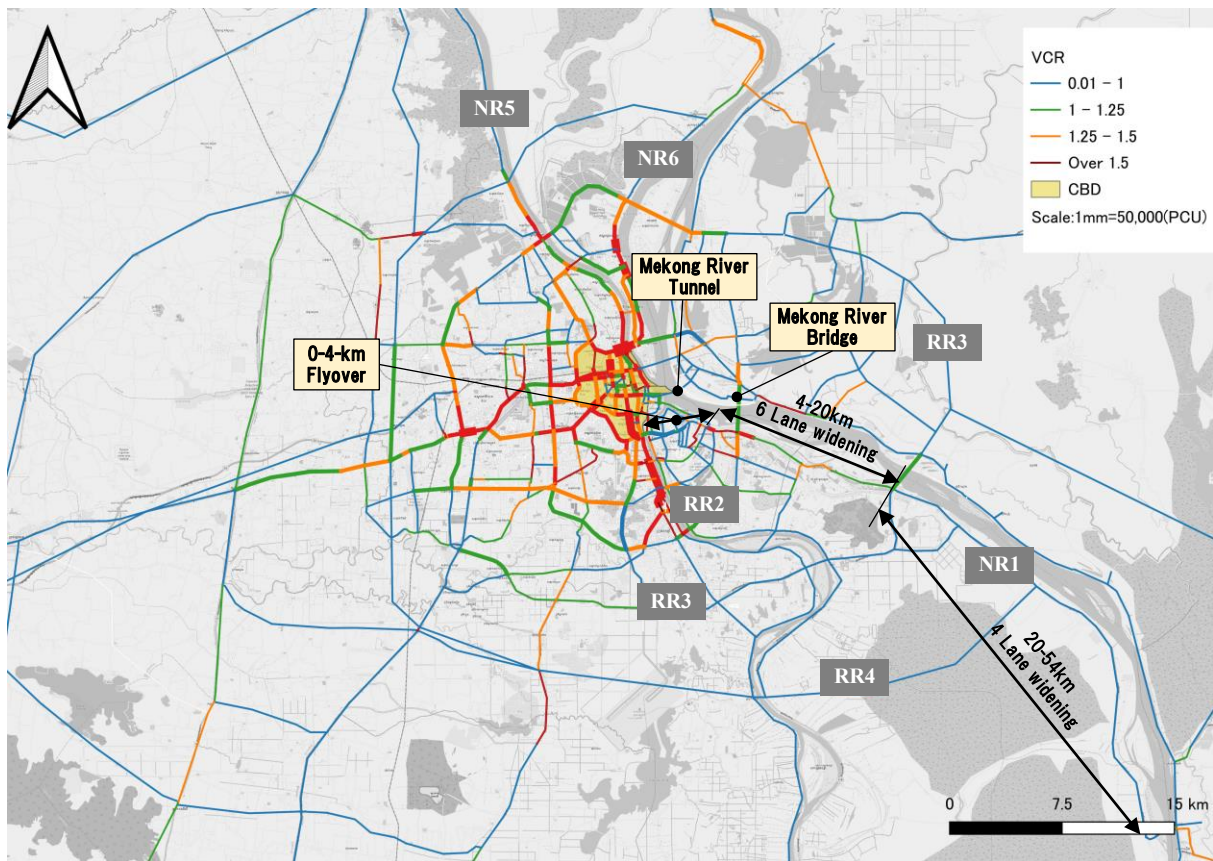


Figure 1.5-8 Case04_2035 Without Requested Project of NR1 Section 4-20km (With the other requested projects)

(9) Case 04_2050

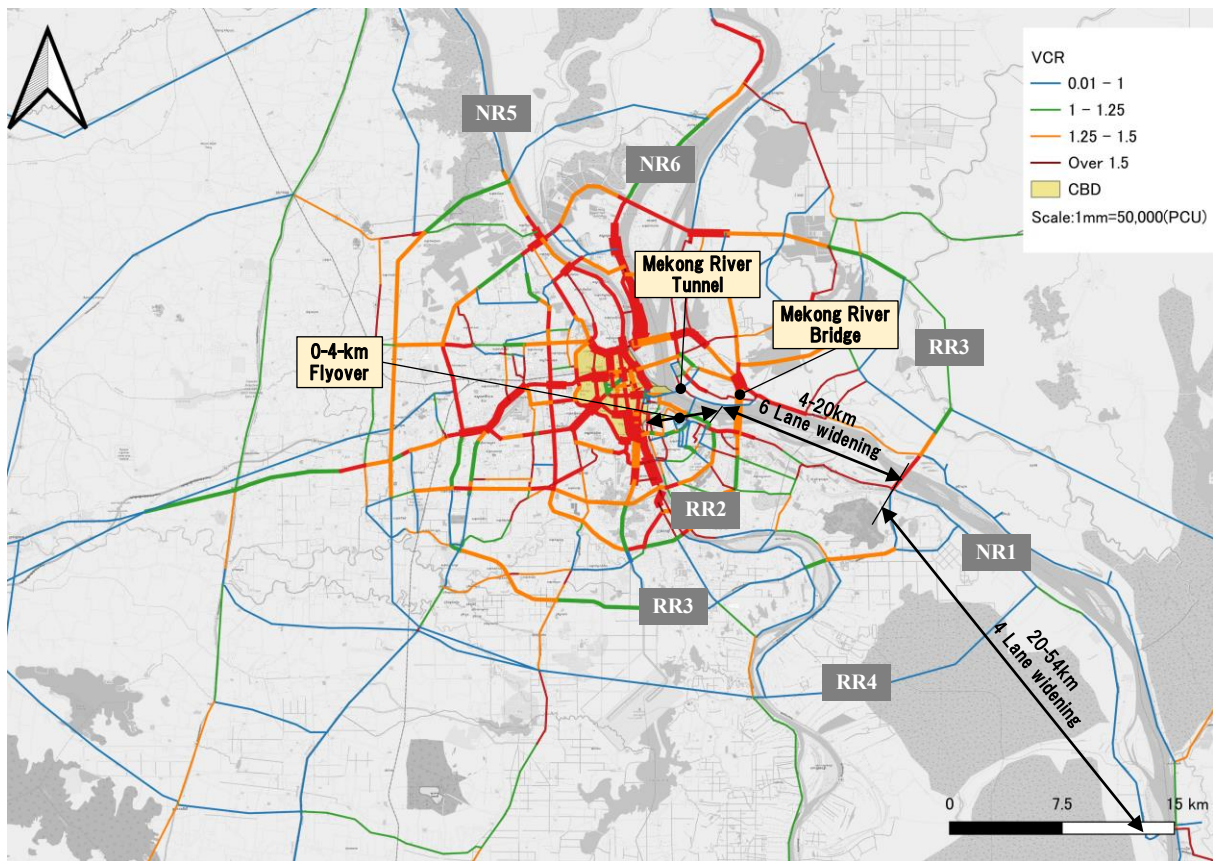


Figure 1.5-9 Case04_2050 Without Requested Project of NR1 Section 4-20km (With the other requested projects)

(10) Case 05_2035

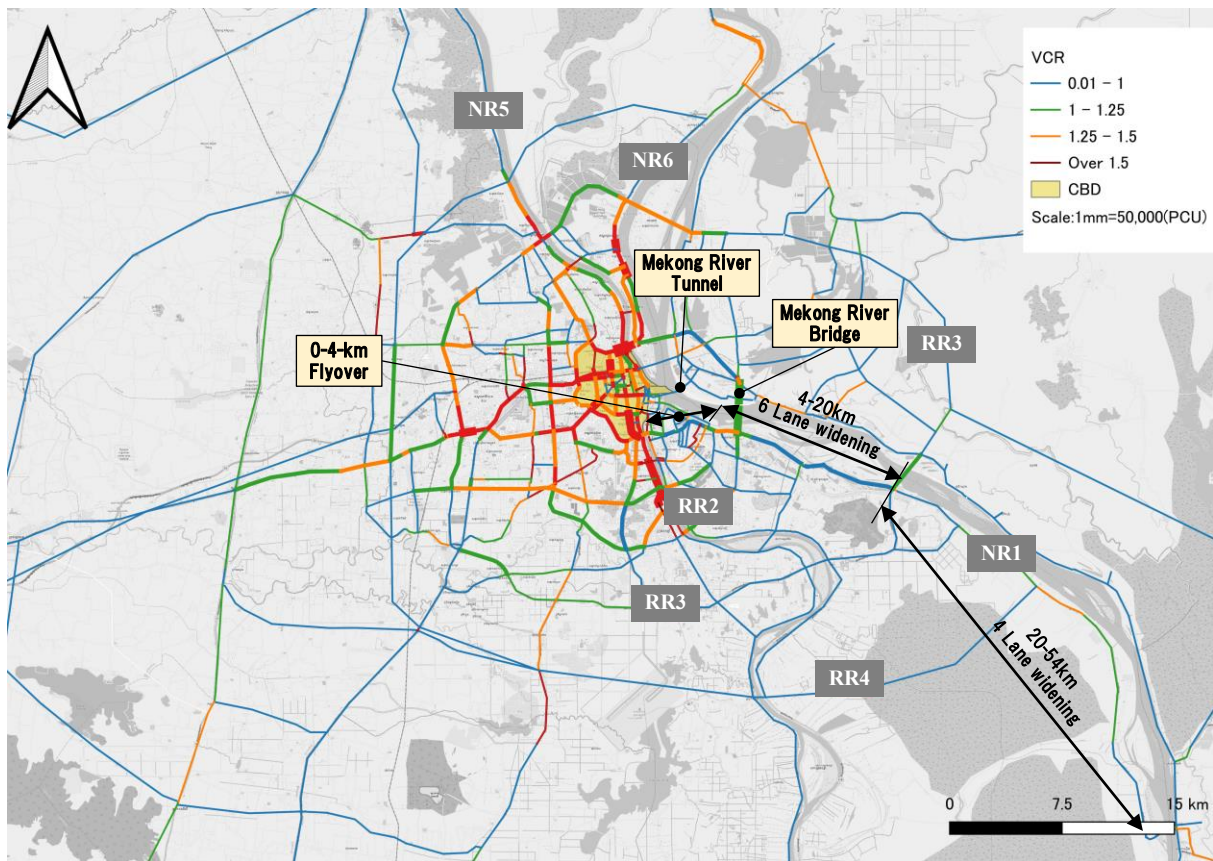


Figure 1.5-10 Case05_2035 Without Requested Project of NR1 Section 20-54km (With the other requested projects)

(11) Case 05_2050

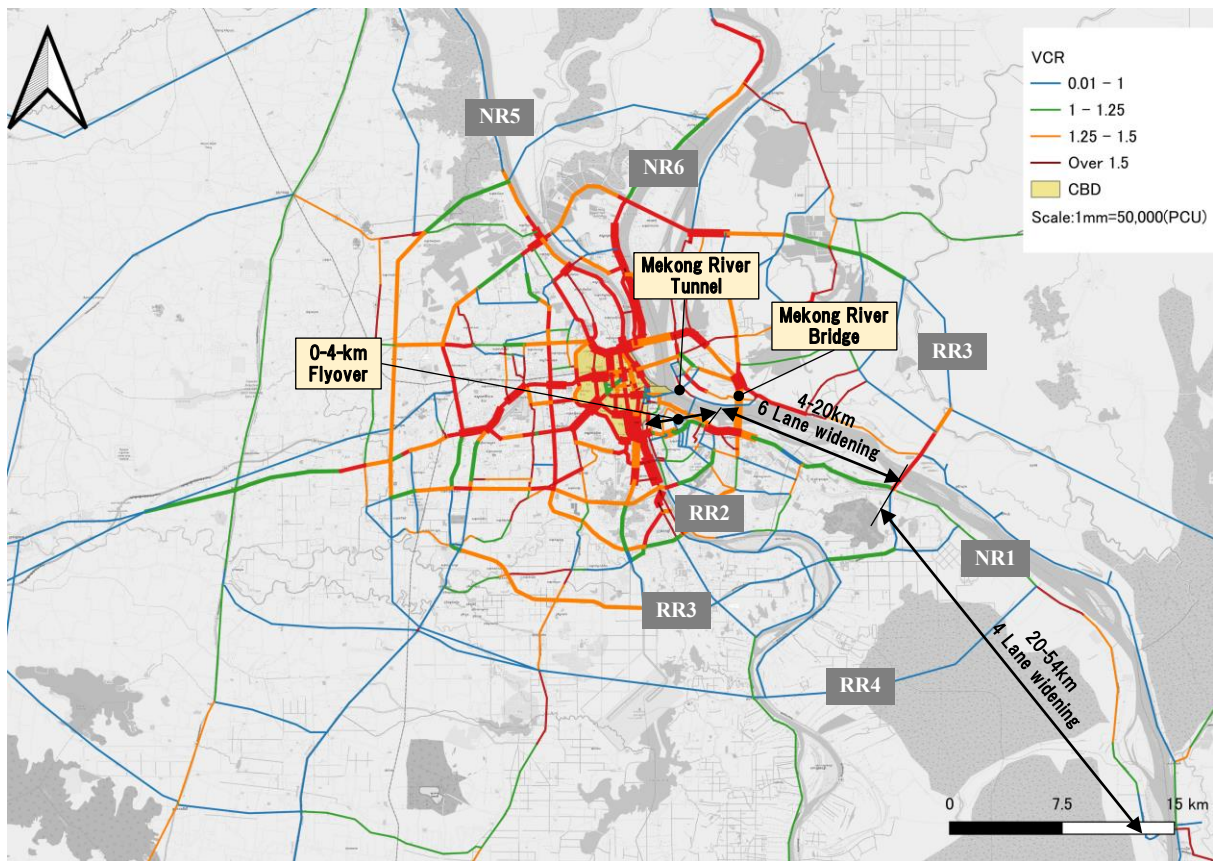


Figure 1.5-11 Case05_2050 Without Requested Project of NR1 Section 20-54km (With the other requested projects)

(12) Case 06_2035

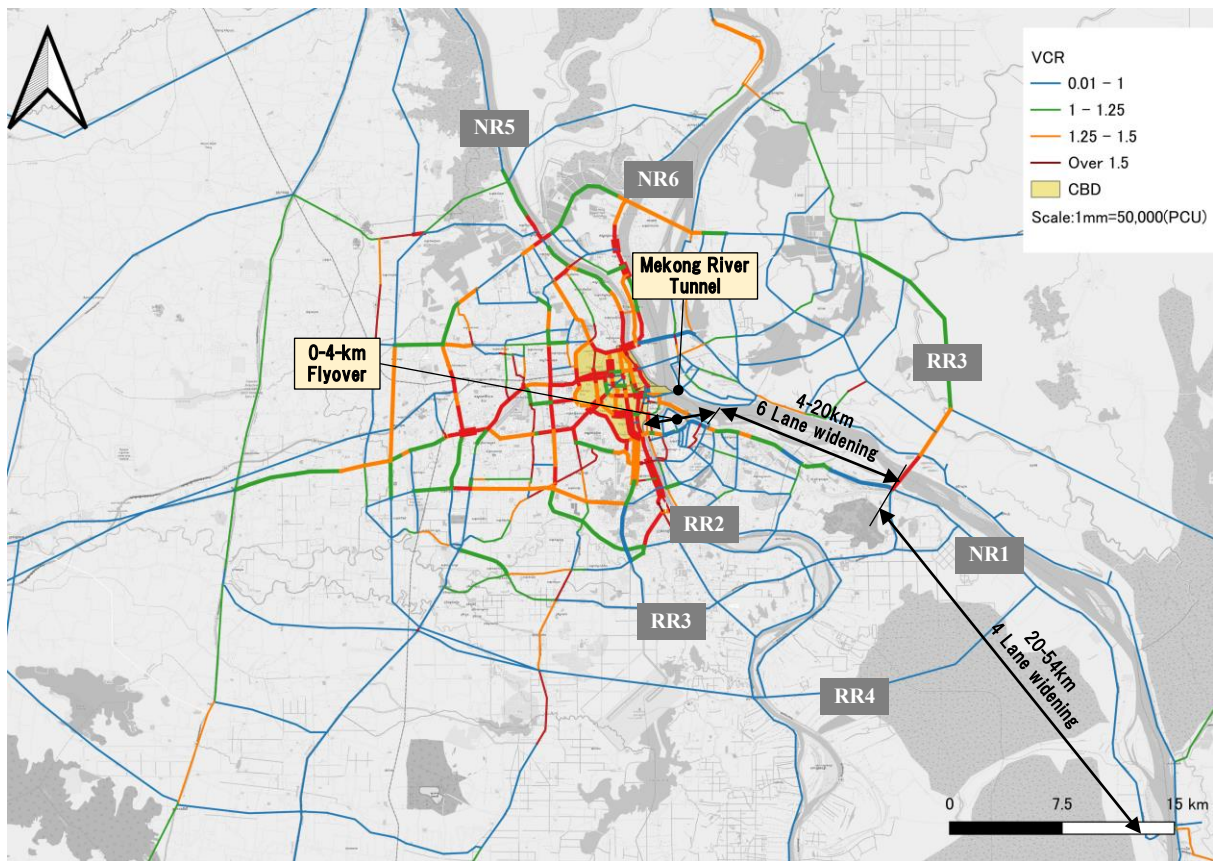


Figure 1.5-12 Case06_2035 Without Requested Project of the Mekong River Bridge (With the other requested projects)

(13) Case 06_2050

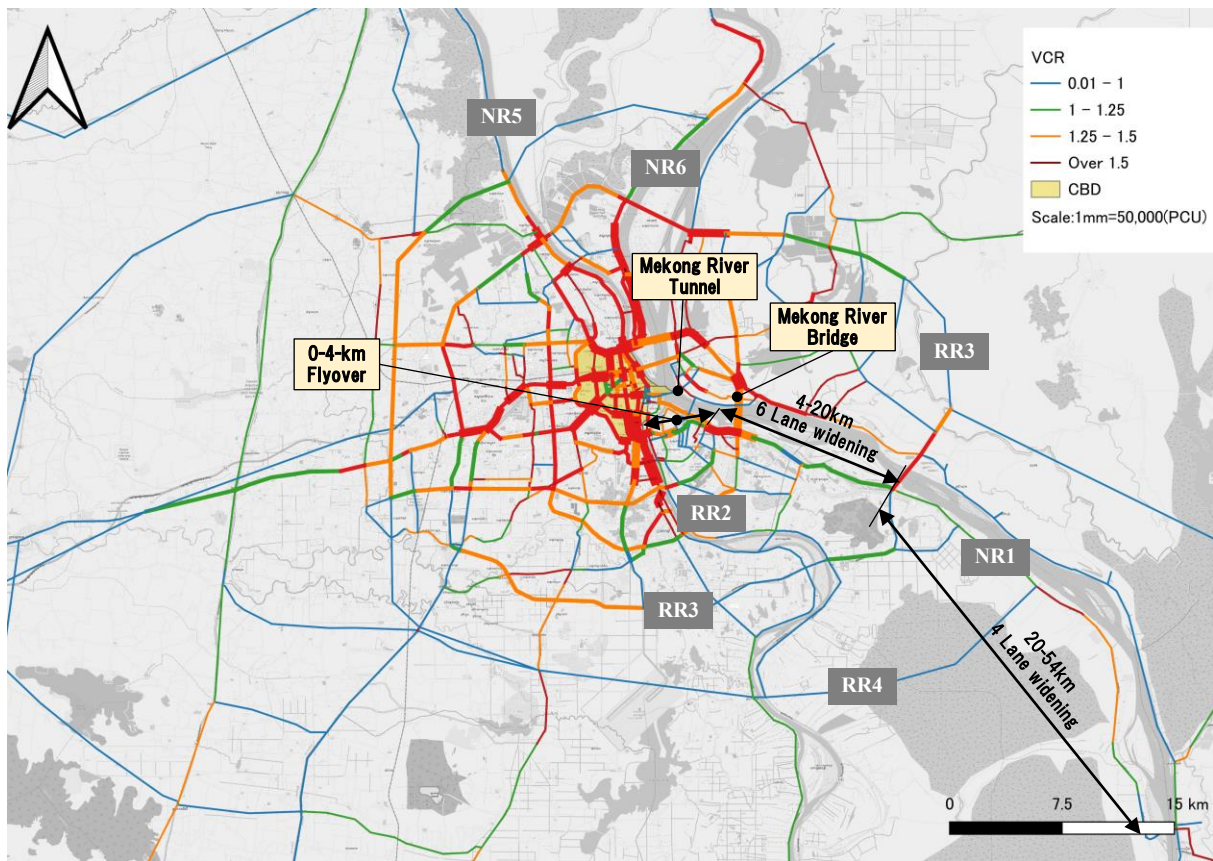


Figure 1.5-13 Case06_2050 Without Requested Project of the Mekong River Bridge (With the other requested projects)

(14) Case 07_2035

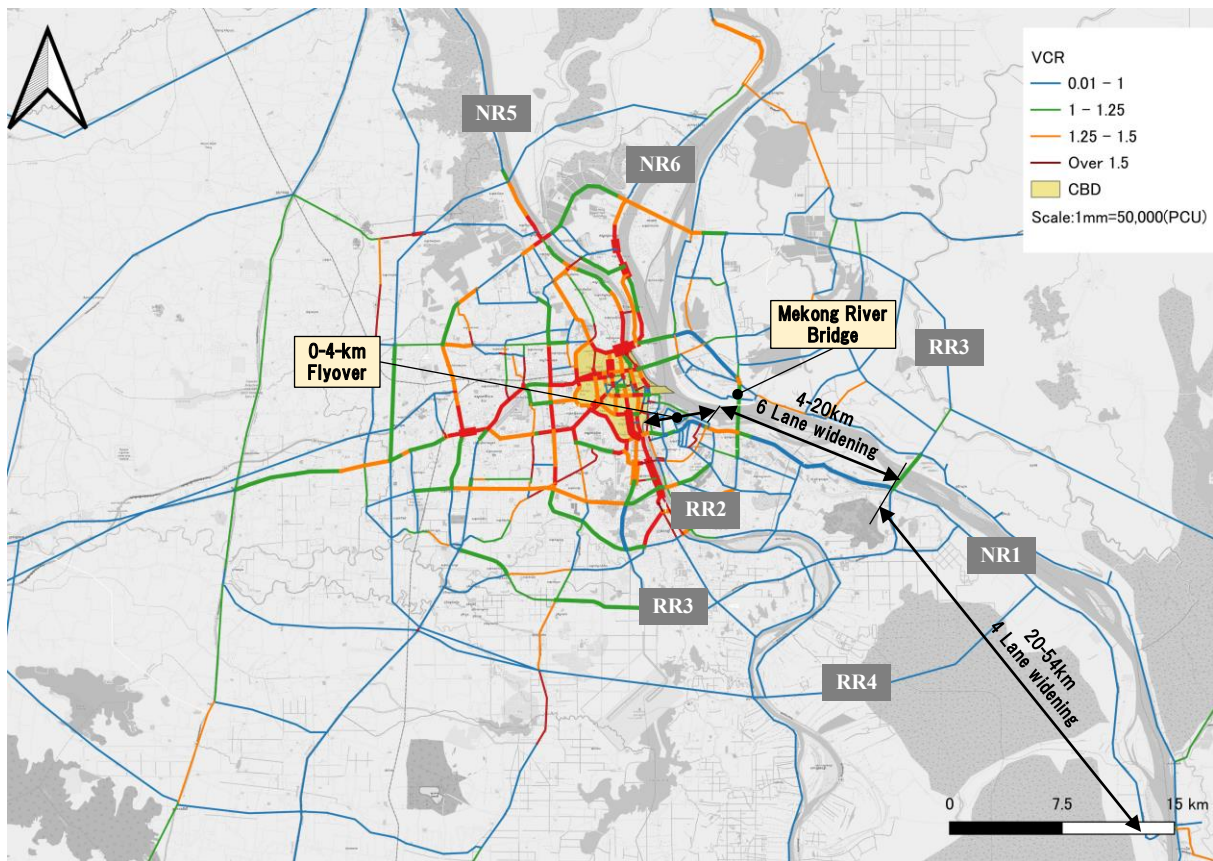


Figure 1.5-14 Case07_2035 Without Requested Project of the Mekong River Tunnel (With the other requested projects)

(15) Case 07_2050

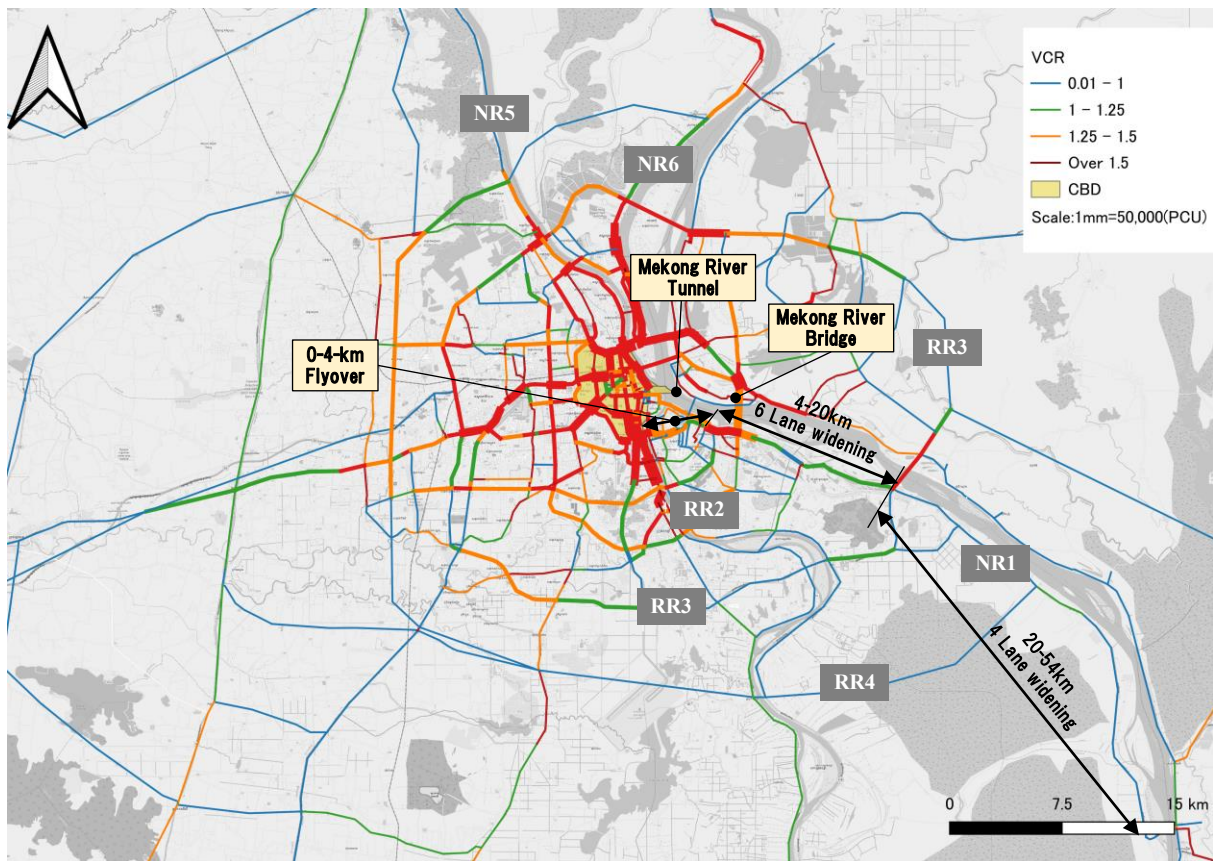


Figure 1.5-15 Case07_2050 Without Requested Project of the Mekong River Tunnel (With the other requested projects)

(16) Case 08

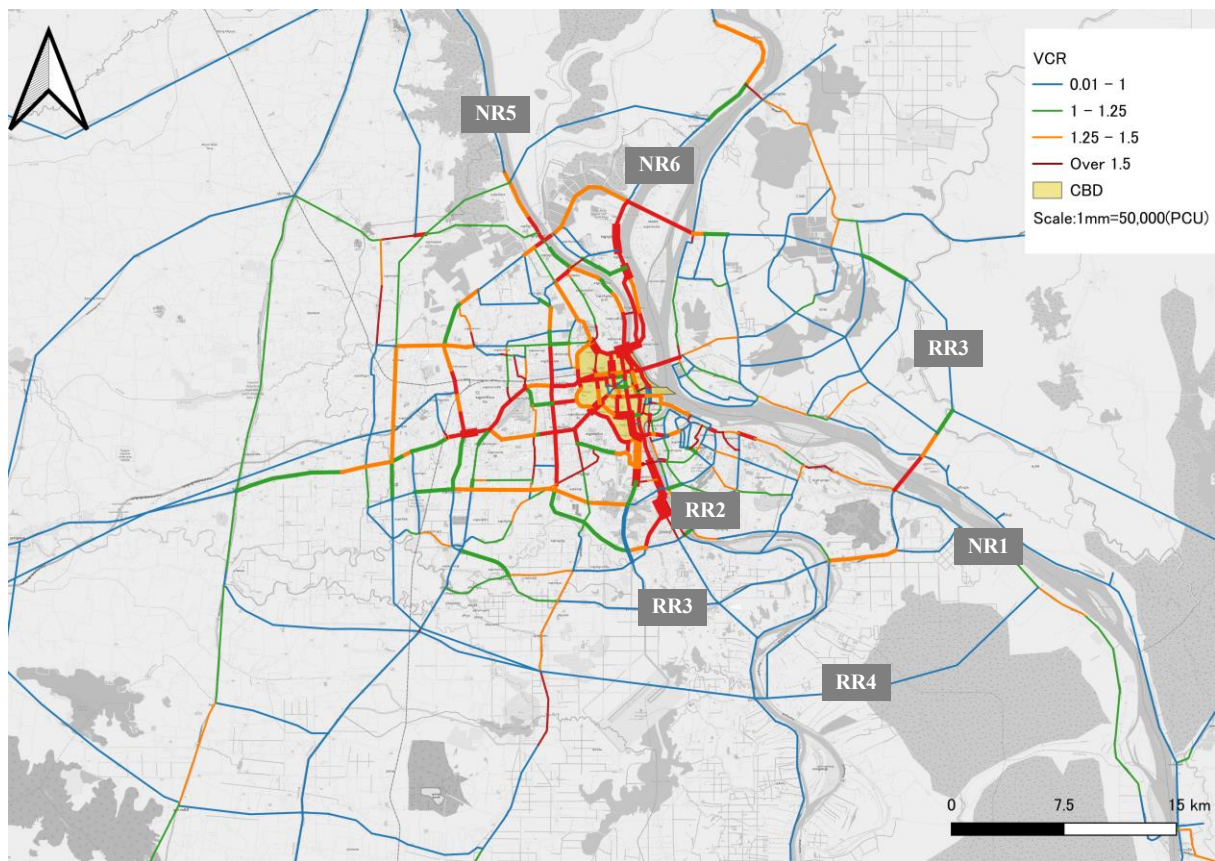


Figure 1.5-16 Case08_2035 Without All Requested Projects

(17) Case 09

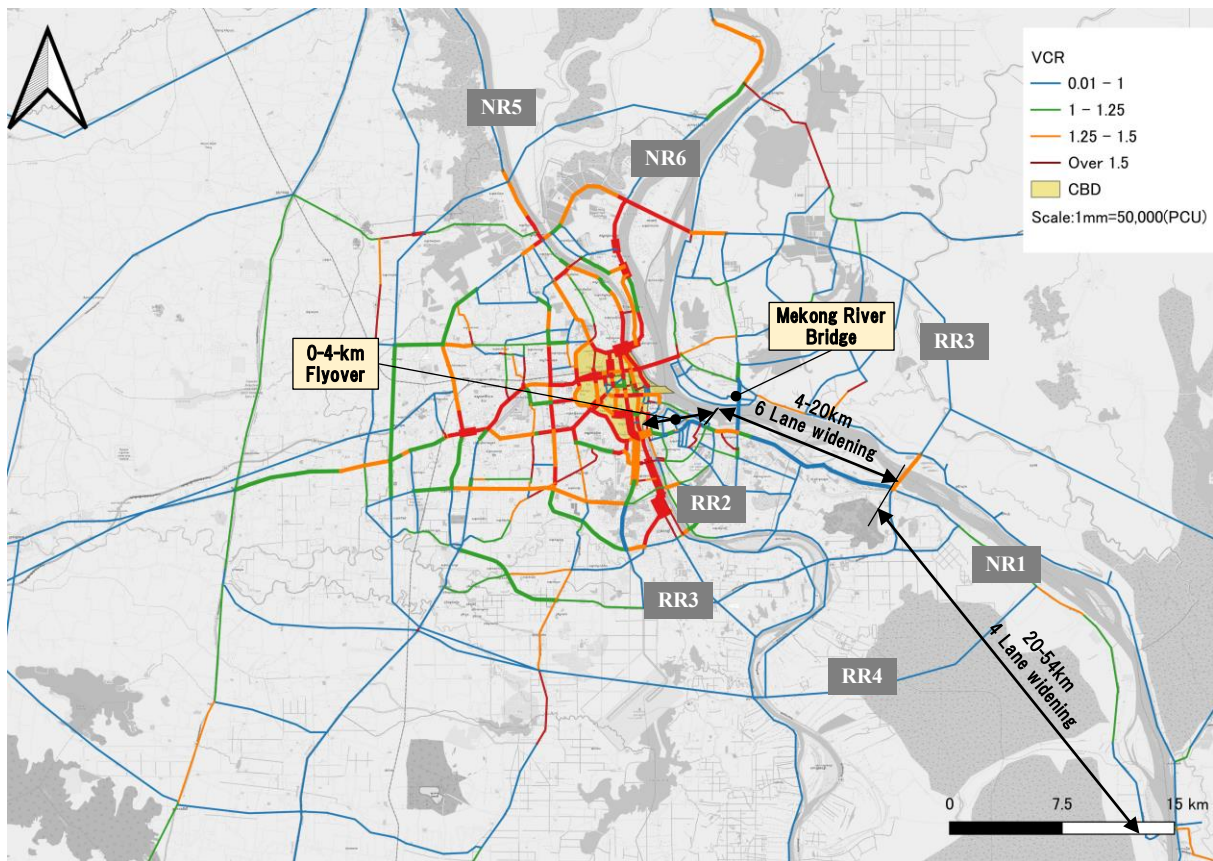


Figure 1.5-17 Case09_2035 With Requested Project of NR1 Section 0-4km: Flyover + NR1 4-20km 6-lane widening +20-54km 4-lane+ The Mekong River Bridge (Without the other requested projects)

(18) Case 10

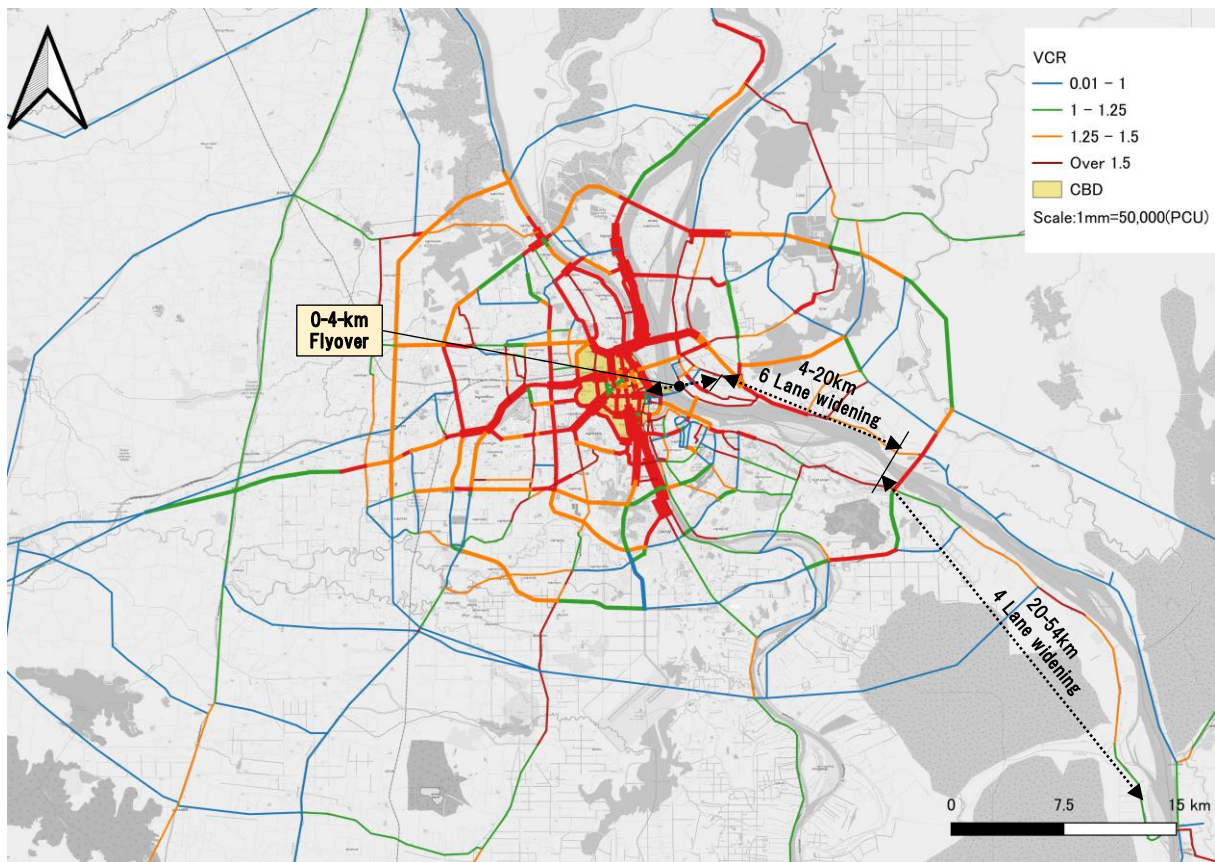


Figure 1.5-18 Case18_2050 Without Requested Project of NR1 Section 0-4km: Flyover + NR1 4-20km 6-lane widening +20-54km 4-lane+ The Mekong River Bridge (Without the other requested projects)