Socialist Republic of Vietnam
People's Committee of Hanoi

Socialist Republic of Vietnam
Data Collection Survey on BRT in Hanoi

Final Report

August 2016

Japan International Cooperation Agency (JICA)

ALMEC Corporation
Nippon Koei Co., Ltd.

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Table of Contents

List of Tables

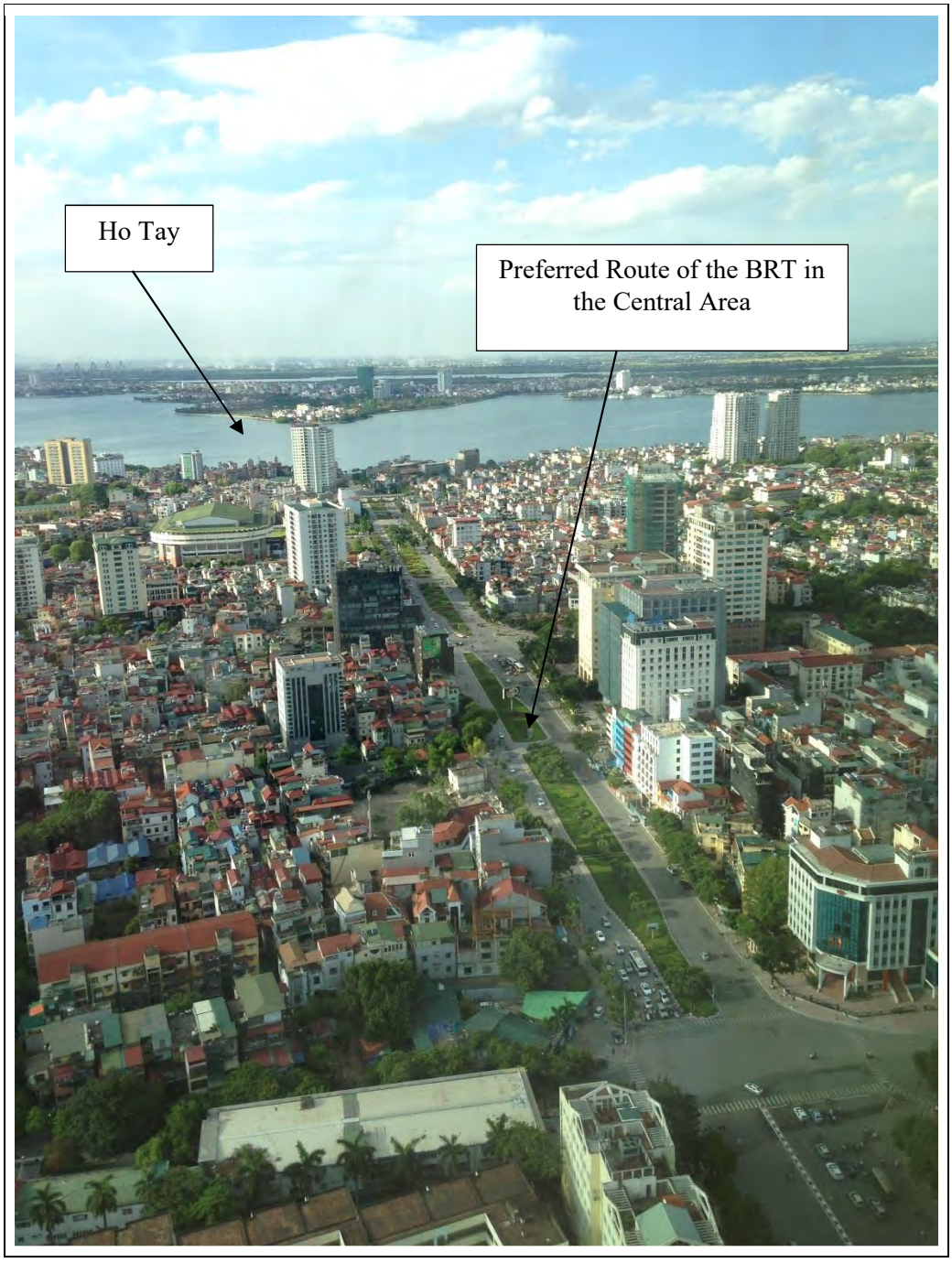
List of Figures

Abbreviations

AFC	Automatic Fare Collection System
BRT	Bus Rapid Transit
CBR	Cost Benefit Ratio
CENMA	Hanoi Center for Environmental and National Resources Monitoring and Analysis
DONRE	Department of Natural Resources and Environment
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENPV	Economic Net Present Value
EPP	Environmental Protection Plan
FIRR	Financial Internal Rate of Return
HAIDEP	The Comprehensive Urban Development Programme in Hanoi Capital City
HAIMUD2	Project for Studying the Implementation of Integrated UMRT and Urban Development for Hanoi in Vietnam
HDOT	Hanoi Department of Transport
HHTP	Hoa Lac High Tech Pack
HPC	Hanoi People's Committee
HUTDP	Hanoi Urban Transport Development Project (World Bank funded project that includes the BRT)
IC Card	Integrated Circuit Card/Smart Card
IEE	Initial Environmental Examination
ITDP	Institute for Transportation Development Policy
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
METROS	Data Collection Survey on Railways in Major Cities in Vietnam
MOC	Ministry of Construction
MONRE	Ministry of Natural Resources and Environment
MOT	Vietnam Ministry of Transport

O&M	Operations and Maintenance
OD	Origin and Destination
ODA	Official Development Assistance
PCU	Passenger Car Unit
PPP-FS	The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5)
PTA	Public Transport Authority
PTPS	Public Transport Priority System
R/W	Bus Mounted Reader/Writer Device for Smart Cards
RR3	Ring Road No. 3
TOD	Transit Oriented Development
TRAMOC	Hanoi Urban Transport Management and Operation Centre
TRANSERCO	Hanoi Transport Corporation
UMRT	Urban Mass Rapid Transit
USD	US Dollar
V/C Ratio	Volume to Capacity Ratio
VAT	Value Added Tax
VND	Vietnamese Dong
VNU	Vietnam National University

The Studied BRT Route in the Central Area of Hanoi



Visualization of the BRT

Before (along Van Cao St.)

After (along Van Cao St.)

1 Introduction

1.1 Background of the Study

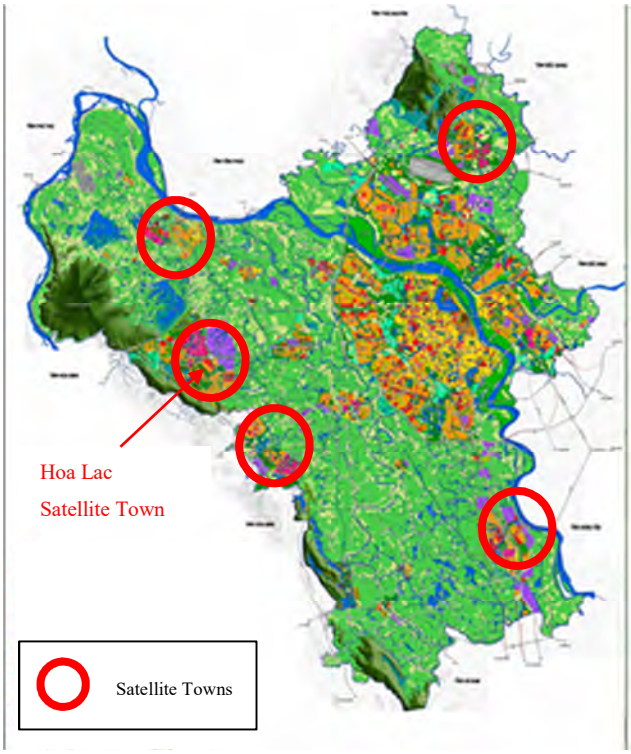
In metropolitan Hanoi, with the increase of urban residents together that comes with economic development of the city and along with increasing motorization, problems such as traffic congestion, traffic accidents, air pollution and difficulty in accessing city services have risen.

In 2008, the Prime Minister of Vietnam approved the Hanoi urban plan. The urban plan calls for the decentralization of the central area of Hanoi and the construction of 5 satellite towns. In the plan, the residential, educational, industrial and service industry functions of the city will be distributed among the satellite towns.

However, the development of these new satellite towns has not necessarily been proceeding smoothly and the situation where the population continues to increase in the central area of Hanoi has remained unchanged. One of the reasons for the late development of the satellite towns is the poor transport network to connect the satellite towns with the central area of Hanoi.

This study is targeted at the Hoa Lac Satellite Town that is located on the western region of Hanoi and the urban functions of this satellite town is centred on science, technology and education. The main facilities in this satellite town will be the construction of the Vietnam National University and the Hoa Lac High Tech Park. The maximum development area is 18,000 ha and by 2030, the population is estimated to reach 600,000.

The Japan International Cooperation Agency (JICA) is implementing official development assistance on the cooperation for developing the basic infrastructure of this science, technology and industrial hub in Hoa Lac for the purpose of promoting economic growth and strengthening international competitiveness through this hub.



Source: Vietnam Ministry of Construction

Figure 1.1.1 Strategic Development of Hanoi by 2050 (Spatial and Transport Development)

At present, the Thang Long Expressway that connects the Hoa Lac Satellite Town with the central area of Hanoi has been completed and as a result, access to Hoa Lac has been greatly improved. Also, in the formulated urban plan of Hanoi, the Urban Mass Rapid Transit (UMRT) Line 5 is planned to be constructed but has not yet been implemented.

The distance between the Hoa Lac Satellite Town and the central area of Hanoi is around 40 km. The travel distance of Vietnam's most typical transport mode, the motorcycle, is around 10-15 km and as a result, there are limitations with the accessibility of Hoa Lac Satellite Town from the central area of Hanoi.

Also, there are restrictions in the budget of the Vietnamese government that makes construction of the UMRT Line 5 difficult and as a result, it is assumed that the introduction of a Bus Rapid Transit (BRT) will be significant. However, in the limited road space, the BRT is expected to use up one lane that would otherwise be used by regular traffic and it is assumed that there could be congestion as a result of this. In consideration of the BRT's influence on regular traffic, for the provision of a high level of service for the BRT, a careful examination of the introduction of the BRT is necessary.

1.2 Objectives of the Study

Based on the background as mentioned above, for the introduction of the BRT in the metropolitan area of Hanoi, existing reports will be utilized and consistency of the master plans, Hoa Lac urban development plan will be confirmed and a review of the traffic demand will be done.

Based on this, the preferred alternative route for the BRT will be selected and an examination of the route planning, operations plan, fare system, traffic management plan, operations management structure will be done for in preparation for a proposal on the implementation of the BRT.

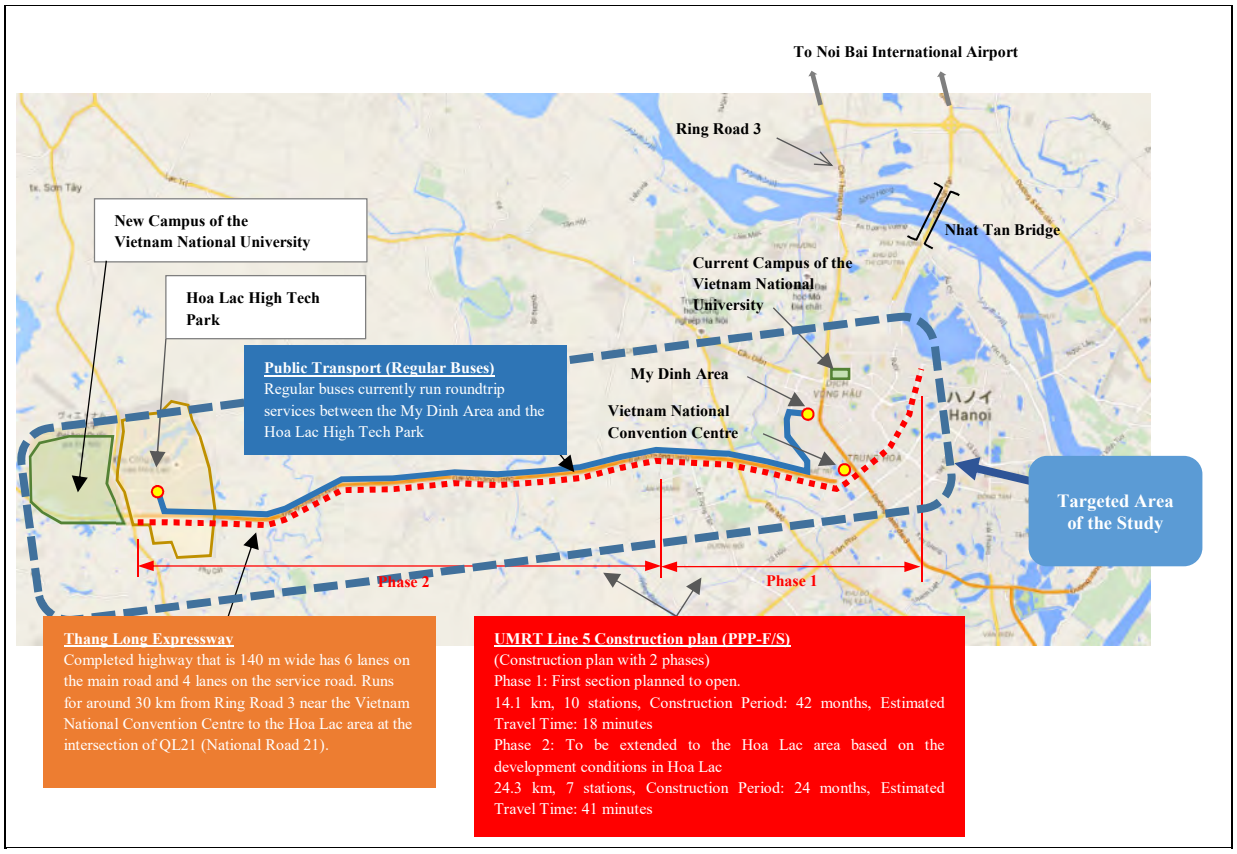
1.3 Study Area

The target area for this study will be the metropolitan area of Hanoi, especially the central area of Hanoi and the corridor to Hoa Lac.

The Hoa Lac Satellite Town is designed as an academic and research city and centred on the Hoa Lac High Tech Park and the Vietnam National University, it is expected that the future population will exceed 600,000. If the development of Hoa Lac proceeds as planned, there will be sufficient traffic demand for secure the profitability of public transport services.

At present, the Hoa Lac High Tech Park and the Vietnam National University area have yet to be developed, however, it is anticipated that with the cooperation of the Japanese government, development of Hoa Lac will progress.

The following figure shows the targeted area of this study.



Source: Study Team

Figure 1.3.1 Targeted Area of Study

2 Review of Existing Studies and Projects

2.1 Hanoi Master Plan to 2030 and Vision to 2050

According to the "Hanoi Master Plan to 2030 and Vision to 2050" that was adopted on July 21, 2011, the Vietnamese government decided to develop Hanoi into a large scale international city of political, cultural, scientific, educational and economic importance. This plan assumes that the population of Hanoi will reach 9-9.2 million in the target year of 2030.

According to this master plan, the spatial development of Hanoi will be as follows. The old urban area west of the Red River to Ring Road 2 is designated as a historically important district where development will be regulated. In the area from Ring Road 2 up to the east bank of the Nhue River, urban development will be expanded and the area west of the Nhue River and north of the Red River to Ring Road 4 is also designated as an urban development district.

In the urban master plan for Hanoi, five satellite towns, Hoa Lac, Son Tay, Xuan Mai, Phu Xuyen and Soc Son, are planned reduce the population density in the old urban area of Hanoi and to spread out the urban functions of Hanoi more evenly around the metropolitan area. These five satellite towns are assumed to have a population of 1.3-1.4 million and a development area of around 35,200 ha by 2030.

The locations of the spatial development plan of Hanoi are shown in the following figure.

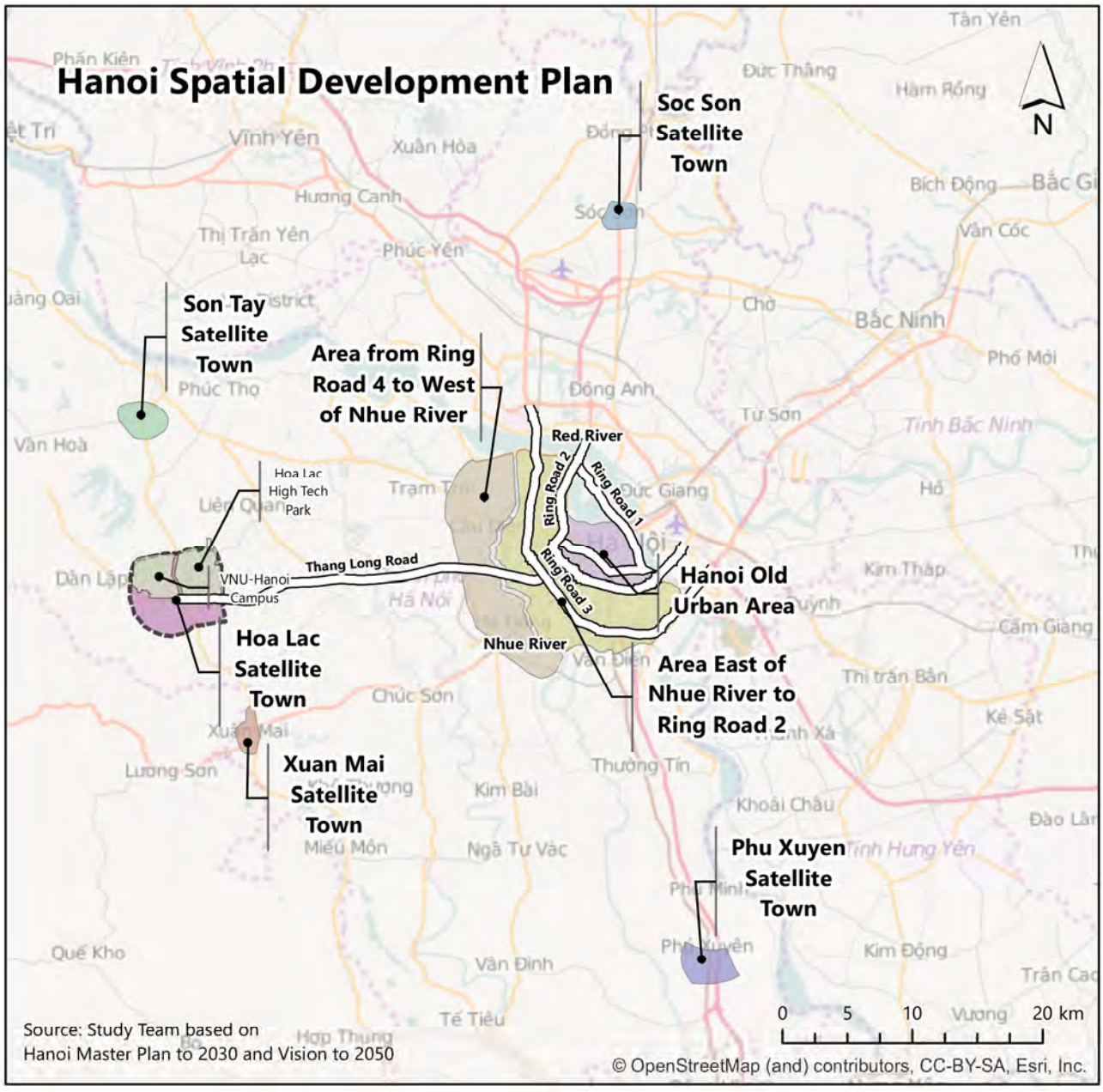
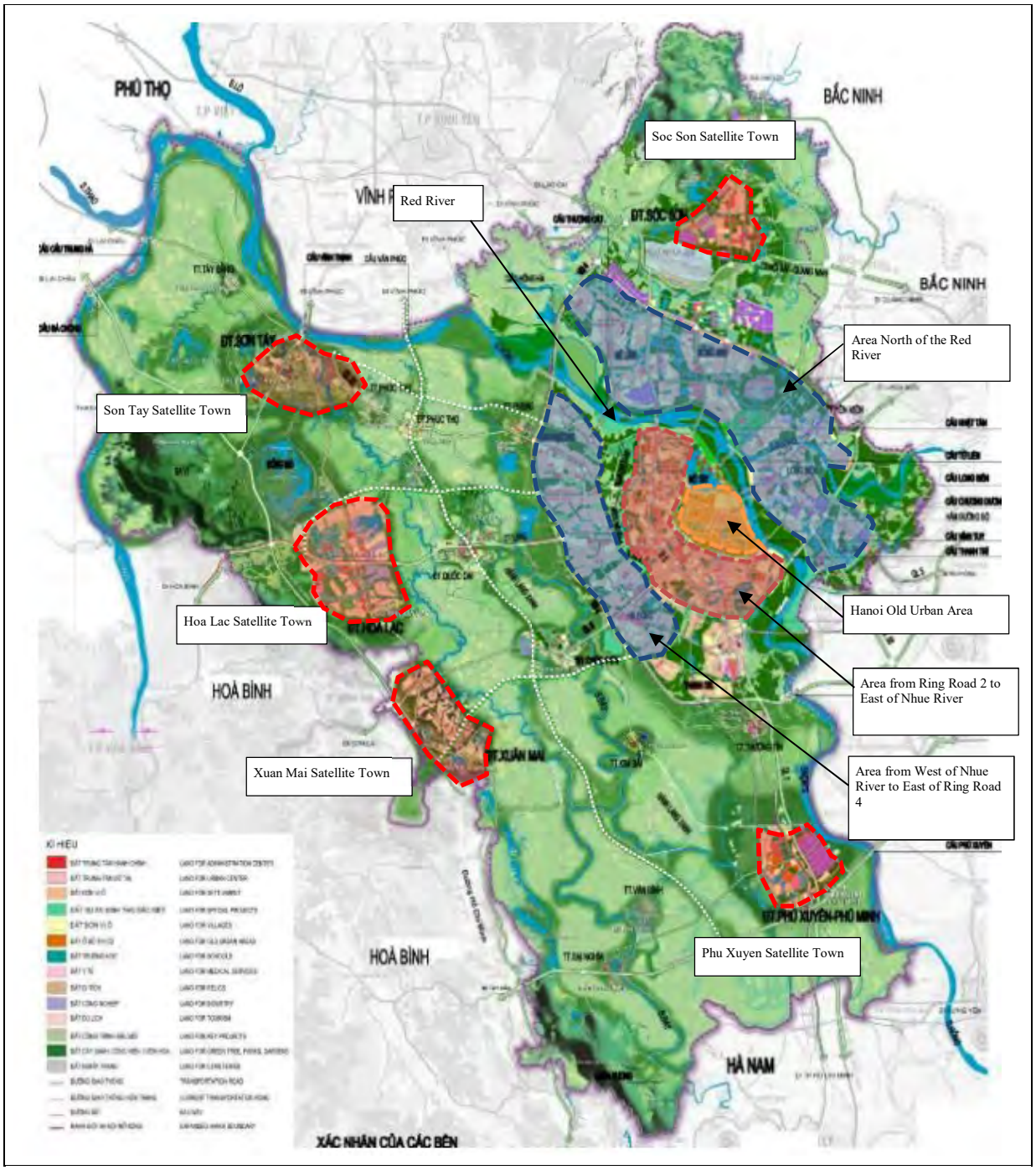


Figure 2.1.1 Spatial Development Plan of Hanoi (Geographic Map)



Source: Hanoi Master Plan to 2030 and Vision to 2050

Figure 2.1.2 Spatial Development Plan of Hanoi (Planning Map)

The satellite towns and the existing central urban areas of Hanoi will be connected by ring roads and radial roads with a green belt constructed between the central urban area and the satellite towns to improve the living environment.

Among the satellite towns planned, the corridor to Hoa Lac and the Hoa Lac Satellite Town is designed to be a "technology corridor" for science and technology where it will be a gathering place for the most advanced technologies of Vietnam. The Hoa Lac Satellite Town is where the 1,586 ha Hoa Lac High-Tech Park is being developed with the support of JICA. The Hoa Lac High-Tech Park is planned to be more than just an industrial park but also as an academic research city to cultivate human resources as the Vietnam National University, Hanoi is to be relocated from the central area of Hanoi to the a new campus adjacent to the Hoa Lac High-Tech Park.

2.2 Planning on Transportation in Hanoi up to 2030, with a Vision towards 2050

On March 31, 2016, the Decision No. 519/QD-TTg was issued by the Prime Minister to approve the planning of transportation in Hanoi up to 2030 with a vision towards 2050. This decision covers all forms of transport infrastructure in Hanoi including road, rail and water transport.

With regards to public transport, the decision sets the criteria for public transport network density of 2-3 km/km^2 in the central area and 2-2.5 km/km^2 in the satellite towns and aims at increasing the public transport modal share by the following:

- 2020 Public Transport Modal Share
  - Central Area: 30-35%
  - Satellite Towns: 15%
- 2030 Public Transport Modal Share
  - Central Area: 65-70%
  - Satellite Towns: 40% (50% after 2030)

2.2.1 Official UMRT Network Plan

For UMRT lines, the following lines are now part of the official network plan. According to the official plan, for UMRT Lines 4 and 8, BRT can be constructed in certain sections depending on the estimated traffic volume before the actual construction of these 2 lines. However, for UMRT Line 5, there is no mention of building a BRT line before the targeted construction of the line and there is an optimistic schedule to have the UMRT Line 5 built from Van Cao to Ring Road 4 by 2020.

Table 2.2.1 Official UMRT Network Implementation Plan

UMRT Line	Section	Length (km)	Stations	Implementation Plan	Remarks
Line 1	Ngoc Hoi-Yen Vien-Nhu Quynh	36	23 (2 depots)		
	Ngoc Hoi-Yen Vien	26		2016-2020	
	Gia Lam- Duong Xa	10		2020-2030	
Line 2	Noi Bai-Thuong Dinh-Buoi (excludes the extension to Soc Son)	43	32 (2 depots)		
	Nam Thang Long-Tran Hung Dao	12		2016-2020	
	Tran Hung Dao-Thuong Dinh	6		2016-2020	
	Thuong Dinh- Road Road 2.5- Buoi	7		2020-2030	
	Noi Bai- Nam Thang Long	18		2020-2030	
	Extend Line 2 to Soc Son	9		After 2030	
Line 2A	Cat Linh- Ha Dong (excludes the extension to Xuan Mai)	14	12 (1 depot)		
	Cat Linh- Ha Dong	14		2016-2020	
	Extend Line 2A to Xuan Mai	20		After 2030	
Line 3	Troi- Nhon- Yen So (excludes the extension to Son Tay)	27	26 (1 depot)		
	Nhon-Hanoi station	13		2016-2020	
	Troi- Nhon	6		2020-2030	
	Section from Hanoi station-Yen So	8		2020-2030	
	Extend to Son Tay	30		After 2030	
Line 4	Me Linh-Sai Dong-Lien Ha	54	41 (2 depots)	After 2030	BRT can be considered for each section before construction of the UMRT
Line 5	Van Cao- Hoa Lac	40	17 (2 depots)		
	Van Cao- Ring Road 4	14		2016-2020	
	Ring Road 3 – Hoa Lac	26		2020-2030	
Line 6	Noi Bai- Ngoc Hoi	43	29 (2 depots)	2020-2030	
Line 7	Me Linh- Ha Dong	28	23 (1 depot)	2020-2030	
Line 8	Son Dong- Mai Dich-Duong Xa	37	26 (2 depot)		BRT can be considered for each section before construction of the UMRT

	Son Dong-Mai Dich	12		2020-2030	
	Mai Dich-Ring Road 3- Duong Xa	25		After 2030	
UMRT Line linking the satellite towns	Son Tay-Hoa Lac-Xuan Mai	32		After 2030	BRT can be considered for each section before construction of the UMRT

Source: Decision No. 519/QD-TTg, March 31, 2016, Prime Minister of Vietnam

2.2.2 Current Implementation Status of the UMRT

Currently (as of June 2016), four UMRT lines (Line 1, 2, 2A and 3) are in the implementation phase. The operator for all the UMRT lines in Hanoi will be a newly formed operating company, Hanoi MRT, which will be under the control of the Hanoi People's Committee. Detailed regarding the current status of the four UMRT lines is shown in the following table.

Table 2.2.2 Current Implementation Status of the Planned UMRT Lines

Line	Route	Length (km)	Implementing Agency	Funding Source (ODA)	Current Status	Planned Opening Year
1	Yen Vien-Ngoc Hoi	26	Railway Project Management Unit under the Ministry of Transport	Japan	In the detailed design phase	2020
2A	Cat Linh-Ha Dong	14		China	Construction of the depot, route and stations underway	2016
2	Nam Thang Long-Tran Hung Dao	12	Hanoi Metropolitan Railway Management Board under the Hanoi People's Committee	Japan	Procurement plan approved and detailed design is in progress	2019
3	Nhon-Hanoi railway station	13		AFD (France), Asian Development Bank and European Investment Bank	Construction of the depot, route and stations underway	2018

Source: Hanoi MRT

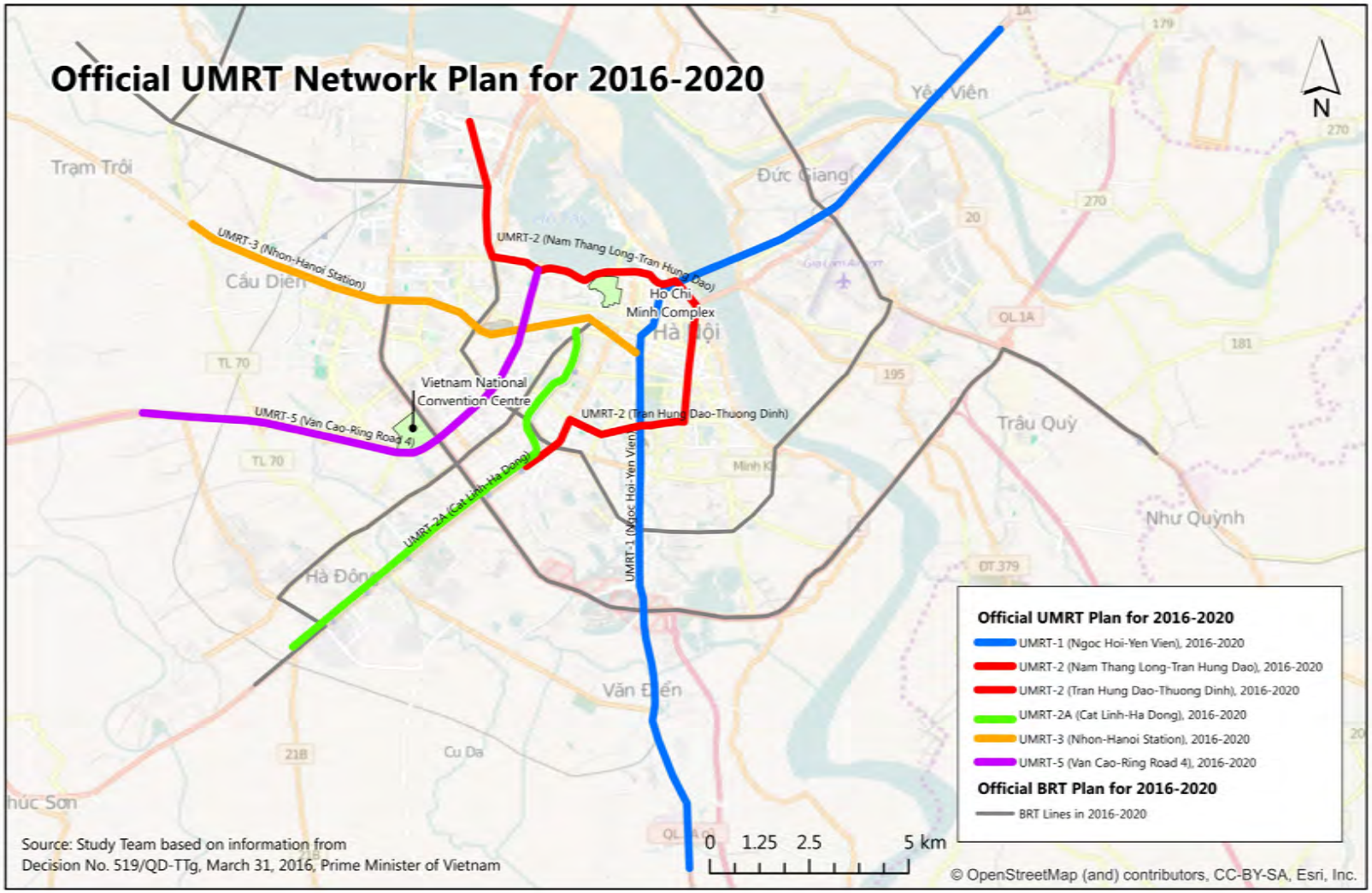


Figure 2.2.1 Official UMRT Network Plan for 2016-2020

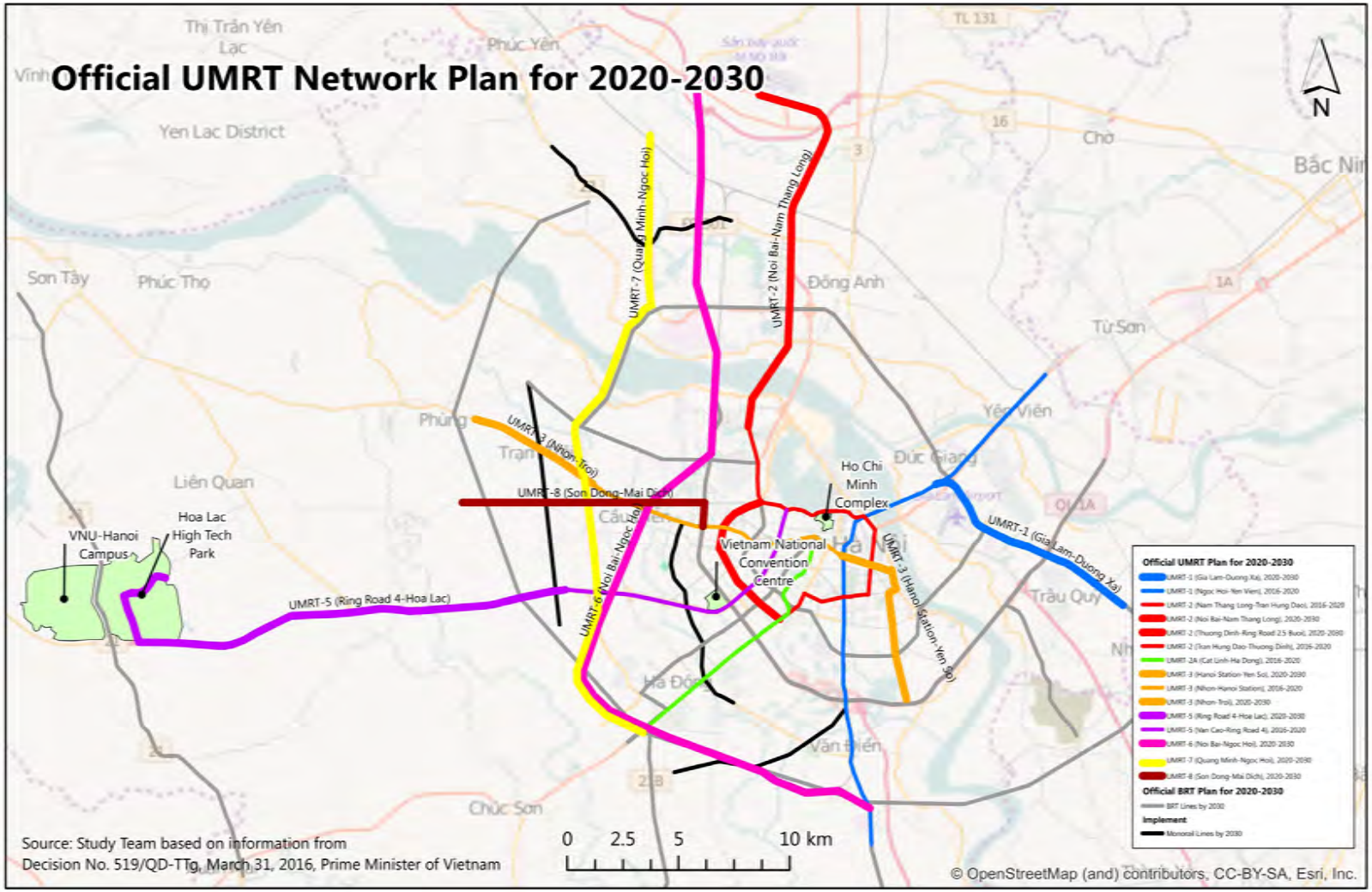


Figure 2.2.2 Official UMRT Network Plan for 2020-2030

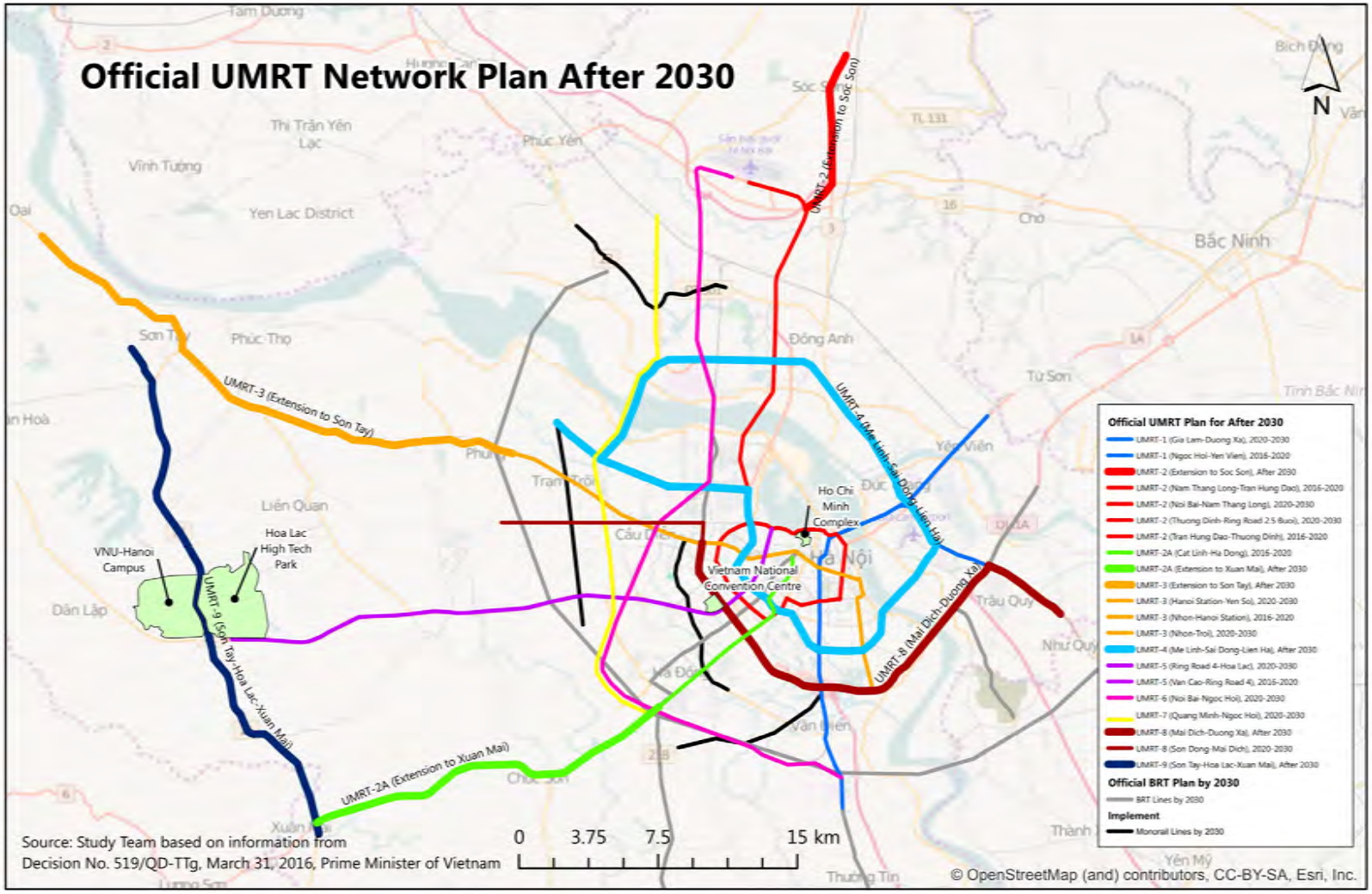


Figure 2.2.3 Official UMRT Network Plan for After 2030

2.2.3 Official Monorail Plan

Also, in Decision No. 519/QD-TTg, for the public transport plan for Hanoi, 3 monorail lines were included. The general details of the planned monorail lines are shown in the following table. The purpose of using the monorail technology is that it can be applied to corridors with high traffic volumes but with narrow road cross-sections and roads with many curves.

Table 2.2.3 Official Monorail Implementation Plan

Monorail Line	Section	Length (km)	Implementation Plan
Line M1	Lien Ha- Tan Lap-An Khanh	11	2020-2030
Line M2	Mai Dich-My Dinh-Van Mo-Phuc La and Giap Bat-Thanh Liet-Phu Luong	22	2020-2030
Line M3	Nam Hong-Me Linh-Dai Thinh	11	2020-2030

Source: Decision No. 519/QD-TTg, March 31, 2016, Prime Minister of Vietnam

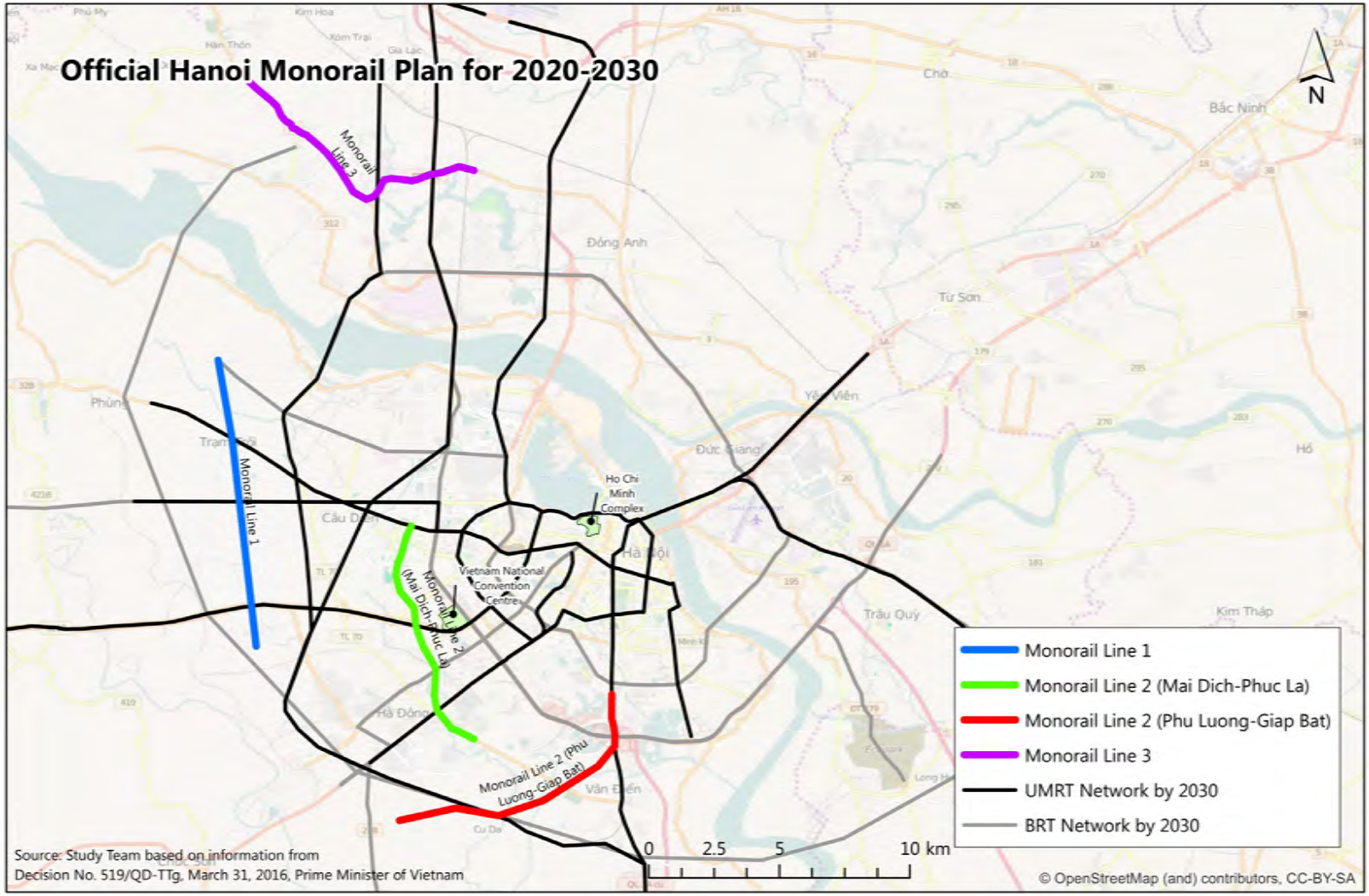


Figure 2.2.4 Official Monorail Plan for 2020-2030

2.2.4 Official BRT Plan

Eleven BRT routes are planned in the public transport plan for Hanoi in Decision No. 519/QD-TTg. Three of these planned BRT routes are on the same corridor as the UMRT Line 4, Line 8 and the UMRT linking the satellite towns of Son Tay, Hoa Lac and Xuan Mai. For these 3 routes, the BRT can be changed to UMRT when there is enough travel demand.

Table 2.2.4 Official BRT Implementation Plan

BRT Line	Section	Length (km)	Implementation Plan	Remarks
BRT Line 1	Kim Ma-Le Van Luong-Yen Nghia	14	2016-2020	World Bank BRT line
BRT Line 2	Road Ring 3 from Mai Dich- Duong Xa	25	2016-2020	Phase 2 of UMRT Line 8 corridor
BRT Line 3	Road Ring 2.5 and Extended along National Highway 5	54	2016-2020	UMRT Line 4 corridor
BRT Line 4	Ngoc Hoi- Phu Xuyen (along old National Highway 1)	27	2020-2030	
BRT Line 5	Son Dong- Ba Vi (along Ho Tay-Ba Vi)	20	After 2030	
BRT Line 6	Phu Dong-Bat Trang- Hung Yen (along Ring Road 3 and entering Ha Noi-Hung Yen)	15	2020-2030	
BRT Line 7	Gia Lam - Me Linh (along Ring Road 3)	30	2020-2030	
BRT Line 8	Me Linh- Son Dong-Yen Nghia-Ngoc Hoi-National Highway 5-Lac Dao (along Ring Road 4)	53	2020-2030	
BRT Line 9	Ba La - Ung Hoa (along National Highway 21B)	29	2020-2030	
BRT Line 10	Ung Hoa - Phu Xuyen (along Do Xa-Quan Son to the junction with National Highway 21B)	17	2020-2030	
BRT Line 11	Son Tay-Hoa Lac-Xuan Mai	32	2020-2030	UMRT Line linking the satellite towns

Source: Decision No. 519/QD-TTg, March 31, 2016, Prime Minister of Vietnam

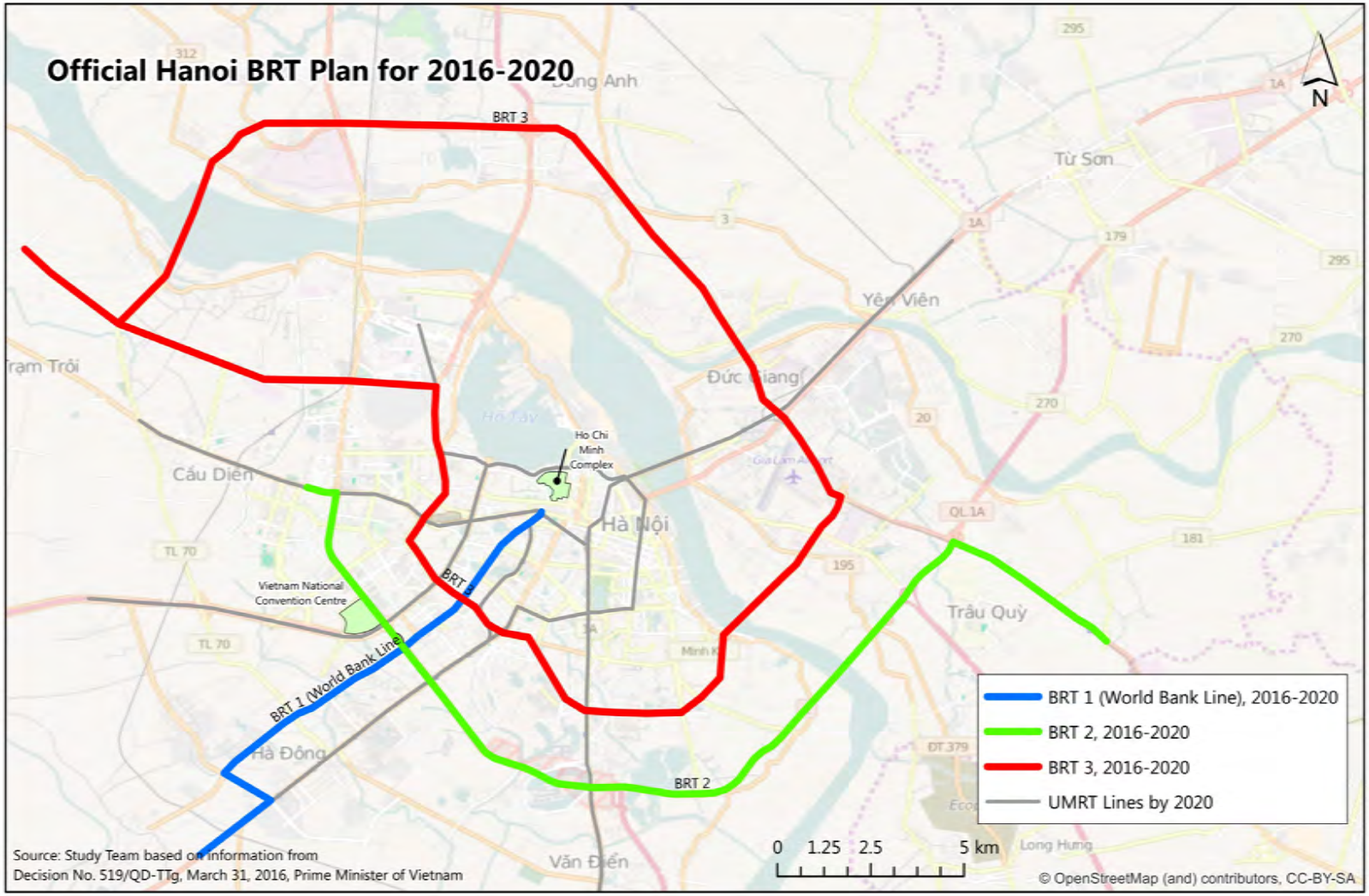


Figure 2.2.5 Official BRT Network Plan for 2016-2020

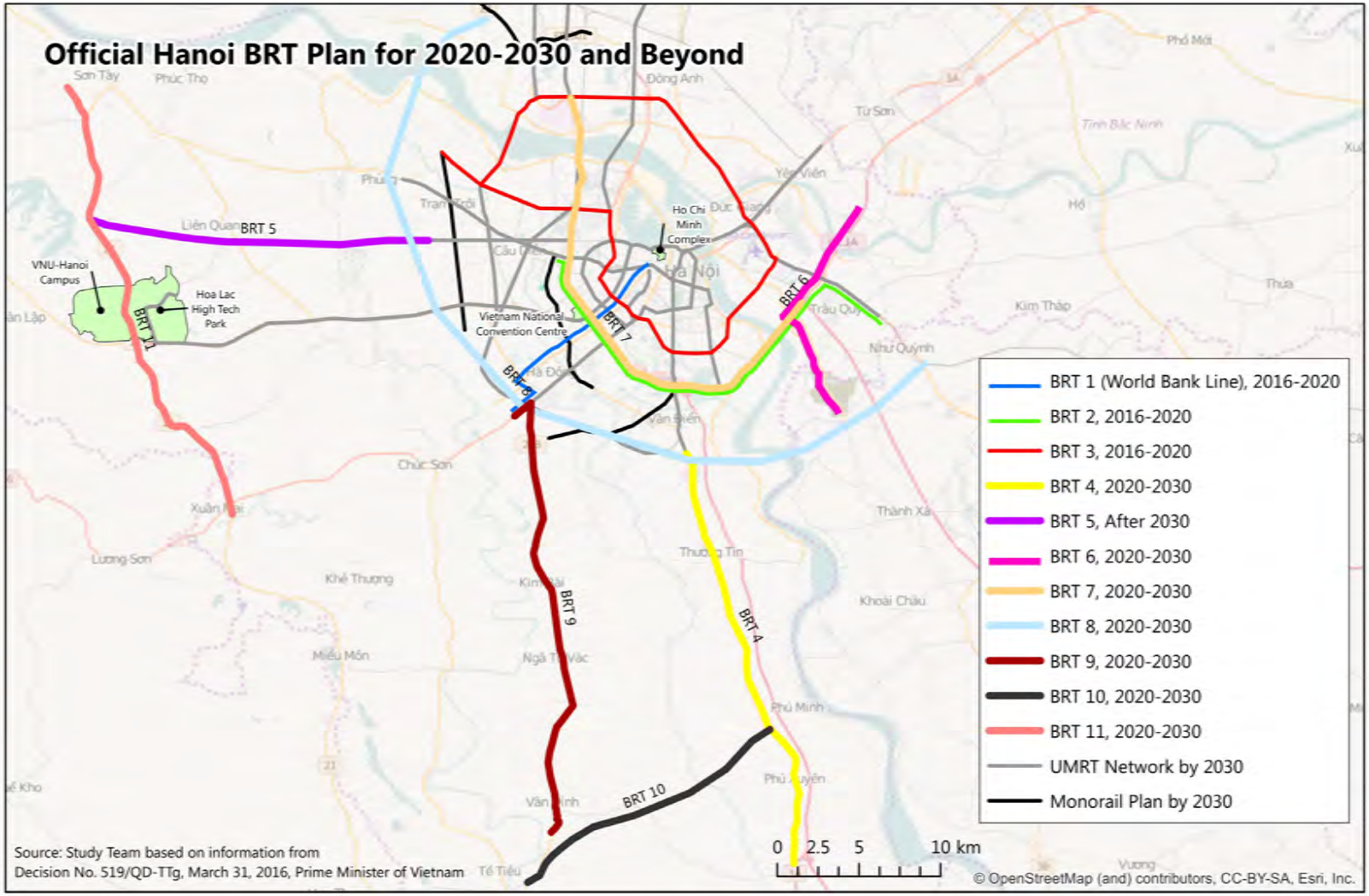


Figure 2.2.6 Official BRT Network Plan for 2020-2030

In addition to the official BRT plan from the Vietnamese government. The Hanoi Department of Transport is proposing to the Hanoi People's Committee to include the BRT lines listed in the following table for the period of 2016-2020 in the official BRT plan. The BRT line from Van Cao-Hoa Lac is on the same corridor as the UMRT Line 5 and is on the same corridor that is the target of this study. The BRT line from Kim Ma-Cau Giay-Noi Bai Airport is a new proposed BRT line that will connect the main international airport of Hanoi with the central area of Hanoi via the western area of Hanoi. The last BRT line from Giai Phong-Linh Dam-Ho Tung Mau is a shortening of BRT-2 in the official plan for 2016-2020.

Table 2.2.5 Additional Proposed BRT Lines for 2016-2020 by the Department of Transport

BRT Line	Section	Length (km)	Implementation Plan	Remarks
BRT Line	Van Cao (Ho Tay)-Hoa Lac	36	2016-2020	Proposal to use ODA of the World Bank, JICA or to use fund's from the city budget. **Route coincides with the BRT route in this study.**
BRT Line	Kim Ma-Cau Giay-Noi Bai Airport	27.5	2016-2020	Proposal to use ODA of the World Bank, JICA or to use fund's from the city budget.
BRT Line	Giai Phong-Linh Dam-Ho Tung Mau (a shortened version of BRT-2 from the official plan of (2016-2020)	12.5	2016-2020	Proposal to use ODA of the World Bank, JICA or to use fund's from the city budget.

Source: Draft Letter from the Hanoi Urban Transport Development Project Management Unit (HUTDPMU) of the Hanoi Department of Transport, May 2016

Lastly, the main agency for implementing the BRT projects is the Hanoi Urban Transport Development Project Management Unit which is an organization that is under the Hanoi Department of Transport.

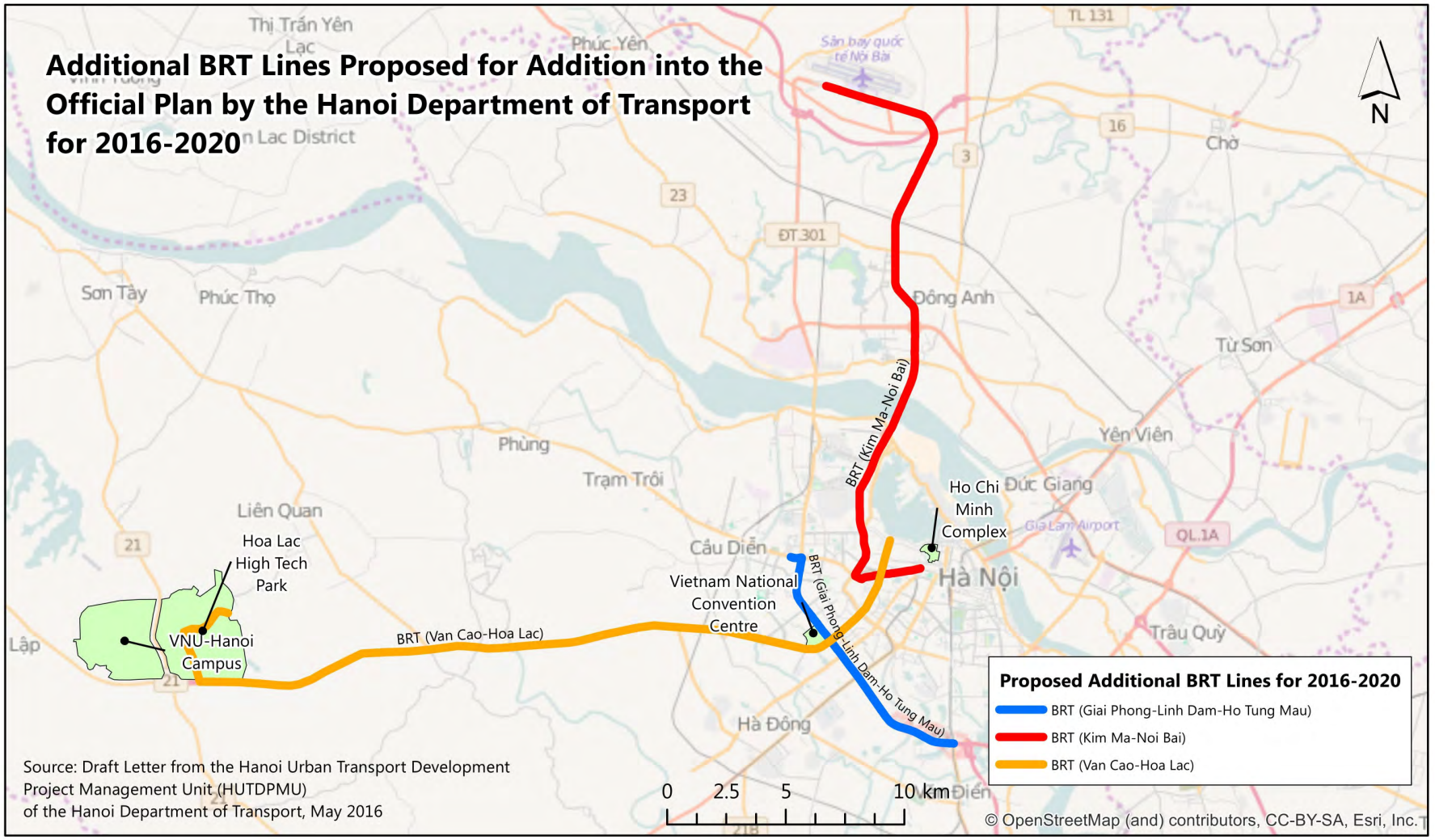


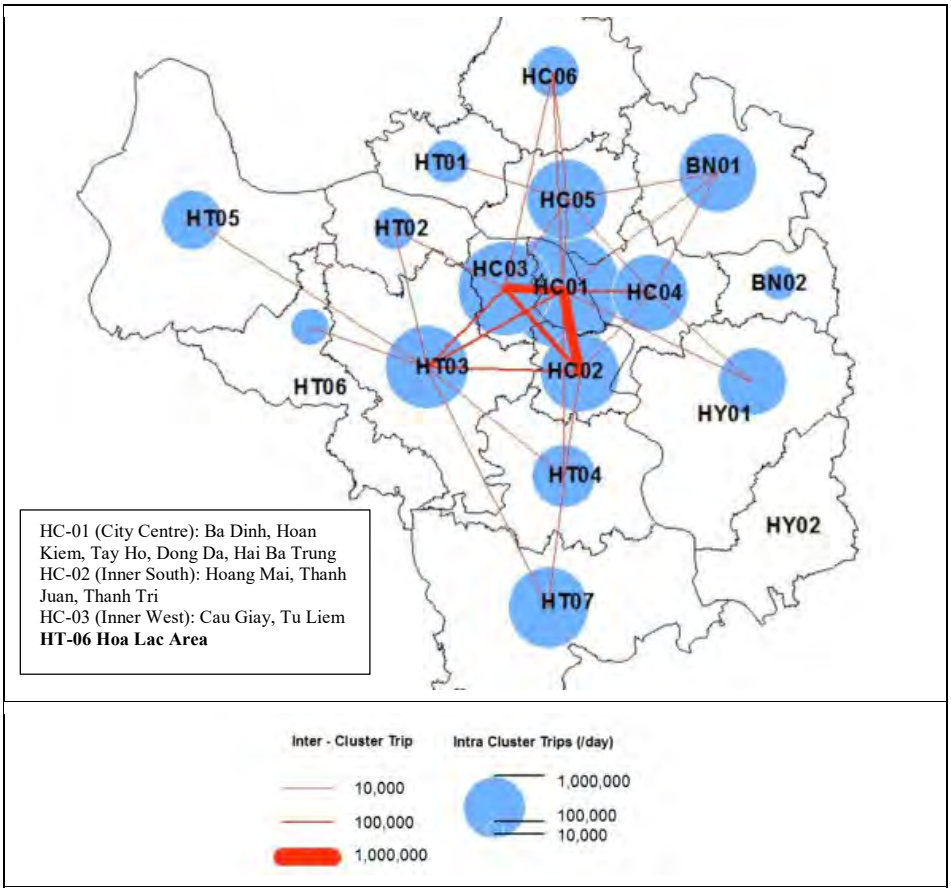
Figure 2.2.7 Map of the Additional Proposed BRT Lines for 2016-2020

2.3 Data Collection Survey on Railways in Major Cities in Vietnam (METROS)

The study titled the "Data Collection Survey on Railways in Major Cities in Vietnam (METROS)" was conducted for the Japan International Cooperation Agency in 2015 by a joint-venture of Japanese firms consisting of ALMEC Corporation, Oriental Consultants Global, Nippon Koei and Japan Transportation Consultants. The objective of the study was to review the current approved UMRT network in Hanoi from a technical and engineering viewpoint and to make recommendations with regards to the future development of the UMRT in Hanoi.

2.3.1 The Main Travel Flow Patterns in Hanoi

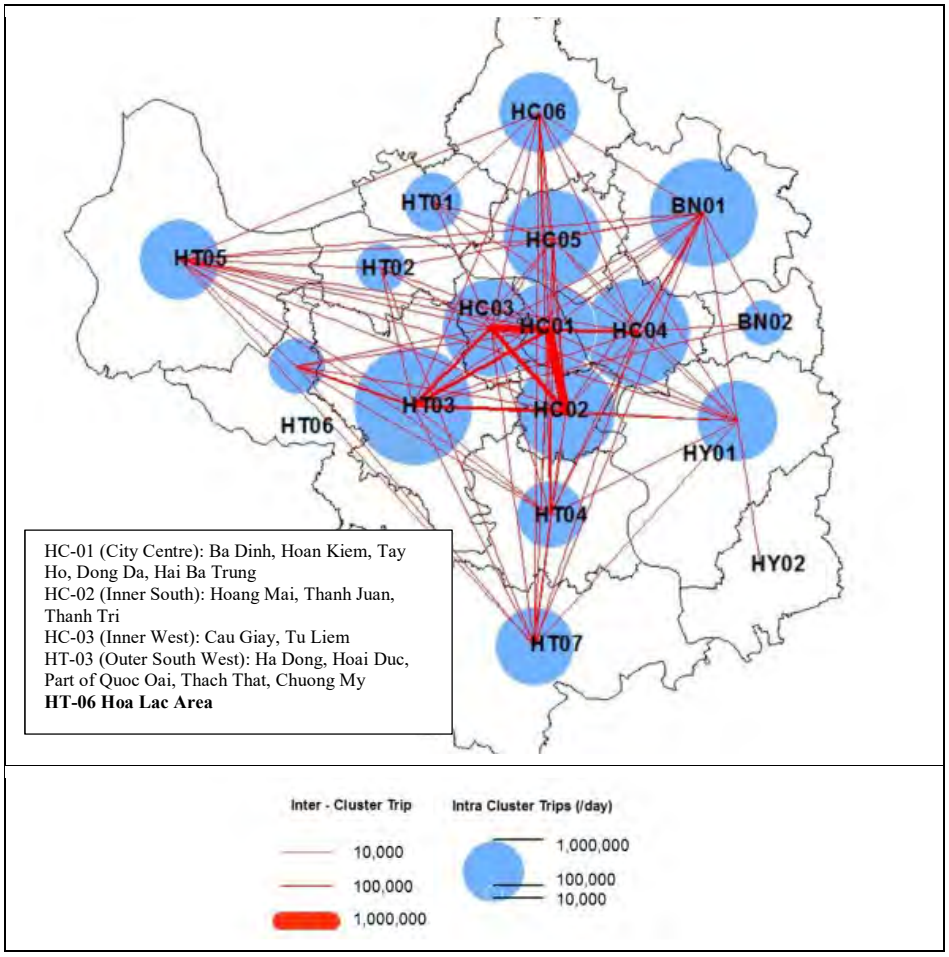
Based on the future population, employment and school attendance socioeconomic data, the main travel flow patterns in Hanoi were obtained from the trip generation and trip attraction steps of the demand forecast model. The trip distribution for 2014 and 2030 in person trips in the study area are shown as follows.



Source: Chapter 5, 5.3, Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 2.3.1 Distribution of Person Trips in the Study Area for 2014

As shown in the figure above, in 2014, most of the person trips in the study area are distributed between 3 main areas (HC-01, HC-02, HC-03) in the central area of Hanoi. This is due to the fact that most of the population is still concentrated in the central area.



Source: Chapter 5, 5.3, Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 2.3.2 Distribution of Person Trips in the Study Area for 2030

As shown in the above figure, by 2030, due to the decentralization of the population in the central area of Hanoi and the distribution of the population to various planned sub-centres and satellite towns of Hanoi, the person trips are more widely distributed among the various areas of Hanoi. However, person trips inside and between the city centre of Hanoi remain large. In addition, it can be seen that there are larger numbers of person trips between the western suburban area (HT-03, Outer South West) of Hanoi to and from the central area of Hanoi.

2.3.2 Results from the Evaluation of the Planned UMRT Lines in Hanoi

In this study, a traffic demand forecast taking into account the road and expressway development plan along with the approved UMRT network was conducted to assess indicators for the road network as well as indicators for the UMRT network. A summary of the important indicators are as follows.

- Road Network Performance Indicators:
  - Volume/Capacity Ratio (V/C Ratio) of the roads on the UMRT line corridors
- UMRT Line Performance Indicators:
  - Number of Passengers per day
  - Average Trip Length
  - Passengers per hour per direction (pphpd)

Other assumptions used in the demand forecast are as follows.

1) Fare System: The UMRT fare was set as a distance-based fare with a base fare of 20,000 VND and 1,000 VND/km for each line. It was assumed that UMRT lines are not integrated in that each time they change lines, they have to pay again.
2) Bus Route: The UMRT will compete with buses on the same corridor as bus re-routing was not considered.
3) No Constraints on Private Vehicle Use: No road pricing or higher parking fees were considered and private vehicles will compete with the UMRT.

The following 3 scenarios were prepared to estimate the passenger demand on the UMRT lines as well as the V/C ratio of the road network.

1) Do-Nothing Scenario (Baseline)
   - In this scenario, it is assumed that no improvements are made to the road network by 2030
2) Road and Expressway Only Scenario
   - In this scenario, it is assumed that no UMRT lines will be implemented and that only planned roads and expressway projects are implemented by 2030
3) UMRT Do-Committed plus Road and Expressway Scenario
   - In this scenario, only committed UMRT projects including Line 1, Line 2, Line 2A and Line 3 along with the planned road and expressway projects are implemented by 2030
4) UMRT Do-Maximum plus Road and Expressway Scenario
   - In this scenario, all of the planned UMRT projects are implemented along with the planned road and expressway projects by 2030

The results of the future demand forecast for the various UMRT lines for the UMRT Do-Committed plus Road and Expressway Scenario and the UMRT Do-Maximum plus Road and Expressway Scenario are shown as follows.

Table 2.3.1 UMRT Do-Committed Scenario for 2030 Indicators

UMRT Line	Length of UMRT Line (km)	V/C Ratio of the Roads Along the UMRT Line	Number of Passengers per Day	Average Trip Length (km)
Line 1	27.2	1.00	597,000	13.2
Line 2	34.4	0.66	556.000	10.1
Line 2A	12.7	0.68	294,000	6.9
Line 3	19.8	0.52	333,000	8.8
Total	94.1	-	1,780,000	10.4
Notes: For each UMRT line, the average speed was assumed to be 40 km/h and the capacity for each line was assumed to be 270,000 passengers/day for 6-car trainsets				

Source: Chapter 7, 7.3, Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Table 2.3.2 UMRT Do-Maximum Scenario for 2030 Indicators

UMRT Line	Length of UMRT Line (km)	V/C Ratio of the Roads Along the UMRT Line	Number of Passengers per Day	Average Trip Length (km)	Passengers per hour per direction (pphpd)
Line 1	27.2	0.60	436,000	10.8	159,000
Line 1A	10.9	0.40	245,000	7.3	112,000
Line 2	39.4	0.50	525,000	10.2	145,000
Line 2A	12.7	0.40	181,000	6.1	111,000
Line 3	25.1	0.49	330,000	9.2	136,000
Line 4	50.3	0.30	381,000	10.2	82,000
Line 5	38.0	0.90	420,000	23.5	235,000
Line 6	45.5	0.20	110,000	13.8	56,000
Line 7	31.1	0.10	87,000	5.3	38,000
Line 8	35.9	0.60	502,000	10.7	153,000
Total	316.6	-	3,217,000	11.5	-
Notes: For each UMRT line, the average speed was assumed to be 40 km/h and the capacity for each line was assumed to be 270,000 passengers/day for 6-car trainsets					

Source: Chapter 7, 7.3, Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

The study concluded that the committed UMRT lines (Line 1, Line 2, Line 2A and Line 3) show good performance in terms of ridership. It also concluded that high levels of ridership on Line 4, Line 5 and Line 8 are largely due to future planned land use along the corridors, especially the Line 5 corridor to the Hoa Lac Satellite Town. It recommended that since Line 4 and Line 8 serves almost the same corridor; Line 4 and Line 8 should be integrated into one line. In addition, from the demand forecasts, Line 6 and Line 7 show low ridership and the study recommended that these two lines should be reconsidered.

2.4 The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5)

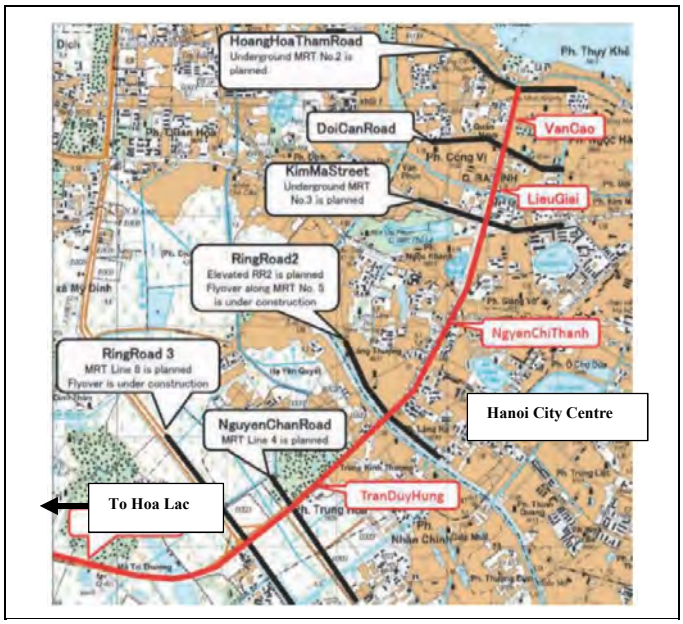
The study titled "The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5)" was conducted by Japan International Consultants for Transportation, Keihan Electric Railway and Nomura Research Institute for the Japan International Cooperation Agency in 2013. This study was the result of a Japan-Vietnam joint declaration on October 31, 2011 by the leaders of the two respective countries to conduct a preparatory study on the UMRT Line 5.

2.4.1 Background of this Study

The Hoa Lac Satellite Town is planned to be home to the Vietnam National University, Hanoi, the Hoa Lac High-Tech Park, Dong Mo health resort and the Vietnamese Ethnic Culture Tourism Village. It is planned for Hoa Lac to eventually have a population of 600,000.

As a result of this planned urban development, the corridor for the UMRT Line 5 was included in the "Railway Transport Development Master Plan up to 2020" which was approved by the Prime Minister's Office as Decision No. 1436/QD-TTG on September 10, 2009 which included 6 UMRT lines under planning. In addition, in the "General Planning on Construction of Hanoi Capital up to 2030 with a Vision to 2050" (Decision No. 1259/QD-TTg), UMRT Line 5 was also included in the plan of urban railways to be constructed which now included 9 UMRT lines under planning.

UMRT Line 5 is planned as a 51.5 km long line with 17 stations that will connect the western part of the city centre of Hanoi with Hoa Lac by going along Van Cao Road, Lieu Giai Road, Nguyen Chi Thanh Road and Tran Duy Hung Road in the city centre until the intersection of Tran Duy Hung Road with Ring Road 3. From the intersection of Tran Duy Hung Road with Ring Road 3, the route will continue along reserved land along the Thang Long Road which starts at the interchange with Ring Road 3 and ends at Hoa Lac. The Thang Long Road is basically a 140 m wide urban expressway with 6 lanes (3 lanes in each direction) and with 2 lane service roads in each direction.



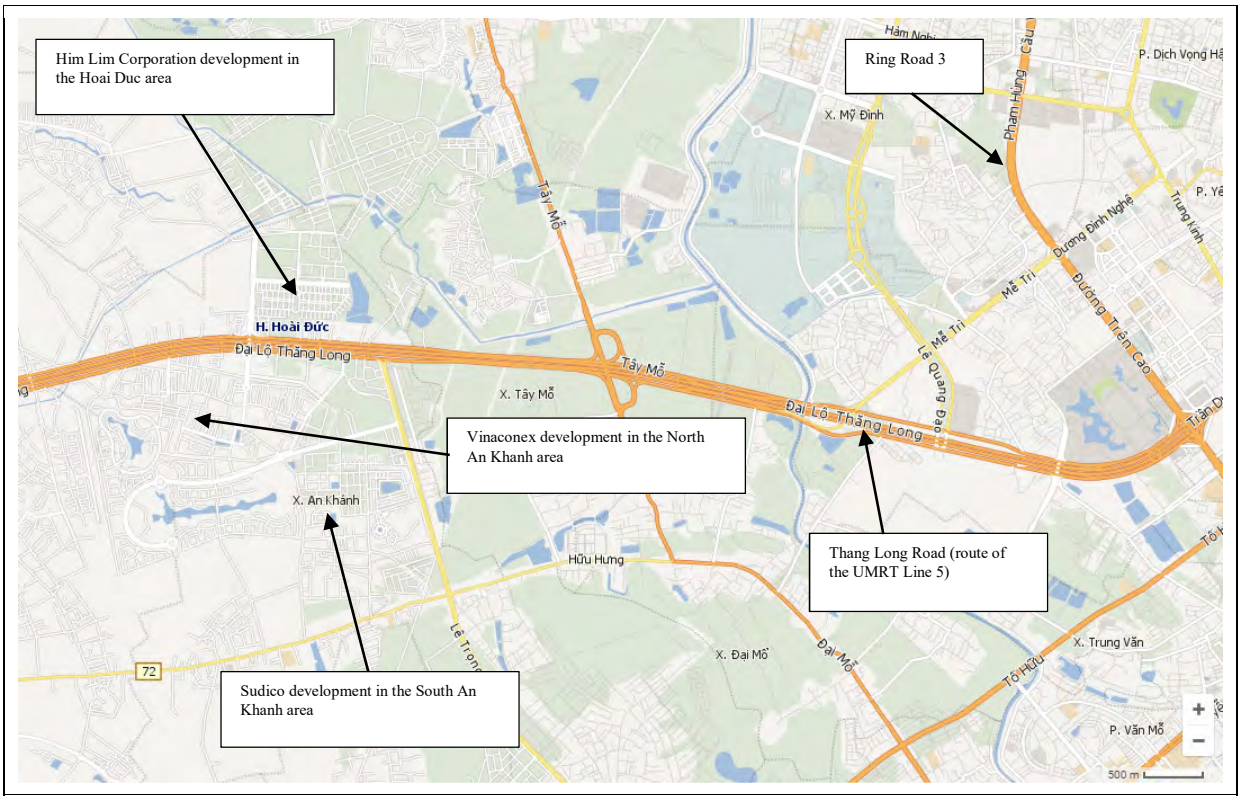
Source: Chapter 1, 1.2, The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5), JICA, 2013

Figure 2.4.1 Planned Route of the UMRT Line 5

2.4.2 Urban Development along the UMRT Line 5

During this study, the study team conducted a survey among local Vietnamese developers on their intention and interest in conducting urban development along this UMRT corridor and found that developers were mostly interested in developing land within a 10 km radius of the planned UMRT Line 5.

At the time of the study, three developers were developing the land along the UMRT Line 5. Song Da Urban & Industrial Zone Investment and Development Joint Stock Company (Sudico) was concentrated on a 300 ha site at south An Khanh consisting of offices and residences. At the Hoai Duc area, Him Lam Corporation was developing residences, shopping centres and a park on a 300 ha site in the Hoai Duc area in addition to 3 smaller scale projects along the line. Also Vietnam Construction and Import-Export Joint Stock Corporation (Vinaconex) was planning on a development at North An Khanh.



Source: Chapter 1, 1.4, The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5), JICA, 2013, Map from Transerco (timbus.vn)

Figure 2.4.2 Overview of Planned Urban Development along the UMRT Line 5

At the end of the UMRT Line 5, at Hoa Lac, a high-tech park is still under development and is supported by a Japanese yen loan from JICA. The Hoa Lac High-Tech Park is planned to have a total area of 1,586 ha and is designed not only as an industrial park but as a research and science city that will have residences and educational facilities. Hoa Lac High-Tech Park is designed to have a capacity to accommodate over 100 enterprises and as of December 2011, 17 enterprises have already started operations and 54 enterprises obtained the approval for investment. It is expected that the park will have a population of 220,000 when it is built out.

Adjacent to the Hoa Lac High-Tech Park is designated area where the Vietnam National University, Hanoi will eventually be moved to. The campus will have a total area of 1,000 ha and by 2020 and 2050, 60,000 and 100,000 students are expected to study there respectively.

2.4.3 Traffic Demand Forecast for the UMRT Line 5

The study team conducted a traffic demand forecast for the UMRT Line 5 for the base year of 2011 and for the year of 2030 by using the traffic analysis zones and data of the person trip survey conducted in 2011 by Vietnamese consulting firm Transport Engineering Design Inc. (TEDI) in a conventional 4-step traffic demand forecast model.

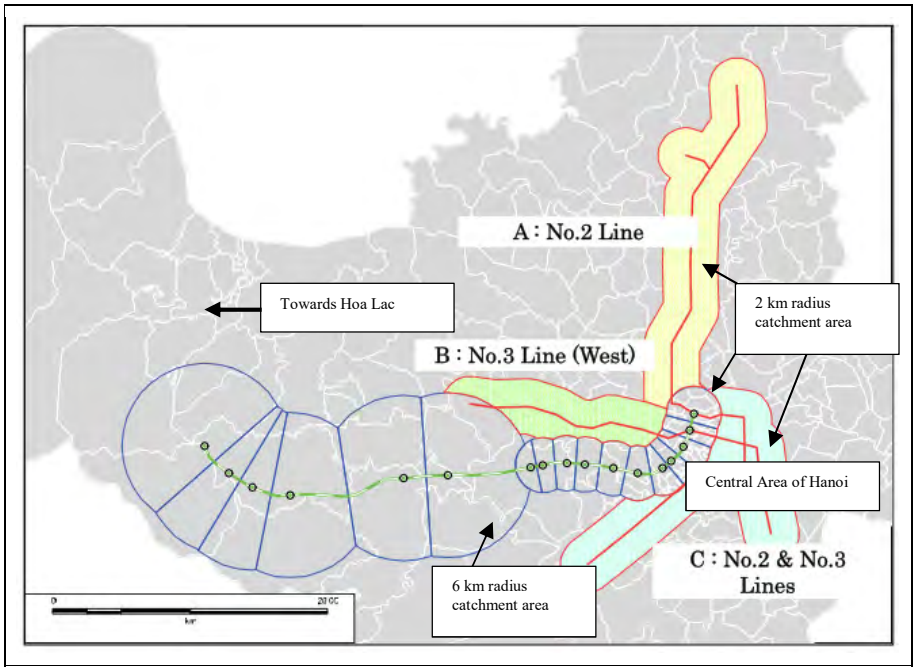
2.4.3.1 Assumptions for the Socioeconomic Framework

The following assumptions were made for the traffic demand forecast. The population of Hanoi would be increasing from 2011 to 2050 and from 2011 to 2020, the annual rate would be increasing at 1.8% and after that the annual population growth rate will slow down. By 2050, the population will exceed 10 million. Also, for the employment population, the employment that was formerly concentrated in the central area of Hanoi will be distributed to the suburban area in the future as a result of new job opportunities created by factories and commercial institutions in the suburban areas.

2.4.3.2 Assumptions for the Demand Forecast

For stations 1 to 11 in the central area of Hanoi, the station catchment area was set at a 2 km radius based on the assumption that passengers would be accessing/egressing the stations by foot while for stations 12 to 17 from the intersection of Ring Road 3 westbound to Hoa Lac, the station catchment area was set at 6 km radius based on the assumption that passengers would be accessing/egressing the stations via feeder buses.

In addition, in order to estimate the number of passengers that will transfer from UMRT Line 2 at UMRT Line 5 at station 1 of UMRT Line 5 and the number of passengers that will transfer from UMRT Line 3 to UMRT Line 5 at station 2 of UMRT Line 5, the station catchment area of both UMRT Lines 2 and 3 were also set at a 2 km radius.



Source: Chapter 2, 2.4, The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5), JICA, 2013

Figure 2.4.3 Station Catchment Area for the Demand Forecast

2.4.3.3 Results of the Demand Forecast

The demand forecast for UMRT Line 5 was estimated using an average fare of US$0.50 (approximately VND 11,000) which yielded a mode share of 15%[1] for line using the mode choice model. For the year of 2030 when the entire line is planned to be operational, the mode share for UMRT Line 5 was set at 15% for stations in the central area and 10% for stations in the suburban area while the mode share for UMRT Lines 2 and 3 (the other 2 lines that interchange with Line 5) was set at 10% based on the experience of other Asian cities.

With these mode shares, by the time the line is fully operational in 2030 and considering the number of passengers transferring from UMRT Lines 2 and 3 to UMRT Line 5, UMRT Line 5 is estimated to have a ridership of 432,000 passengers/day (this takes into account the increase in population in the Hoa Lac area and corridor).

[1] Chapter 2, 2.4 (3), Transport Shares, The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5), JICA, 2013

Table 2.4.1 Results of the Demand Forecast for UMRT Line 5

Unit: 1,000 passengers/day

	2011	2012	2030	2040
UMRT Line 5 (Stations 1-17)	199.1	221.3	399.6	410.6
Transferring Passengers from UMRT Lines 2 and 3	30.0	30.4	32.1	33.0
UMRT Line 5 + UMRT Lines 2, 3 Transferring Passengers	229.1	251.7	431.8	443.6

Source: Chapter 2, 2.5, The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5), JICA, 2013

2.4.4 Reasons for the Non-Implementation of the UMRT Line 5

In this study, the study team conducted an economic and financial evaluation for the project. For the economic evaluation, the Economic Internal Rate of Return (EIRR) was calculated for a period of 48 years until 2064 when the yen loan repayment of the principal and interest for Phase 2 will end. The EIRR calculated was 10.90% and this is lower than the 12% that is recommended by the Asian Development Bank for the "Guideline for Preparing Performance Evaluation Reports for Public Sector Operations".

For the financial evaluation, the Financial Internal Rate of Return (FIRR) was calculated for the same period as the EIRR and the calculated value was negative due to the large cost of the investment and insufficient fare revenues.

2.5 World Bank Funded BRT Project (BRT Line 1)

2.5.1 Background and Overview

The Hanoi Bus Rapid Transit project is one of the components of the Hanoi Urban Transport Development Project (HUTDP) that was approved by the Hanoi People's Committee in Decision 1837/QĐ-UBND dated May 10, 2007 and funded by the World Bank. The HUTDP was originally approved by the World Bank board on July 3, 2007 with the original closing data of December 31, 2013. However, it has since been extended until December 31, 2016.

The HUTDP actually comprises of 3 major components, the Hanoi Bus Rapid Transit Project, Road Infrastructure and Sustainable Urban Planning and Institutional Development. The HUTDP is primarily funded by the World Bank through its International Development Association (IDA) loan and a grant from its Global Environment Facility (GEF) program for combating environmental issues. In addition, the Government of Vietnam also funds a part of the project. The original contents and the cost from 2007 are shown in Table 2.5.1.

Originally, there were supposed to be 2 BRT lines in the Hanoi Bus Rapid Transit Project, but it was cut down to 1 line due to the delays in the overall project. The original cost of the BRT component was US$97.88 million but this was reduced to US$49 million after the reduction in scope of the BRT component.

According to a source within the project management unit of the HUTDP, the main reasons that the overall project was delayed for 3 years are the following: lack of skilled human resources in the project management unit of the BRT project which lead to major parts of that project being outsourced. In particular, an outside consultant was contracted to put together the technical package for the bus fleet, fare system and etc.

Table 2.5.1 Components of the Hanoi Urban Transport Development Project and Original Cost in 2007

Unit: US$ millions

Component	Financed by Vietnam	IDA Loan	GEF Grant	Total
1. Hanoi Bus Rapid Transit Project				
A. BRT System. civil works and equipment	11.76	84.12	1.40	97.28
B. Pedestrian and non-motorized transport access at BRT stations	0.00	0.00	1.30	1.30
C. BRT Consultation, Communications and Media Strategy	0.00	0.00	1.30	1.30
Subtotal of the BRT Project	11.76	84.12	4.00	97.88
2. Road Infrastructure and Sustainable Urban Planning				
A. Second Ring Road between Cau Giay and Nhat Tan	124.28	46.47	0.00	170.75
B. Resettlement site	3.64	18.18	0.00	21.83
C. Integrated Sustainable Urban Land Development & Transport Planning	0.00	0.00	1.75	1.75
3. Institutional Development				
A. Air Quality Management	0.00	1.65	0.00	1.65
B. Traffic Safety	0.00	1.92	0.00	1.92
C. Public Transport Authority Strengthening & policy development	0.00	2.20	2.70	4.90
D. National and Regional Replication	0.00	0.00	0.90	0.90
E. Project Management and results management support	0.0	0.67	0.45	1.12
Total Cost (including taxes) of the HUTDP	**139.68**	**155.21**	**9.80**	**304.70**

Note: International Development Association (IDA), Global Environmental Facility (GEF)
Source: World Bank

A breakdown of the costs for the single line BRT component is shown as follows.

Table 2.5.2 Cost Breakdown of the World Bank BRT Line

Unit: US$ millions

Contract	Description	Revised Cost in 2010	Funding	Contract Type
CS01a	BRT Detailed Design and Procurement Support	2.490	IDA	Consultant
	Contract 1A BRT 1	2.490	IDA	
CS02	BRT Construction Supervision	2.500	IDA	Consultant
Contract 1	Equipment Installation and Construction Supervision for the BRT section from Health Ministry-Khuat Duy Tien	0.600		
Contract 2	Equipment Installation and Construction Supervision for the BRT section from Khuat Duy Tien to Ba La	0.650		
Contract 3	Equipment Installation and Construction Supervision for Kim Ma Interchange and Giang Vo - Giang Van Minh Intersection.	0.600		
Contract 4	Equipment Installation and Construction Supervision for Vinh Quynh Depot	0.650		
CS03	Communications an d Media Program	1.486	GEF	Consultant
BRT CP3a	Civil Works for the Depot	4.050	IDA (90%) Vietnam Govt. (10%)	Civil Works
BRT CP3b	Equipment Supply for the Depot	0.550	IDA	Goods
BRT CP4a	Civil Works for the Road and Bus Stops between Heath Ministry and Khuat Duy Tien	4.770	IDA (90%) Vietnam Govt. (10%)	Civil Works (unit price)
BRT CP4b	Civil Works for the Road and Bus Stops between Khuat Duy Tien-Ba La	6.550	IDA (90%) Vietnam Govt. (10%)	Civil Works (unit price)
BRT CP4c	Civil Works for the Kim Ma Interchange and Giang Vo-Giang Van Minh Intersection	4.090	IDA (90%) Vietnam Govt. (10%)	Civil Works (unit price)
BRT CP6	Signal system from Ha Dong centre station to Kim Ma interchange	3.500	IDA	Civil Works (unit price)
BRT CP7	Equipment supply from Lang Ha to Giang Vo	6.940	IDA	Goods
BRT CP8	BRT Vehicles	11.690	IDA	Goods
	BRT systems for non-motorized transport and pedestrians	0.660	GEF	Civil Works
	Total	**49.276**		

Breakdown of the funding sources: Vietnam Govt.:US$1.946 million (3.95%), IDA: US$45.184 million (91.70%), GEF: US$2.146 million (4.36%)
Note: International Development Association (IDA), Global Environmental Facility (GEF)

2.5.2 Route and Design Features of the BRT

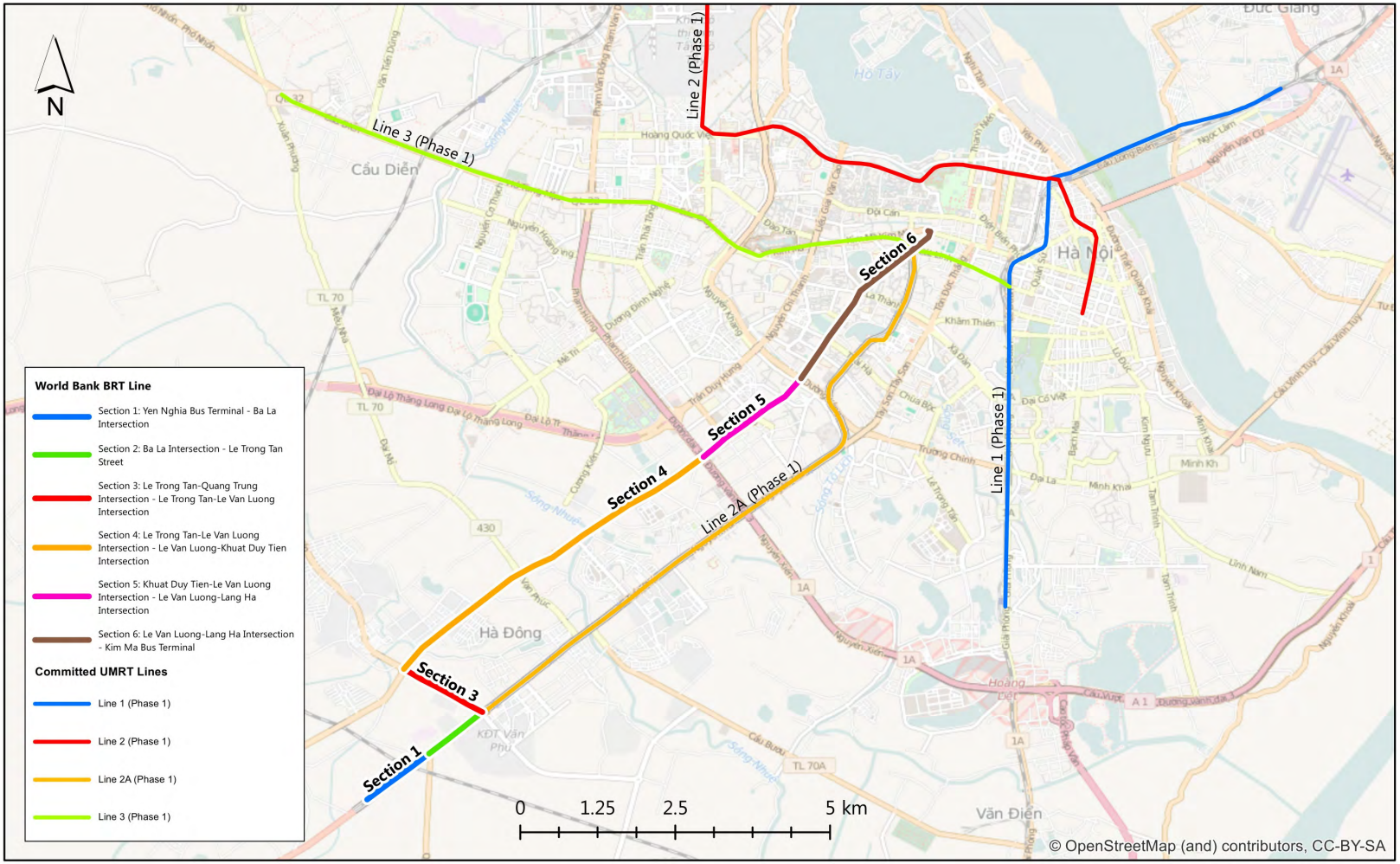
2.5.2.1 BRT Route

In the original plan, there was to be 2 BRT lines in Hanoi, one line from Kim Ma to Yen Nghia and another line from Quang Lai to Van Dien to Bo Ho according to Decision No. 1837/QD-UBND dated May 10, 2007. However, because it took such a long time to implement the first line from Kim Ma to Yen Nghia, the World Bank decided to stop the second BRT line and this was made official in Decision No. 1821/QD-UBND dated February 22, 2013.

The BRT line from Kim Ma to Yen Nghia was selected based on detailed studies conducted by the French consultancy Egis. The 14.7 km BRT route goes from Kim Ma station in the central area of Hanoi and goes southwest along Giang Vo, Lang Ha, Le Van Luong, Le Van Luong keo dai, Le Trong Tan, Quang Trung to Yen Nghia station. A schematic map of the BRT line is shown in the following figure.

Source: Hanoi BRT website (hanoibrt.vn)

Figure 2.5.1 Schematic Map of the World Bank BRT Line



Source: Study Team based on World Bank and HUTDP information

Figure 2.5.2 Geographic Map of the World Bank BRT Line

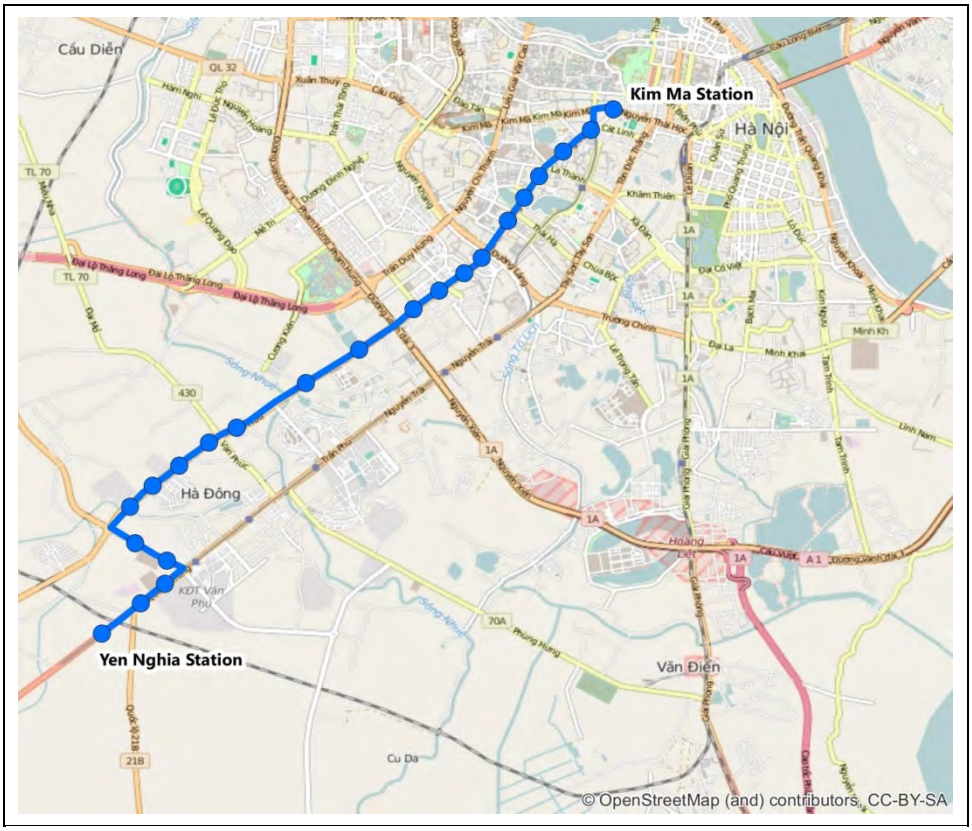
A geographic map of the World Bank BRT line is shown in Figure 2.5.2. Exclusive BRT lanes are planned to be used in all sections of the line except for Section 6. Details regarding the cross-sections for each section of the line are summarized in the following table.

Table 2.5.3 Cross-Sectional Characteristics of the World Bank BRT Line

	Location	Length (m)	Cross-Sectional Width (m)	Number of Lanes (1 direction)	Exclusive BRT Lanes
Section 1	Yen Nghia Bus Terminal-Ba La intersection	1.5 km	Currently: 9-10 m, Planned to be widened to 56 m	Currently: 2 lanes Planned: 5 lanes	Planned for the centre of the road
Section 2	Ba La intersection-Le Trong Tan St.	1 km	44 m (2 m wide median)	3 lanes	3.5 m lane proposed at the centre of the road
Section 3	Quang Trung-Le Trong Tan intersection to Le Trong Tan-Le Van Luong intersection	1.4 km	42 m (5 m wide median)	3 lanes	3.5 m lane proposed at the centre of the road
Section 4	Le Trong Tan-Le Van Luong intersection to Le Van Luong-Khuat Duy Tien intersection	5.7 km	40 m (3 m wide median)	3 lanes	3.5 m lane proposed at the centre of the road
Section 5	Khuat Duy Tien intersection-Le Van Luong-Lang Ha intersection	2 km	-	3 lanes	3.5 m lane already constructed at the centre of the road
Section 6	Le Van Luong-Lang Ha intersection to Kim Ma Bus Terminal	3.1 km	-	1-3 lanes	No exclusive lane planned

Source: On-site observations and interviews with relevant local staff

In addition, currently there is an existing regular bus route (designated as “BRT”) that is operating on the same route of the BRT line that is under construction and the route is shown in the following figure. This existing bus route uses bus stops that are located on the right side of the road.



Source: Study Team/Transerco/timbus.vn

Figure 2.5.3 Route of the Existing Regular Bus Line "BRT"

2.5.2.2 BRT Fleet Sizing and Operation Plan

The BRT operational plan was roughly done according to the Bus Operations Design document of the Detailed Designs of BRT Component BRT Line 1: Kim Ma-Ba La Bong Do for the HUTDP prepared by Egis Beceom International and ING INGENIERIA from June 2009.

Sections of the line with the highest transport demand by time of week was estimated and on weekdays, during the morning peak hour (1 way) in the design year of 2010, 2,300 passengers per hour per direction was estimated and for the design year of 2020, 6,200 passengers per hour per direction was estimated.

Based on these estimated numbers, the project management office of the BRT project set the design ridership target of the line at 6,000 passengers per day per direction. This design targeted ridership is the ridership averaged for the entire day (neither peak nor off-peak hours) after the system comes into operation.

From this design ridership target, 35 BRT vehicles were calculated to be needed (including reserve vehicles) and this is the number of vehicles that is used in the bidding package.

Table 2.5.4 Section with the Highest Transport Demand by Time of Week

(Unit: Number of passengers)

Time of Week	Year	Daily Demand (2 way)	Morning Peak Hour (1 way)	Evening Peak Hour (1 day)	Off Peak (1 day)
Weekdays	2010	28,843	2,300	1,630	1,122
	2020	77,752	6,200	4,393	3,025
Saturday	2010	26,699	1,760	-	1,237
	2020	71,972	4,744	-	3,336
Sunday	2010	26,121	1,452	1,656	1,064
	2020	70,412	3,913	4,464	2,868

Source: Bus Operations Design, Detailed Designs of BRT Component BRT Line 1: Kim Ma-Ba La Bong Do, June 2009

There are 2 different ridership targets in the implementation phase from different organizations:

- Communications Technics Center (Trung tam ky thuat Vien thong) under the Army Academy - Designer of the ITS Package
  - **6,000 passengers per day per direction** (average ridership for the entire day) for the first few years and then increasing to **20,000 passengers per day per direction** in the next years, Chapter 1, Page 5, Basic Design for BRT Information System
- Draft Letter from the Hanoi Urban Transport Development Project of the Hanoi Department of Transport, May 2016
  - Operating time: 17 hours (5:00-22:00)
  - 512 trips/day/direction, 90 passenger/trip/direction = **46,080 passengers/day/direction**
  - **2,710 passengers/hour/direction (average)**

According to the Bus Operations Design Document, to meet 100% of the morning weekday peak hour demand, a frequency of 30 buses/hour which corresponds to a headway of 2 minutes was designed. During the off peak hours, in order to generate competition, the consultants of this study recommended a frequency of 12 buses/hour (5 minute headway) in order to generated competition with motorbikes. In summary, for this BRT line, the headway as per the original Bus Operations Design Document is for 2 minutes during the peak hour periods and 5 minutes during the off peak periods. The actual operational plan may be different when the BRT line comes into full operation.

2.5.2.3 Station Design

A typical centre median BRT station that has been constructed is shown in the following figure. According to sources, only 4 centre median BRT stations will have overhead bridges for pedestrians and these overhead bridges will not have any escalators or elevators. Therefore, the BRT stations on this line are not barrier-free.

For other centre median BRT stations, passengers to the BRT will need to cross the road at-grade to reach the stations.

Source: VNExpress.net (http://vnexpress.net/photo/giao-thong/bay-tu-than-tren-tuyen-buyt-nhanh-1-000-ty-dong-o-ha-noi-3204045.html)

Figure 2.5.4 Typical Centre Median BRT Station

Source: VNExpress.net (http://vnexpress.net/photo/giao-thong/bay-tu-than-tren-tuyen-buyt-nhanh-1-000-ty-dong-o-ha-noi-3204045.html)

Figure 2.5.5 Typical Overhead Pedestrian Bridge

2.5.2.4 Vehicles

Articulated buses will not be used as non-articulated buses were specified in the project documents and so the BRT line will utilize standard 12 m long bus vehicles. The Vietnamese company Thaco (Truong Hai Auto) is the manufacturer of the bus vehicles.

2.5.3 Organizations Related to the Project

The organizations that are involved in the BRT project are the Hanoi Department of Transport (DOT), Hanoi Urban Transport Development Project Management Unit (HUTDPMU), TRAMOC, TRANSERCO and the Traffic Signal Control Centre (TSCC) of the Hanoi Police Department and their responsibilities are shown in the following table.

Table 2.5.5 Organizations Involved in the World Bank BRT Project

Organization	Responsibilities
Hanoi Department of Transport (DOT)	• Project owner • Supervision, review and appraise HUTDPMU's implementation
Hanoi Urban Transport Development Project Management Unit (HUTDPMU)	• Executing agency for the BRT project • Implement all project components • Signs all contracts with contractors and consultants
TRAMOC	• Act as the public transport authority
TRANSERCO	• Designated as the operator of the BRT line
Traffic Signal Control Centre (TSCC)	• Under the Hanoi Police Department • Manages the network of traffic signal controllers on the route

2.5.4 Current Implementation Status

According to the "Implementation Status & Results Report" dated December 11, 2015 from the World Bank and from the "Report on Implementation Status of Hanoi Urban Transport Development Project (No. 185/BC-BQL)" dated February 26, 2016 and issued by the Hanoi Urban Transport Development Project Management Unit (HUTDPMU), the implementation status of the BRT project is as follows.

With regards to contracts, there are 12 main contracts (8 for civil works and 4 for equipment) and 11 out of 12 contracts have already been signed with the exception of the fare collection and communications system contract.

Details regarding the current implementation status for each component of the BRT project are described as follows.

2.5.4.1 Civil Works and Systems

8 civil contracts worth US$13.62 million are progressing and the current status is as follows:

- Stations: Both terminals (Kim Ma station, Yen Nghia station) as well as all 19 stations have been completed and have been handed over to the operator (TRANSERCO) on May 31, 2016 for repair and maintenance

- Pedestrian Bridges for Access to the Stations: 4 bridges have been completed. In February 2016, a revised plan was approved which includes the structural modification of 2 existing bridges that have already been built and the construction of 4 additional bridges with a targeted completion date of between August and September 2016.
- Road Civil Works: Ongoing along sections of the line as well as at the depot. The original deadline was at the end of June 2016, however, with the operations plan still not decided yet (see Section 2.5.4.5), the deadlines are extended and the scope of works may be reduced.
- Traffic Signalling Systems: Ongoing work. Of the 32 intersections in total, traffic signals and intersection improvements in 14 locations and already have been completed (as of April 30, 2016) and the deadline for the remaining ones has been extended from the end of June 2016 to September 2016.

2.5.4.2 BRT Vehicles

The contract for the BRT vehicles was signed on November 9, 2015 with the joint venture of Thien Thanh An Joint Stock Company and Truong Hai Joint Stock Company with a contract price of VND176,290,592,500 after being re-tendered for a second time due to the first tender failing.

Currently, the prototype vehicle was reviewed and approved in May 2016. The manufacturing of 35 BRT vehicles is in the final assembly phase in Danang and will be handed over to the project management unit in August.

2.5.4.3 Fare Collection, Fleet Management, User, Information and Communications Systems

For fare collection, the BRT line will use a smart card system and In general, the procurement for the smart card system will follow the Technical Regulation of Integrated Ticketing (Article 6 in Chapter 2) of Decision No. 3978/QD-UBND dated August 13, 2015 from the Hanoi People's Committee. In this decision, procurement of the smart card system must follow either the ISO 14443 Type A/B (NFC-A/B[2]) or ISO 18092 (NFC-F). The Mifare smart card product developed by Netherlands-based NXP Semiconductors uses the ISO 14443 Type A standard while the Calypso smart card originally developed by a consortium of European transit operators uses the ISO 14443 Type B standard. Japan's Felica smart card product uses the ISO 18092 standard.

Approval for the result of the procurement and contract signing was expected by March 2016 and was delayed until June 2016, however, bidding for this package (CP07) has completely failed and a winning bidder could not be selected.

2.5.4.4 Public Opinion on the World Bank BRT Project

In the Vietnamese media, there have been various criticisms of the World Bank BRT project. Some editorials in the newspapers say that the 1,000 billion VND (US$49 million) project is a waste of funds because the BRT line will operate on a street which already has high traffic congestion during the peak hour and once the BRT officially starts operations, one traffic lane will be taken away from regular traffic use and congestion on that road will become more severe. In addition, the editorial also says that since not even BRT station in the centre median of the road will have overhead pedestrian bridges so passengers crossing the road to reach the BRT stations in the centre median will also cause traffic congestion.

[2] There are 3 global Near Field Communications (NFC) standards NFC-A (ISO 14443 Type A), NFC-B (ISO 14443 Type B) and NFC-F (ISO 18092)

With regards to the physical construction of the BRT line, the editorials criticized the poor quality of construction of the exclusive lanes. In particular, the exclusive lanes were constructed using concrete and are not level with the existing road surface. As a result, many motorbike-related traffic accidents occurred due to the uneven surface between the concrete exclusive lanes and the existing road surface.

2.5.4.5 Schedule for the Full Opening of the Line

There have been a lot of public opinions with regards to this BRT project and many shortcomings in the design and the biggest question that has emerged is how to operate the BRT system. After a lot of discussions, three options have emerged from a meeting chaired by Mr. Vien, Director of the HDOT on July 5, 2016[3].

- Option 1: Wait for the fare collection and communications system package (CP07) to be successfully procured and the BRT line will come into operation when all the components are completed. In this case, the loan from the World Bank will be extended by 2 more years.
- Option 2: Downgrade the BRT into a regular bus line. In this option, a regular bus line will be operated using the infrastructure and vehicles built for the BRT, but no items from CP07 (automatic fare collection) will be used and ticketing will utilize paper tickets like regular buses. In this case, operations will start as planned, in the last quarter of 2016.
- Option 3: Change the route.

At the July 5, 2016 meeting, Mr. Vien concluded that Option 2 (downgrade the BRT into a regular bus line) is the preferred option. And on July 6, 2016, the HDOT and the World Bank Hanoi office met to confirm this option. Now, this option has been submitted to higher authorities for consideration.

In this case, some civil works and public transport priority systems will be reduced. As a result of this, some of the deadlines for the civil works are being delayed because of the wait for the official decision from higher authorities with regards to which option to select.

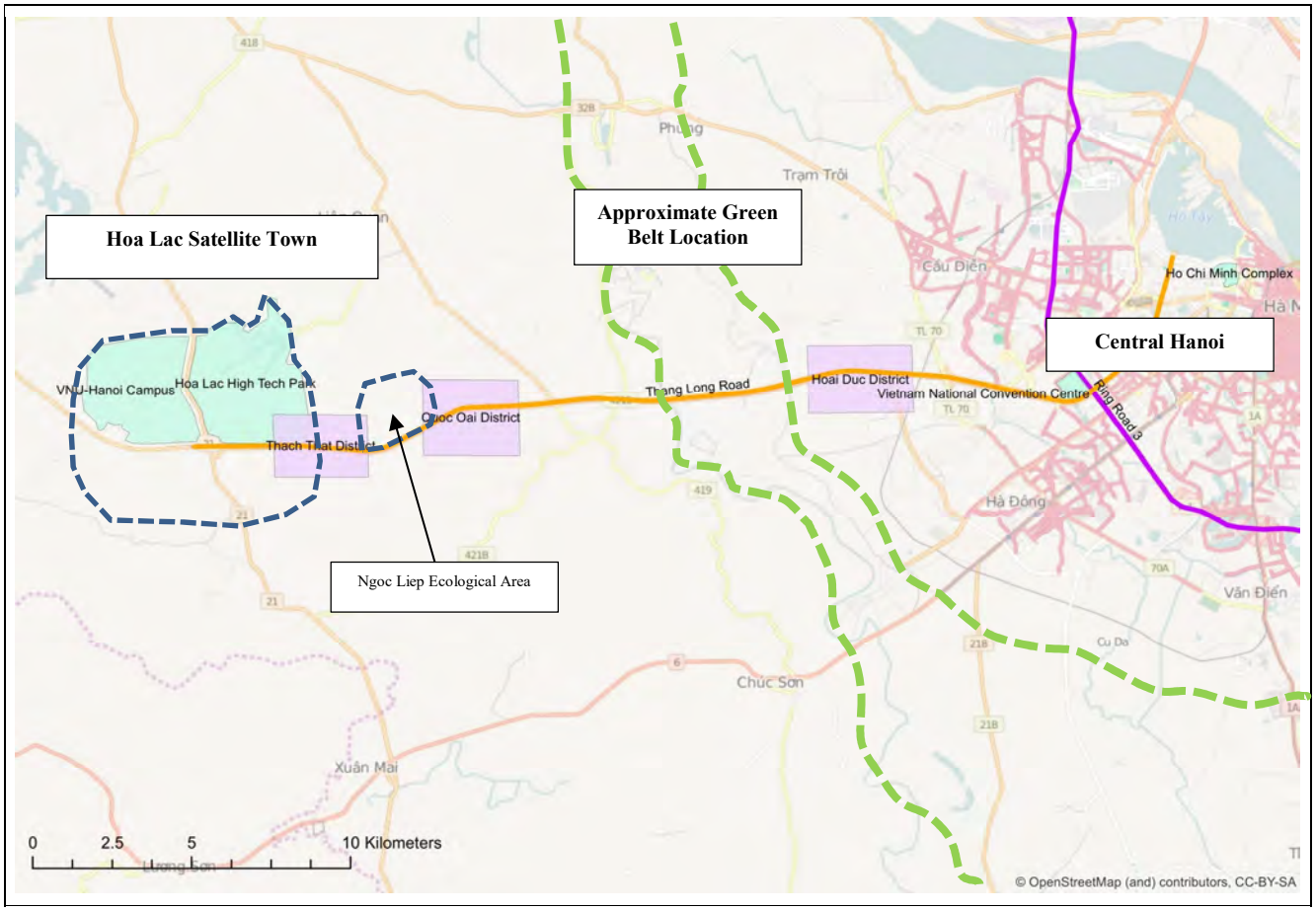
2.6 Urban Development along the UMRT Line 5/BRT Corridor

2.6.1 Current Urban Development

Based on collected information from local sources, current urban development along the UMRT Line 5/BRT corridor outside of the central area of Hanoi (outside Ring Road 3) is mainly concentrated in 3 districts in addition to the : Hoai Duc District, Quoc Oai District and Thach That District near the Hoa Lac High Tech Park. In particular, among these 3 districts, Hoai Duc District is planned to be completely urbanized.

In the areas outside of the these 3 districts, between Hoai Duc District and Quoc Oai District, a green belt has been designed in the spatial planning of Hanoi and between Quoc Oai District and Thach That District, the Ngoc Liep Ecological Area has been designated.

[3] Confirmed from the attendance of the Vietnamese members of the Study Team in the meeting



Source: Study Team

Figure 2.6.1 Major Urban Development Areas along the UMRT Line 5/BRT Corridor

2.6.1.1 Hoai Duc District

Hoai Duc is currently one sub-urban district (Huyen) with an area of 82.47 km^2 and a population of 250,000 people (as of the end of 2015). Hoai Duc district is identified as lying in a zone with a high development rate of services and economic and financial transactions. This district has a transportation system that is at the most modern level in Hanoi. With the wide Thang Long Road, Highway No. 32 runs through the area and there is a well developed road system. The existing supply of roads meets the current traffic demand without congestion unlike the central are of Hanoi. In addition, condominiums, shops, villas are continuously being developed.

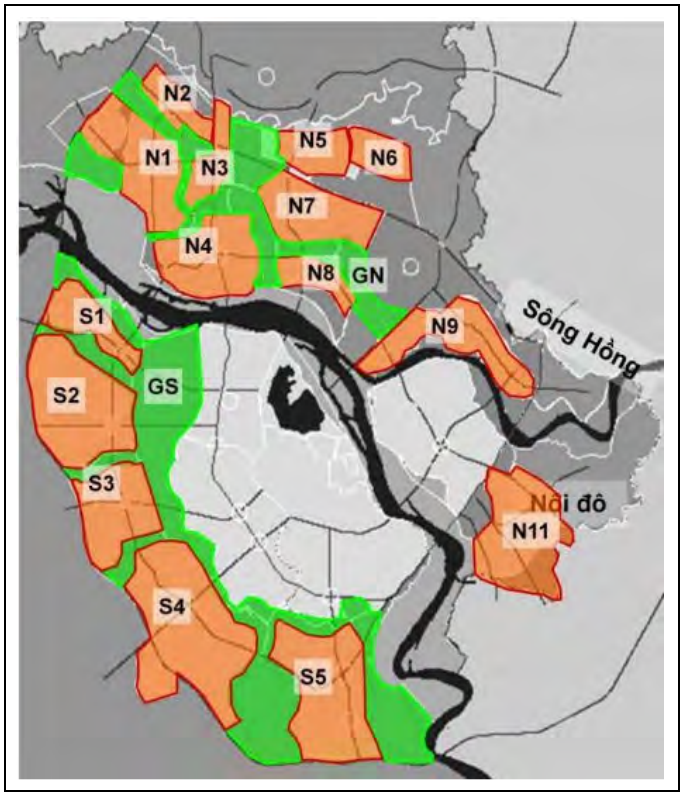
Until now, this district is not officially an urban area, but a sub-urban one. That is why the Hanoi government has planned in 2017 for Hoai Duc to become an urban district (Quan). There are 5 criteria to reach this target and the below table shows that among them, three of the criteria have already been met and Hanoi is trying to reach the two remain ones. To reach this target, by 2017, Hoai Duc's population should increase to at least 320,000 persons. This is actually a high number to reach. To meet the population target, in the development plans, two urban zones (named S2 and S3) have been approved.

Table 2.6.1 Criteria for Hoai Duc to become an Urban District in 2017

No.	Criterion	Requirement	Current
1	Population density (person/km^2)	> 10,000	3,031
2	Labour in non-agricultural sectors in comparison with the other labor force	> 90%	84%
3	Percentage of agriculture sector in the whole economy	< 10%	5.7%
4	Infrastructure network	Should meet various conditions	Meet these conditions already
5	Planned to be approved as an urban area in coming future	Officially approved	Official approved in 2015 by the Decision No. 3976/QD-UBND dated August 13, 2015 of HPC

Source: CEO LAND Media

For detailed planning, the territory of tentative urban areas of the entire area of Hanoi is divided into 38 different development zones. These zones do not have same borders as administrative boundaries, but will be invested in so that the urbanization rate in these zones becomes higher than the remaining area. The following figure shows these zones for the near future, in which the entire Hoai Duc District belongs to two zones, named S2 and S3.



Source: Hanoi Urban Planning Institute

Figure 2.6.2 Development Zones of Hanoi for the Near Future (Hoai Duc District Belongs to S2 and S3)

The development zone S2 is planned officially in Decision No. 405/QD-UBND dated January 16, 2014 from the HPC. It is related to different communes of Hoai Duc (and various communes of other districts). According to this plan, high-density urban areas will be formed along the urban main roads along the Thang Long Road, Highway 32 and other inter-regional routes.

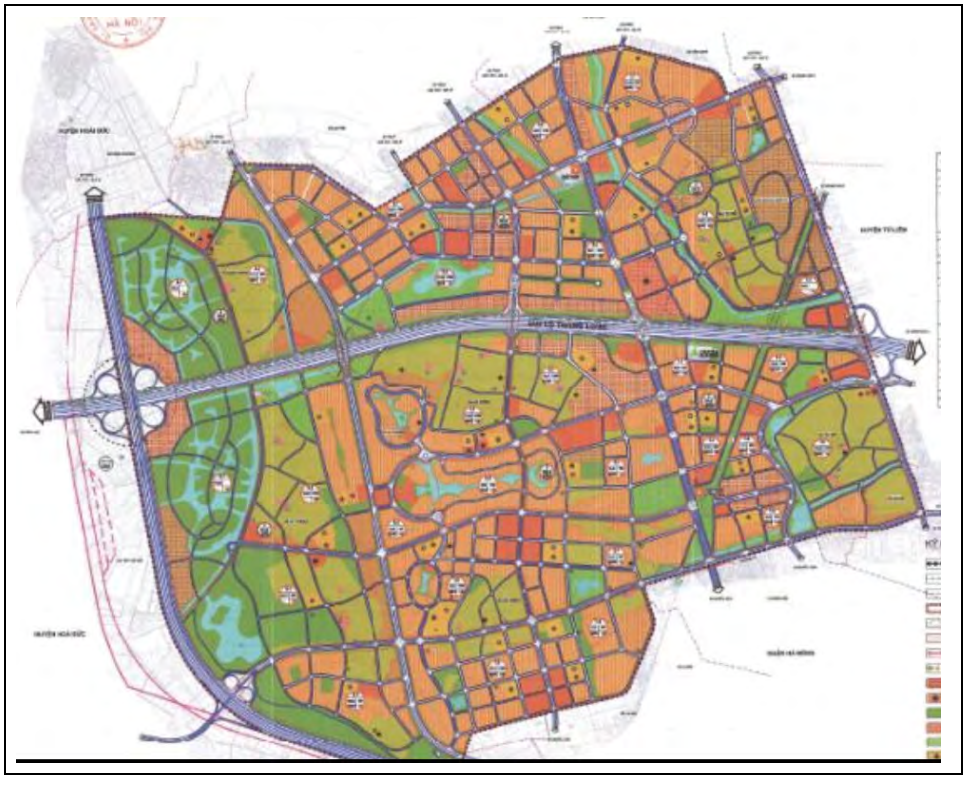
Source: Hanoi Construction Planning Institute

Figure 2.6.3 Artist's Rendering of the Future Development in Development Zone S2

The development zone S3 is planned officially in Decision No. 4874/QD-UBND dated August 15, 2014 from the HPC. It is related to various communes of Hoai Duc (and a commune of Ha Dong District). Among the communes, An Khanh is one of the places with a high concentration of projects.

Source: Hanoi Construction Planning Institute

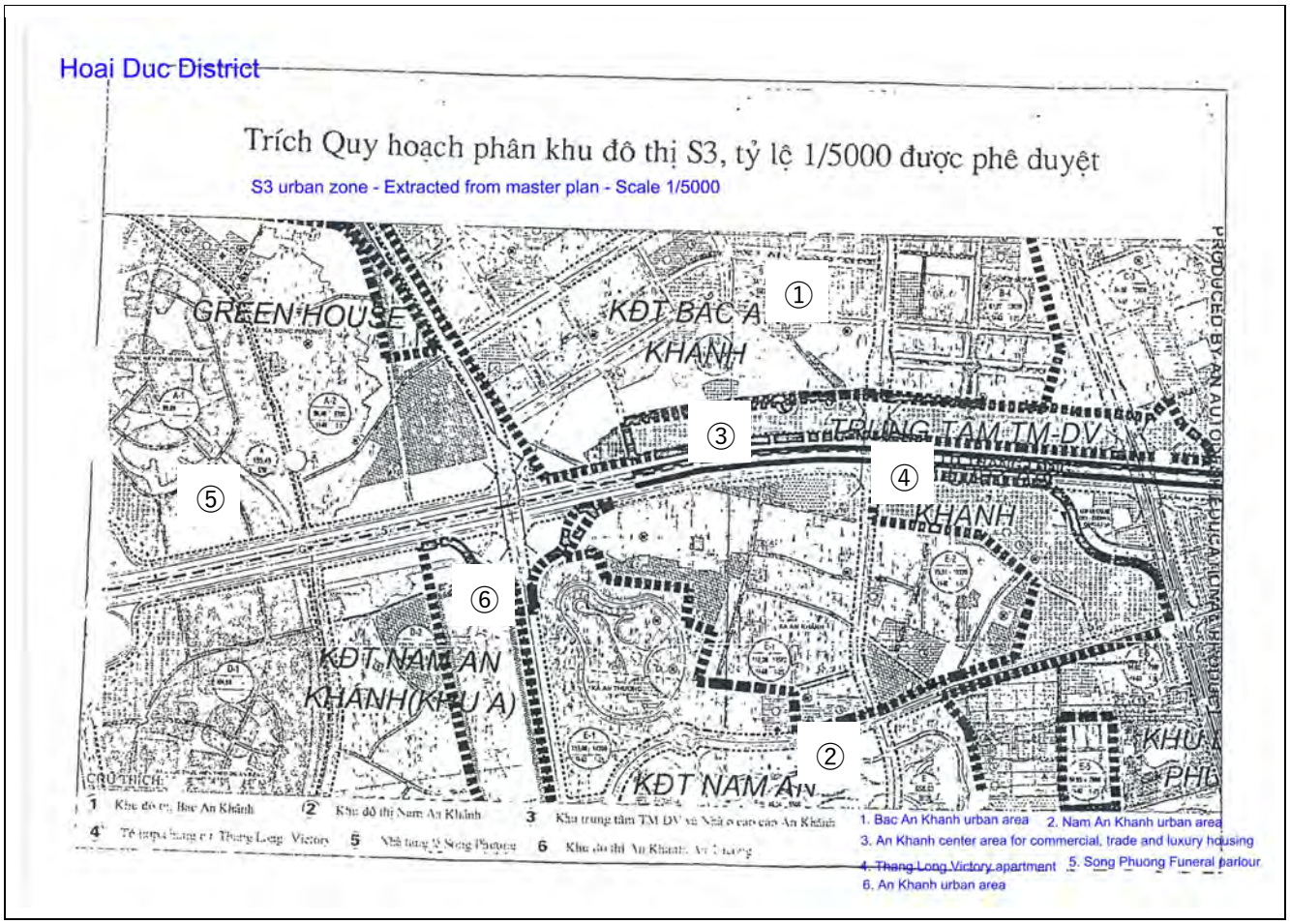
Figure 2.6.4 Artist's Rendering of the Future Development of Development Zone S3



Source: Hanoi Construction Planning Institute

Figure 2.6.5 Plan of Development Zone S3

The above-mentioned decisions listed a number of projects to develop the zones in the urbanization process. These projects cover a number of different sectors: houses, schools, electricity infrastructure, factories etc. so that the urbanization can be sustainable and comprehensive. Some projects in S3 are indicated in the following figure and table.



Source: Letter from the Hanoi Authority for Urban Planning & Architecture to the Hanoi Department of Transport

Figure 2.6.6 Urban Development in Development Zone S3 in Hoai Duc District

Table 2.6.2 Some Urban Development Projects in Development Zone S3 in Hoai Duc District

No.	Name of Project	Investor	Location	Area (ha)	Type of Development	Project Implementation	Planned/Targeted Completion Date
1	Bac An Khanh urban area	An Khanh JVC limited company	An Khanh ward,Hoai Duc district	272.4	Residential	A portion of the urban area has been constructed. Now the investor submitted the document to the government for revising the overall Bac An Khanh urban area	Constructed a part of the urban area
2	Nam An Khanh urban area	Da river urban and industrial area development Joint stock company	An Khanh ward,Hoai Duc district	181	Residential	A portion of the urban area, including the technical infrastructure, social infrastructure and adjacent villas has been constructed	Constructed a part of the urban area
3	An Khanh trading, service and luxurious housing area	Joint venture of enterprises in An Khanh industrial hub	An Khanh ward,Hoai Duc district	34.7	Commercial and luxury housing	Current, one joint venture (8 investors) proposes to revise partially a part of the land lot in the project of the An Khanh trading, service and luxurious housing area with the area of around 8 ha	Not constructed yet

4	The project for apartment and mixture service Thang Long Victory in planned land lot	Phuc Ha infrastructure development for industrial zone Joint stock company	HH1 land lot in Nam An Khanh urban area, An Khanh ward, Hoai Duc district	3.19	Residential	Constructed Building T1, T2 (Department issued Official letter No 842/QHKT-P5 dated 10/3/2014). Now T3, 4,5 not invested and constructed.	Constructed a part of the urban area
5	Funeral home in Song Phuong ward	Ministry of Construction	Song Phuong ward, Hoai Duc district	13.5	Public area	Prime Minister approved the project in Decision No 1627/QD-TTg dated 18/9/2015. Not invested and constructed yet	Not invested and constructed yet
6	Project for An Khanh- An thuong urban area	Ha Do coropration Joint stock company	An Khanh, An Thuong ward, Hoai Duc distrct	30	Residential	Department issued the guideline for investor to prepare the overall revising document. Now the investor has not sent to the Department for appraising. Currently, the technical infrastructure system was invested in and constructed	Technical infrastructure system was invested in and constructed

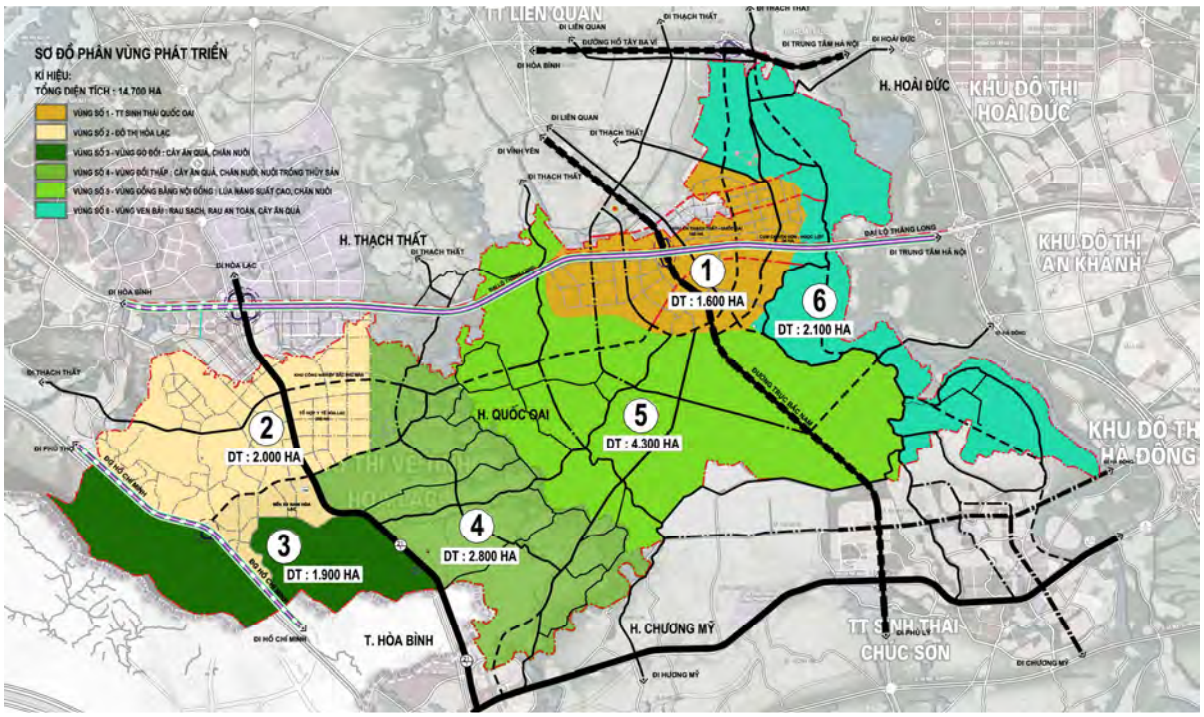
Source: Letter from the Hanoi Authority for Urban Planning & Architecture to the Hanoi Department of Transport

2.6.1.2 Quoc Oai District

In this area, there is actually a "Quoc Oai District" and "Quoc Oai Town". According to the current administration hierarchy system of Vietnam, a rural district is divided into communes (xa) and town (thi tran).

A town is usually the administration center of the district and has the highest population density. In the case of Quoc Oai, both the district and the town has the same name. The Thang Long Road runs through 9.4 km in the territory of this district. Among this length, 6.2 km runs through the town and the rest 3.2 km runs through 3 other communes.

In contrast with Hoai Duc which has a target to become an urban district, Quoc Oai has been planned in a different way. In this district, development is planned for 3 different areas: the urban area, countryside and the green corridor (see the following figure).

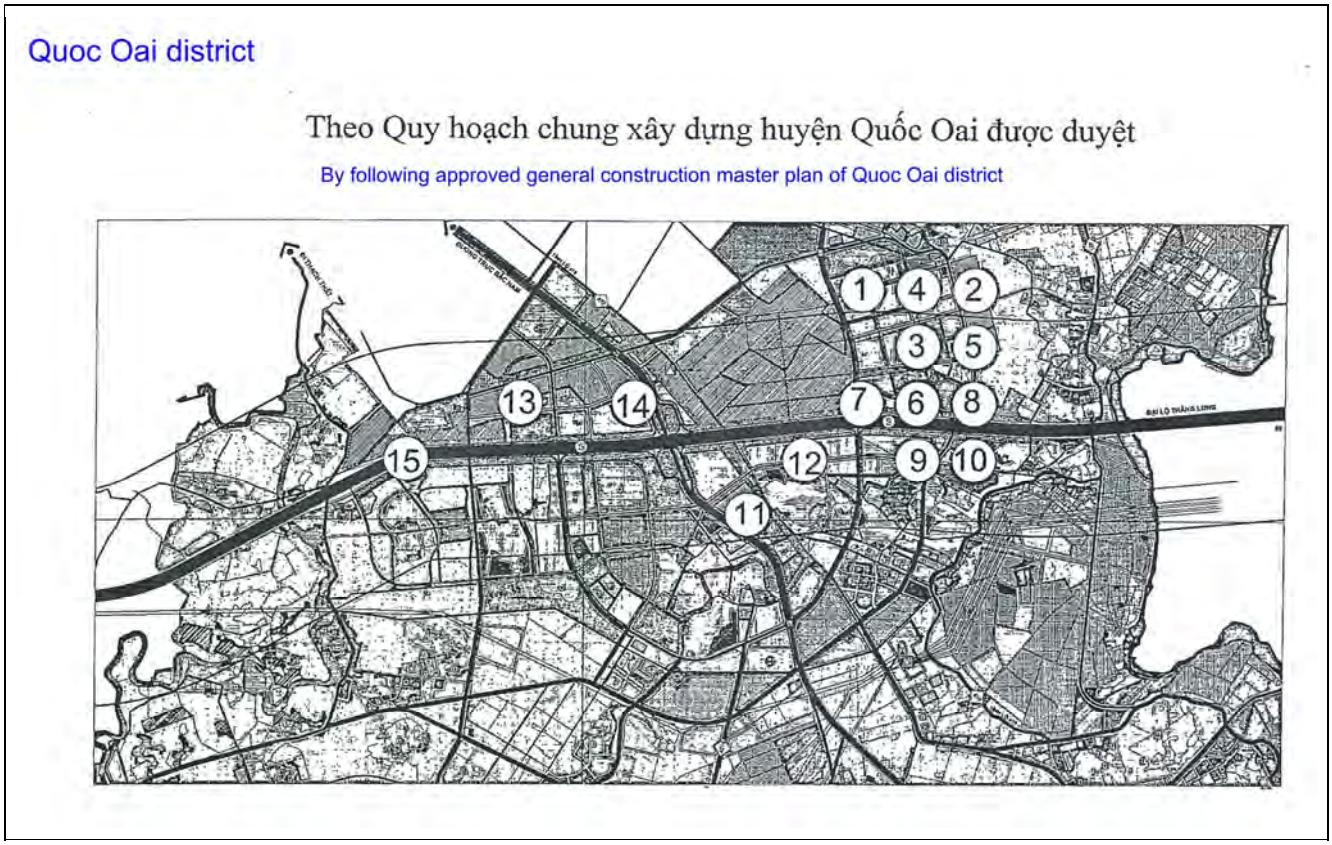


Note: ① Quoc Oai Town, ② Hoa Lac Satellite Town ③ Mountain Area, ④ Hill Area, ⑤ Plain Area and ⑥ Green Corridor
Source: Ministry of Construction (2013), Official Report on the Development Planning of Quoc Oai

Figure 2.6.7 Development Zoning of Quoc Oai District

- Urban Areas
  - Quoc Oai Town (indicated as ① in the figure): An ecological urban area with low population density and with places of history, culture and high tech agriculture
  - Hoa Lac Satellite Town (indicated as ② in the figure): are urban area of science, high technology and education (details are shown in the following section, 2.6.2)
- Countryside
  - ③ Mountain Area, ④ Hill Area and ⑤ Plain Zone: these areas are oriented to be developed with model farms, scientific research for agriculture, tourism activities, preservation and promotion of traditional craft villages.
- Green corridor (indicated as ⑥ in the figure)
  - To develop tourism, model farms and scientific research for agriculture.
  - Protection and conservation of traditional villages, the areas of biodiversity and productive agricultural areas
  - Develop social infrastructure systems and infrastructure for the entire city of Hanoi, especially the interurban transport systems

Some of the urban developments in Quoc Oai District are shown in the planning map as follows and details for each urban development project are shown in the following table.



Source: Letter from the Hanoi Authority for Urban Planning & Architecture to the Hanoi Department of Transport

Figure 2.6.8 Urban Development in Quoc Oai District

Table 2.6.3 Some Urban Development Projects in Quoc Oai District

No.	Name of Project	Investor	Location	Area (ha)	Type of Development	Project Implementation	Planned/Targeted Completion Date
1	Low residential area N1-N3	C.E.O Investment Joint Stock Company	Sai Son Ward	24.24	Residential	Under construction	Under construction
2	Low density residential area for staff of parliament	Vinaconex 11	Quoc Oai Ward	21.047	Residential	Approved in Decision No 444/QD-UBND Ha Tay dated 29/02/2008	Under construction
3	Monaco Garden Urban Area (1)	Son Dong Limited Company	Phuong Cach, Sai Son	39.23	Residential	Asking for instructions from the government	Asking for instructions from the government
4	Monaco Garden Urban Area (2) – CC1, CC3, N4	Neltra Investment and Trading International System Joint Stock Company	Phuong cach ward	15.36	Residential	Had decision to assign investor; decision No. 2623/QD-UBND Ha Tay dated 21/07/2008	Decision issued to assign an investor
5	Monaco Garden Urban Area (3)-Greenwich Village Ha Noi	BB Technology Joint Stock Company	Yen Son, Phuong Cach	24.2	Residential	Had Decision to approve on the 1/500 scale based on Decision No 2624/QD-UBND Ha Tay dated 21/07/2008	Decision to approve planning on the 1/500 scale
6	Complex trading center and luxurious villa Metropole	Praha Ha Tay Joint Stock Company	Yen Son, Phuong Cach	31.95	Commercial	Approved 1/2000,1/500-N2B1; Decision No 1488/QD-UBND Ha Tay dated 16/08/2007	Approved on the 1/2000, 1/500 scale.
7	Construction of the business for eco-garden and	Van Phu-House Investment Company	Quoc Oai Town	13.3	Residential	Under planning preparation	Under planning preparation

	weekend housing (The Project of Tat Thanh Joint Stock Company, Hoang Loc Electrical Equipment Joint Stock Company						
8	Yen Son Industrial Hub	People's Committee in Quoc Oai District	Yen Son Ward	8.9	Industrial	Under construction	Under construction
9	Quoc Oai Eco-Urban Area and Trading Center	T&M Investment Joint Stock Company	Quoc Oai Town	32.34	Residential	Had decision to assign investor. Decision No 705/QD-UBND Quoc Oai district dated 4/03/2008	Decision issued to assign investor
10	Skylight Gardens Eco-Tourism Area	TUD Tourism and Urban Development Joint Stock Company	Quoc Oai Town, Yen Son	24.08	Residential	Decision to approve planning 1/2000; Decision No 2912/QD-UBND Ha Tay dated 25/07/2008	Decision to approve planning in the 1/2000 scale
11	PBS service urban area in the west of Quoc Oai	FBS Entertainment and Enterprise Development Joint Stock Company	Ngoc My Ward	52.53	Residential	Under planning	Under planning
12	Luxurious residential area New house- Nam Quoc Oai urban area	New House Trading Joint Stock Company	Quoc Oai Town	28.76	Residential	Under construction	Under construction
13	Van Minh Urban Area	Van Minh Limited Company	Binh Phu Ward, Phung Xa (Thach That), Ngoc Liep, Ngoc My (Quoc Oai)	123.2	Residential	Approved planning 1/500 (Decision 1846/QD-UBND by HPC, 07/4/2014)	Approved planning in the 1/500 scale
14	Area No 10- Ngoc Liep eco-urban area- Dong Truc	Kenmec-Taiwan Corporation	Ngoc My Ward	54.9	Residential	Decision to approve planning 1/2000; Decision No 437/QD-UBND Ha Tay dated 29/02/2008; Decision No 2307/QD-UBND Ha Tay dated 11/07/2008	Approved planning in the 1/2000 scale
15	Ngoc Liep Industrial Hub	People's Committee	Ngoc Liep Ward	20.5	Industrial	Under construction	Under construction

Source: Letter from the Hanoi Authority for Urban Planning & Architecture to the Hanoi Department of Transport

2.6.2 Hoa Lac Satellite Town

2.6.2.1 Background

The political decision to construct the Hoa Lac Satellite Town comes from Decision No. 1259/QD-TTg dated July 26, 2011 from the Prime Minister for the General Planning of Hanoi by 2030 with a Vision to 2050. In this decision, the Vietnamese government decided to build five satellite towns in Hanoi: Hoa Lac, Son Tay, Xuan Mai, Phu Xuyen-Phi Minh and Soc Son and each satellite town was planned to have a population of between 21,000 to 75,000 persons.

In 2014, the Prime Minister approved the Housing Development Program of Hanoi by 2020 with an Orientation to 2030 and in this program, there were proposals for urbanization to be highly concentrated in certain areas. Because the Hoa Lac Satellite Town is the location of two Key National Projects, the development of the Vietnam National University campus and the Hoa Lac High Tech Park, development of Hoa Lac has been prioritized compared to the four other satellite towns that are planned.

In Decision No. 497/QD-TTg dated April 14, 2015, the Prime Minister approved the tasks for General Planning for the Hoa Lac Satellite Town by 2030 with a scale of 1/10,000. In this decision, the main contents for the satellite town were fixed. As of now, the Hanoi People's Committee has determined to speed up work for the general planning of the Hoa Lac Satellite Town so that the Hanoi People's Committee can carry out an evaluation in October 2016.

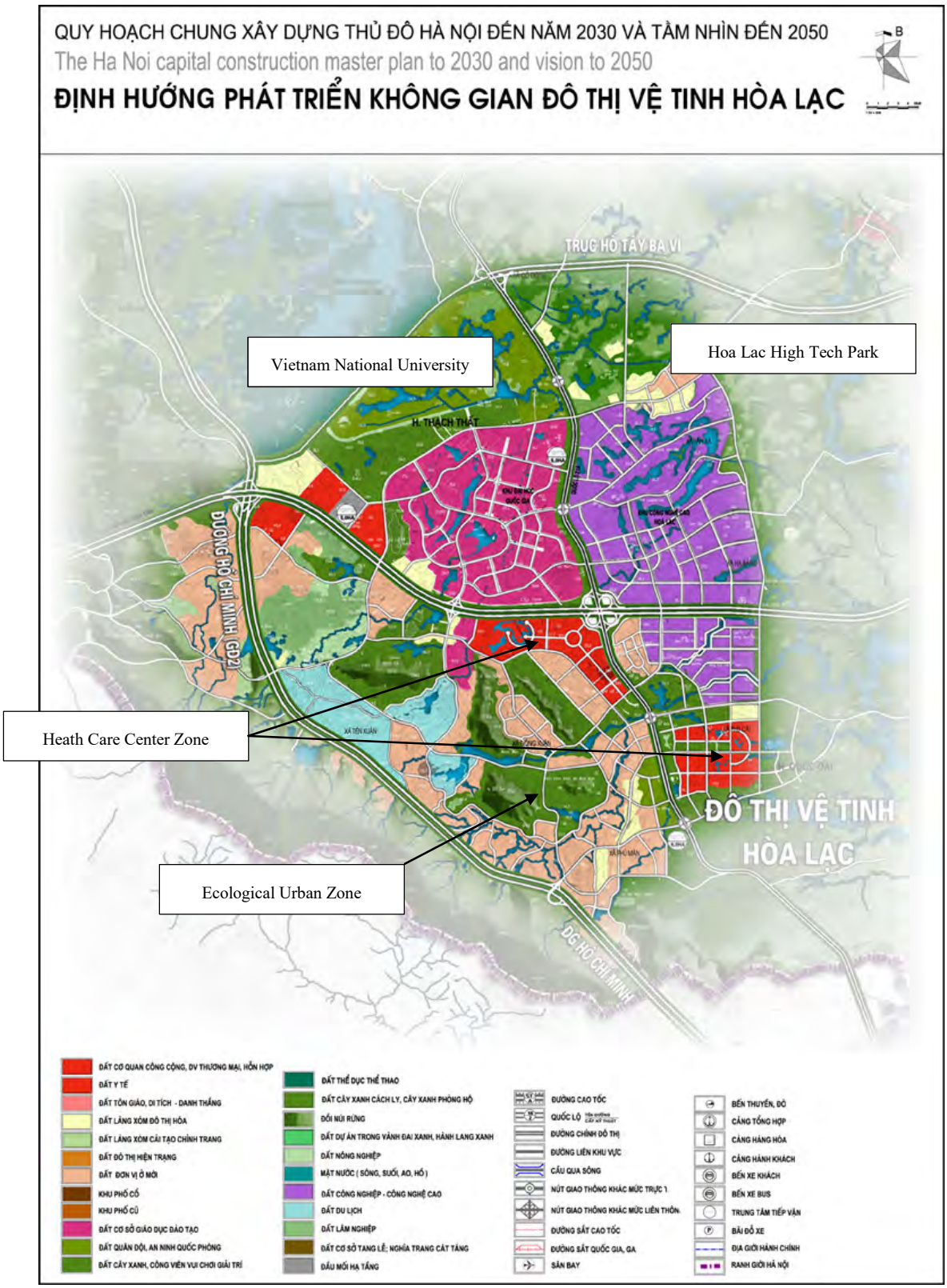
2.6.2.2 Development Plan

The Hoa Lac Satellite Town lies on the administrative boundaries of Quoc Oai and Thach That districts and Son Tay and has an area of 17,294 ha. The Hoa Lac Satellite Town is planned as a sub-centre of Hanoi focusing on research and development and education not just for Hanoi but for the entire country of Vietnam.

With regards to spatial planning, the Hoa Lac Satellite Town consists of 4 zones with specialized functions:

- Vietnam National University campus
- Hoa Lac High Tech Park
- Zone for health care centres
- Ecological urban zone with emphasis on sustainable development that respects the hilly terrain and existing lake system of the area

The development of the Vietnam National University campus and Hoa Lac High Tech Park are Key National Projects of Vietnam as previously described. Development planning for the two other zones (health care center zone, ecological urban zone) is still under preparation.



Source: Institut des métiers de la ville

Figure 2.6.9 Spatial Development Plan for the Hoa Lac Satellite Town

2.6.2.3 Vietnam National University Campus

The Vietnam National University (VNU) was established from Decree 97/ND-CP dated October 10, 1993 by the Prime Minister. In this original decree, the campus of the VNU was planned for Hoa Lac and Luong Son District in Hoa Binh Province. Currently, the campus of the VNU is located temporally in Cau Giay in central Hanoi.

1. First Relocation Plan

The first relocation plan of the VNU from Cau Giay (central Hanoi) to Hoa Lac was approved in 2003 with the VNU as the investor. The initial estimate was for the relocation to last for 13 years (2003-2015) and for the entire VNU to have been relocated to Hoa Lac by 2015 but for various reasons, this plan failed.

2. Change of the Investor and the 1/2000 Scale Plan

On October 30, 2008, the Prime Minister issued Decision No. 1404/QD-TTg to change the investor for the relocation of the VNU from the VNU to the Ministry of Construction (MOC).

The MOC then issued Decision No. 117/QD-BXD on January 29, 2011 to approve the Adjusted General Planning to Build the VNU in Hoa Lac by 2020 with a Vision to 2050 and approved the Detailed Planning with a Scale of 1/2000 (Decision No. 234/QD-BXD dated November 3, 2011). In this 1/2000 scale plan, the campus of the VNU was to be relocated only to Hoa Lac and the plan for Luong Son was cancelled.

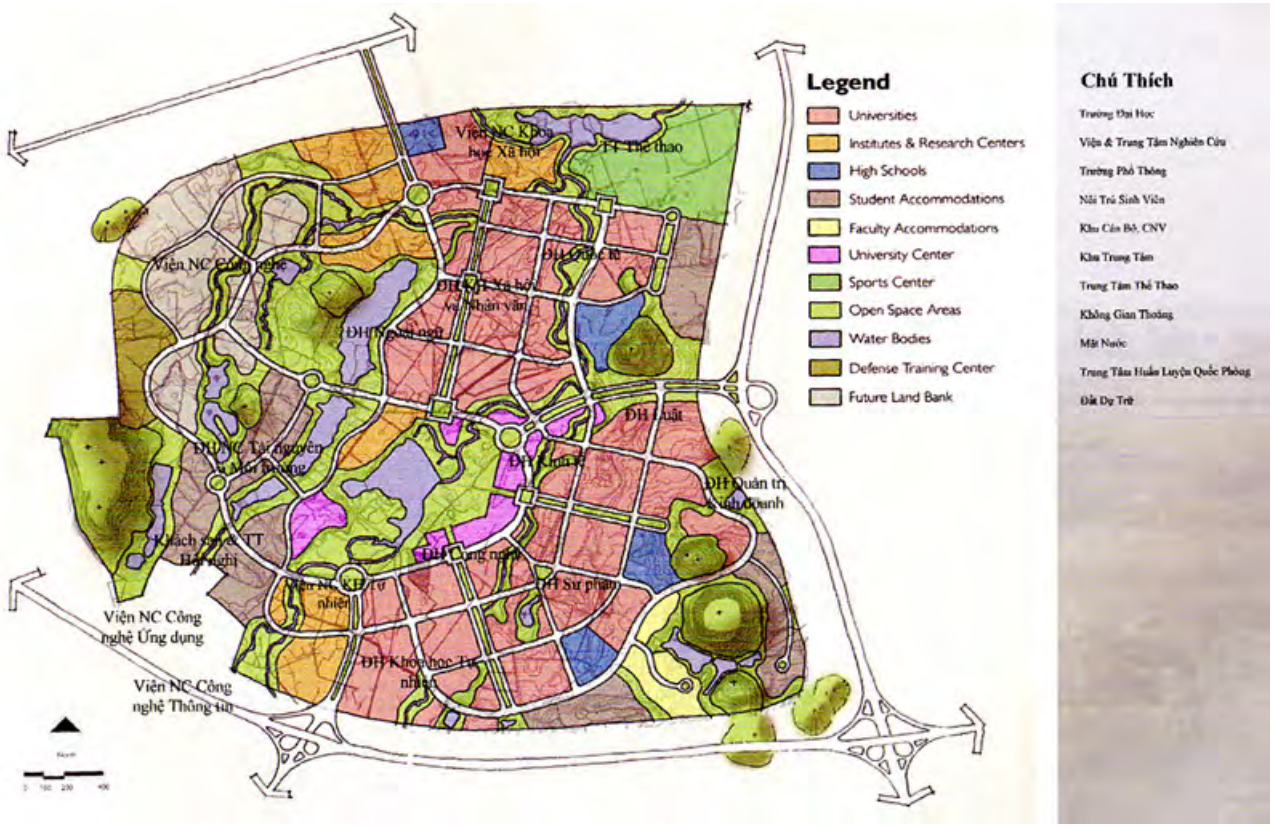
3. VNU General Plan

The Scheme for the General Planning for the Development of the VNU was approved in Decision No. 1907/QD-TTg dated October 18, 2013 from the Prime Minister. In this decision, the development of the VNU was named as a Key National Project and in addition to the previous development plans for the VNU, a new area for high ranking research and development (R&D) institutions was added to the plan. These R&D institutions will not be controlled by the VNU but will be under the direct leadership of the central government.

In the plan for this Key National Project, there are 22 components which includes the Vietnam-Japan University project.

Source: VNU

Figure 2.6.10 Land Use Planning for the VNU in Hoa Lac



Source: VNU

Figure 2.6.11 Master Plan for the VNU Campus in Hoa Lac

4. Current Relocation Plan for the VNU

In the current plan, relocation is to be implemented in three stages.

- First Stage (2013-2016)
  - Complete resettlement on the site of the VNU in Hoa Lac
  - Complete the relocation from Cau Giay (central Hanoi) of the following constituent members of the VNU
    - University of Natural Science
    - University of Technology
    - Security Defense Training Center
    - Students' Dormitory No. 4
    - Francophone Informatics Center and other units of the VNU
  - As of this moment, the Security Defense Training Center and the Francophone Informatics Center along with some administrative units of VNU have moved to Hoa Lac
- Second Stage (2017-2020)
  - 75-80% of all the constituent members of the VNU to be relocated to Hoa Lac
    - 8 member universities, 5 faculties, 5 R&D institutes, 10 training/research centers, 10 support/administrative units (however, this list is not yet fixed)
- Third Stage (2021-2025)
  - Complete the 100% relocation of the entire VNU to Hoa Lac

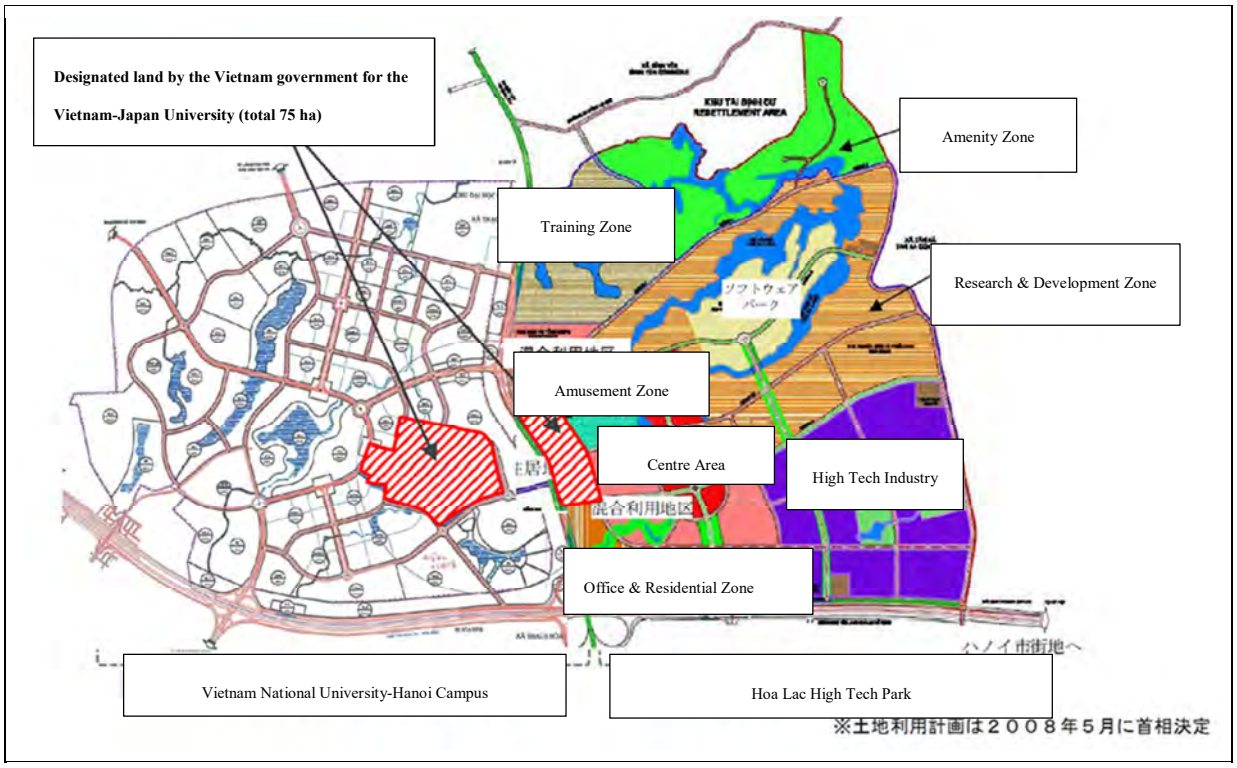
5. Current Relocation Plan for National R&D Institutions

The Institute of Mathematics will be the first national R&D institution to be relocated to Hoa Lac and will be built a site of approximately 3-5 ha.

6. Location for Collaborative Universities

The campus of the VNU along with the Hoa Lac High Tech Park will also be the location for three collaborative universities with foreign countries. The three universities are described as follows:

- University of Science and Technology of Hanoi (Vietnam-France University)
  - Funding and Support: Government of Vietnam, Government of France, Vietnam Academy of Science and Technology, Asian Development Bank, consortium of high level universities and research institutes of France
  - Current Status: Operating in temporary facilities since 2010 in shared facilities with the Vietnam Academy of Science and Technology in Cau Giay in central Hanoi and has started to take in students for courses
  - Relocation Plans: The campus was first planned to open by 2015, but as of now, only the location has been identified and the relocation plan is now in the preparation for implementation stage
- Vietnam-Korea Institute of Science and Technology (V-KIST)
  - Funding and Support: Grant aid from Korea
  - Current Status: The Vietnamese and Korean governments had preliminary discussions about establishing the K-VIST as an R&D institution and not as a university
  - Establishment Plans: This institute is to be located in the Hoa Lac High Tech Park with an area of 20 ha
- Vietnam-Japan University
  - Funding and Support: Government of Vietnam, Government of Japan
  - Current Status: Planning stage
  - Establishment Plans:
    - Phase 1 (2016-2019): Start the Master's program using the existing facilities of the VNU
    - Phase 2 (2019-2022): Build a new campus within the Hoa Lac High Tech Park and start the PhD program
    - Phase 3 (2022-2025): Continue building the new campus within the Hoa Lac High Tech Park and within the new campus of the VNU in Hoa Lac and start the undergraduate program
  - The designated land by the Vietnamese government for the Vietnam-Japan University (75 ha) in the campus of the VNU and in the Hoa Lac High Tech Park is shown in the following figure.



Source: Information with regards to the concept of the Vietnam-Japan University

Figure 2.6.12 Future Plan of the Vietnam-Japan University

2.6.2.4 Hoa Lac High Tech Park

1. Background and General Plan

The Hoa Lac High Tech Park was established under Decision No. 198/1998/QD-TTg dated October 12, 1998 from the Prime Minister as a research and development center for high tech as well as an incubator for cultivating human resources in the high tech industry.

The total area of 1,586 ha of the Hoa Lac High Tech Park was approved by the Prime Minister in Decision No. 621/QD-TTg dated May 23, 2000. Recently, on May 27, 2016, in Decision No. 899/QD-TTg from the Prime Minister, the Scheme for Adjusting the General Plan for a Construction Scale of 1/5000 for the Hoa Lac High Tech Park by 2030 was approved. In this decision, the following was confirmed:

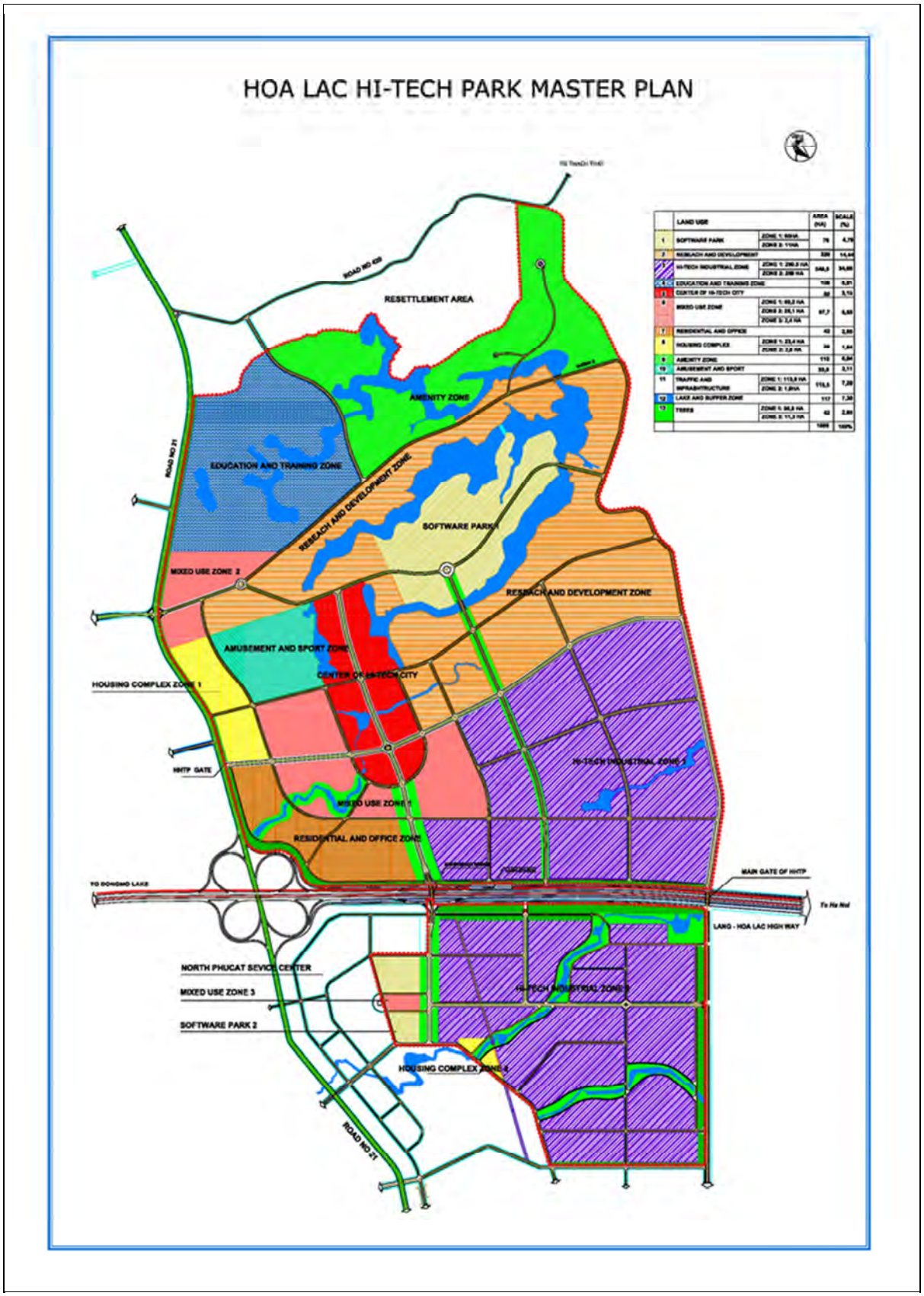
- Scope and Boundaries
  - Administrative Boundaries: The Hoa Lac High Tech Park is located on both sides of the Thang Long Expressway and includes both Quoc Oai District and Thach That District of Hanoi
  - Scale Area: Approximately 1,586 ha
    - Area north of the Thang Long Expressway: 1262.2 ha
    - Area south of the Thang Long Expressway: 323.7 ha
- Population Size
  - 2015 Population: The population and labour force is approximately 12,600 people
  - 2030 Forecasted Population: Approximately 229,000 people of which 99,300 are residents (40-50% of the total population)
- Investment Period
  - Continuously invested in until 2030

In addition the land use planning according to this decision is as follows:

Table 2.6.4 Land Use for the Hoa Lac High Tech Park

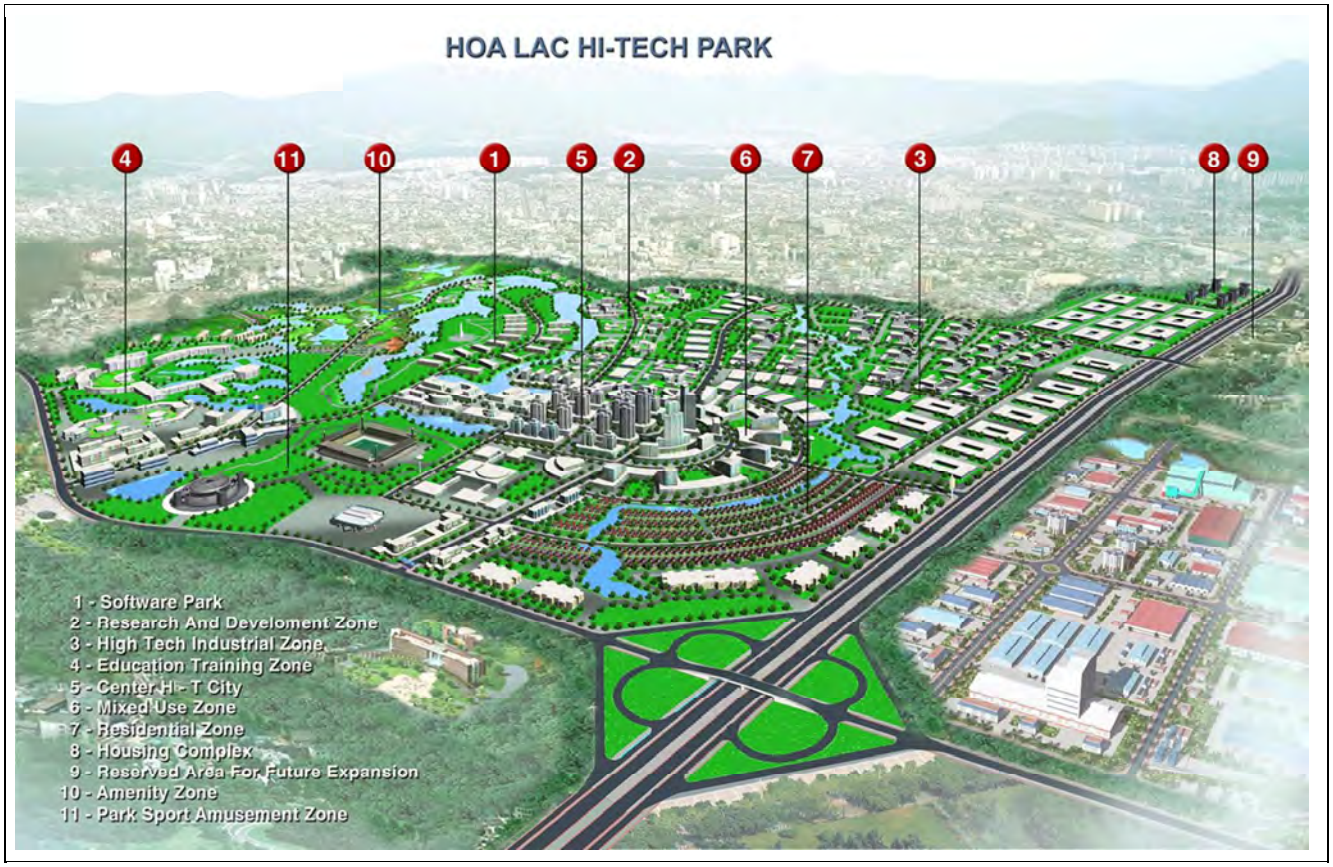
No.	Function Zone	Area (ha)	Percentage of Land Use (%)
1	Education and Training Zone	123.53	7.79
2	R&D Zone	263.15	16.59
3	Software Park	55.93	3.53
4	High Tech Industrial Zone	391.01	24.65
5	Central Zone	43014	2.72
6	Mixed Use Zone	80.12	5.05
7	Residential Zone and Housing Complex	75.50	4.76
8	Park Sport Amusement Zone	32.92	2.08
9	Tan Xa Lake and Buffer Zone	150.77	9.51
10	Transport and Other Main Infrastructure	220.55	13.91
11	Greenery	149.37	9.42
	Total	**1586.00**	**100.00**

Source: Hoa Lac High Tech Park Project Management Unit



Source: Hanoi Construction University

Figure 2.6.13 Master Plan for the Hoa Lac High Tech Park



Source: Hoa Lac High Tech Park Project Management Unit

Figure 2.6.14 Artist's Impression of the Hoa Lac High Tech Park

2. Current Implementation Status

The current implementation status of the Hoa Lac High Tech Park is as follows:

- Owner of the Project: Ministry of Science and Technology
- Management Agency: Hoa Lac High Tech Park Project Management Unit (Hoa Lac PMU)
- Investment Policy:
  - Planning and construction of major infrastructure to come from the budget from the Vietnamese government and from Japanese ODA
  - The Hoa Lach High Tech Park is designated as a Key National Project so investors in this park can enjoy special privileges such as tax and administrative procedures
- Situation from 1998-2015
  - Land Acquisition: Ongoing for 20 years and the government hopes to complete it by 2018
  - Major Infrastructure:
    - The road system in the park has basically been completed and connected with the Thang Long Expressway
    - Wastewater treatment plant completed
    - To ensure that the park has modern infrastructure, the Government of Vietnam requested the Japanese government to support the infrastructure development in the Hoa Lac High Tech Park and on March 30, 2012, JICA signed the first loan agreement worth 15.22

billion yen for the construction of infrastructure. It is expected that the total amount of ODA will add up to 28.5 billion yen and construction of the essential infrastructure will be completed by 2018 (deadline of the ODA is in 2018) while all of the major infrastructure will be completed by 2025

- Investment Projects:
  - At the end of 2015, there are currently 72 projects on about 353.74 ha. However, in recent years due to the domestic and international economic situation, some projects have not been implemented as promised and the Hoa Lac PMU has revoked the investment certificates of 3 foreign investment projects and 5 local investment projects.
  - Compared to the High Tech Park in Ho Chi Minh City, in the last couple of years, there is no foreign direct investment in Hoa Lac[4]
  - Major Projects:
    - JSC Entertainment Services Gia Phat Hoa Lac has been approved as the investor for the development of a sports center, cinemas, restaurants and amusement park in the 33.5 ha Recreation and Sports zone
    - FPT University, a university that focuses on technical education, has already opened on a site of 30 ha and was funded by FPT Corporation, one of Vietnam's leading IT firms
    - Software Project Area (6.4 ha site, capital of 924 billion VND) – funded by the Corporation for Investment and Development and Promoting Technology
    - High Technology Center Project (1.4 ha site, 495 billion VND) – funded by Viettel Corporation
    - Consortium for the Research, Design and Manufacture of Telecom Equipment (7.4 ha site, 2,080 billion VND) – funded by Viettel Corporation
    - Vietnam Space Center Project (7.4 ha site, capital of 54.4 billion yen) – 46.6 billion yen funding from Japanese ODA and 7.8 billion from the Vietnamese government
    - Banknote Printing Plant of the State Bank of Vietnam
    - Foreign Collaborative Universities as previously mentioned: Vietnam-Korea Institute of Science and Technology (V-KIST, 20 ha), Vietnam-Japan University (23.4 ha), University of Science and Technology of Hanoi (Vietnam-France University, 65 ha)

A summary of the development plan for the Hoa Lac High Tech Park is shown in the following table.

[4] Source: http://enternews.vn/khu-cong-nghe-cao-hoa-lac-bi-lang-quen.html

Table 2.6.5 Summary of the Hoa Lac High Tech Park Development Plan

No.	Activities	…	2016	2017	2018	…..	2020	…	2025	…	2030
1	Land Acquisition (1469 ha) (Of the 1586 ha in total, 117 ha are previously available, no need to be acquired)										
2	Major Infrastructure • Essential Infrastructure Complete by 2018 from Japanese ODA Funds • All Infrastructure Complete by 2025										
3	Investment Projects (e.g., universities, R&D, high tech industries, etc.)										

Source: Study Team

2.7 Existing and Planned Public Transport Systems in the Study Area

Currently in the study area from the My Dinh Bus Terminal near Ring Road 3 to the Hoa Lac Satellite Town area, there are 2 existing intra-city public bus lines, No. 71 and No. 74 that run along the service road of the Thang Long Expressway. Only bus line No. 74 is subsidized by TRAMOC.

A summary of the operating conditions of public bus lines No. 71 and No. 74 are shown in the following table. (Bus line No. 71 does not receive any subsidies so the farebox revenue is unclear)

Table 2.7.1 Summary of the Operating Conditions of Bus Lines No. 71 and 74

Bus Number	**No. 71**		**No. 74**	
Route	Be Xe My Dinh – Xuan Mai		Ben Xe My Dinh – Xuan Khanh	
Fare	Entire Route	20,000 VND	Entire Route	7,000 VND
Route Length		46.6 km		49.9 km
Farebox Revenue (in 2015)		-		13,734,772,000 VND
Operating Subsidy (in 2015)		-		15,874,488,763 VND

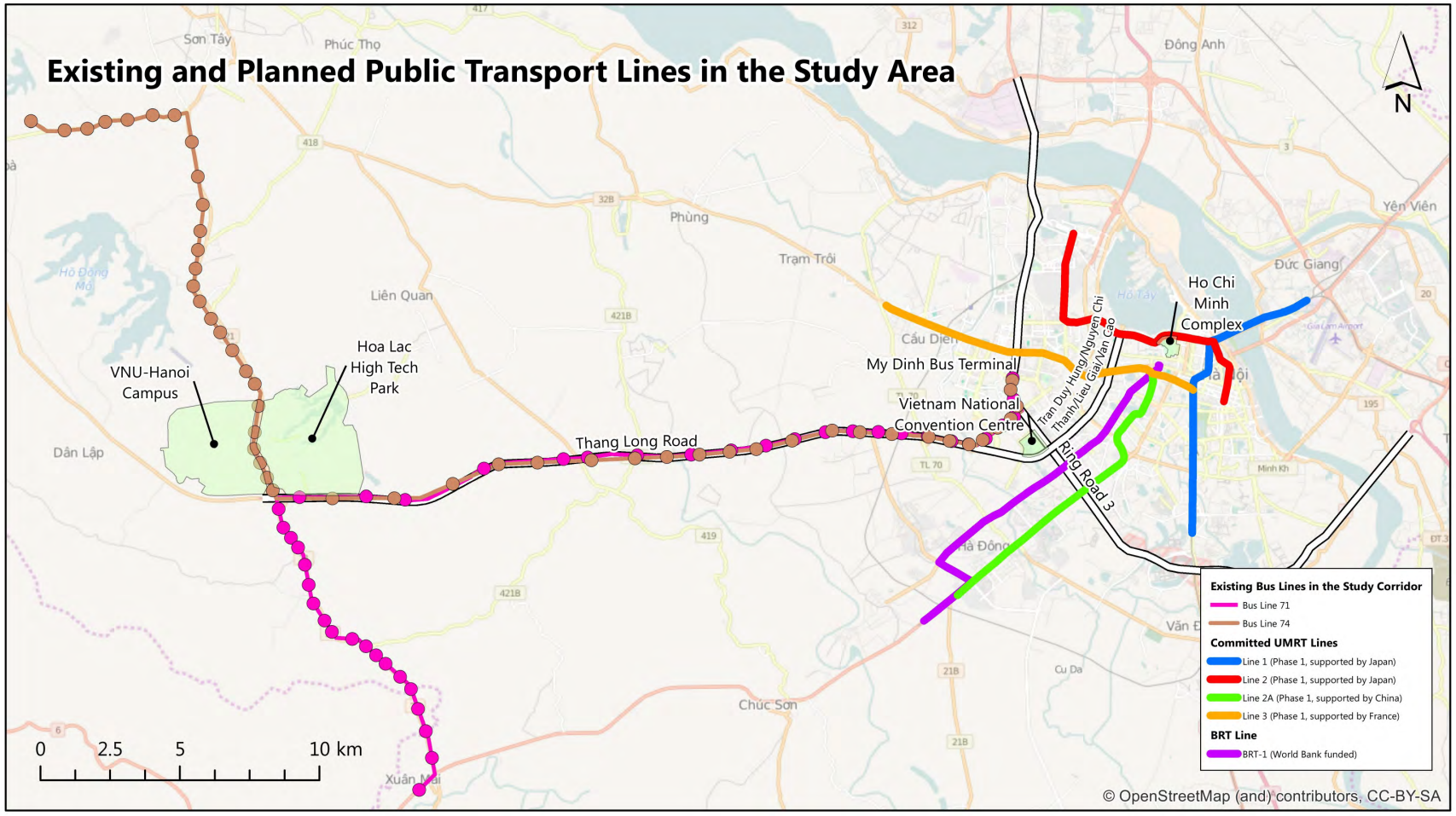
Source: Study Team

The FPT University located in the Hoa Lac High Tech Park owns some buses for transporting students to the campus but this service does not run on a daily basis. It only runs on an irregular schedule to meet the students' academic needs. FPT Corporation which runs the FPT University also has a subsidiary called Hoa Lac FPT Software Company Limited (FSoft) which has an office on a 6.4 ha site in the Hoa Lac High Tech Park and headquarters in the central area of Hanoi (Duy Tan Street). In order to connect the FSoft headquarters and Hoa Lac office, FSoft has been spending 19 billion VND to hire private buses to transport staff between the 2 office locations. In 2016, FSoft will have to spend 300 billion VND[5] to hire more private buses to shuttle the staff between the 2 office locations. In addition, FPT Corporation proposes to operate extra private buses for both the FPT University and the FSoft office (feeder buses to connect with bus line No. 74) in Hoa Lac but so far, this proposal has not been accepted.

In general, the Hoa Lac High Tech Park is very large and the station for bus lines No. 71 and No. 74 is located on the perimeter of the park and there is poor access to buildings located inside the park as there is no feeder bus services nor are there any park and ride facilities and the distances within the park are too far for people to walk.

The location of the 2 existing public bus lines is shown in the following figure. The figure also shows the location of the committed UMRT lines (Line 1, Line 2, Line 2A, Line 3). Currently, only UMRT Lines 2A and 3 are under construction.

[5] Source: http://dantri.com.vn/xa-hoi/tuyen-xe-buyt-nhanh-dau-tien-o-ha-noi-brt-hay-khong-brt-20160627181928599.htm, accessed on July 01, 2016.

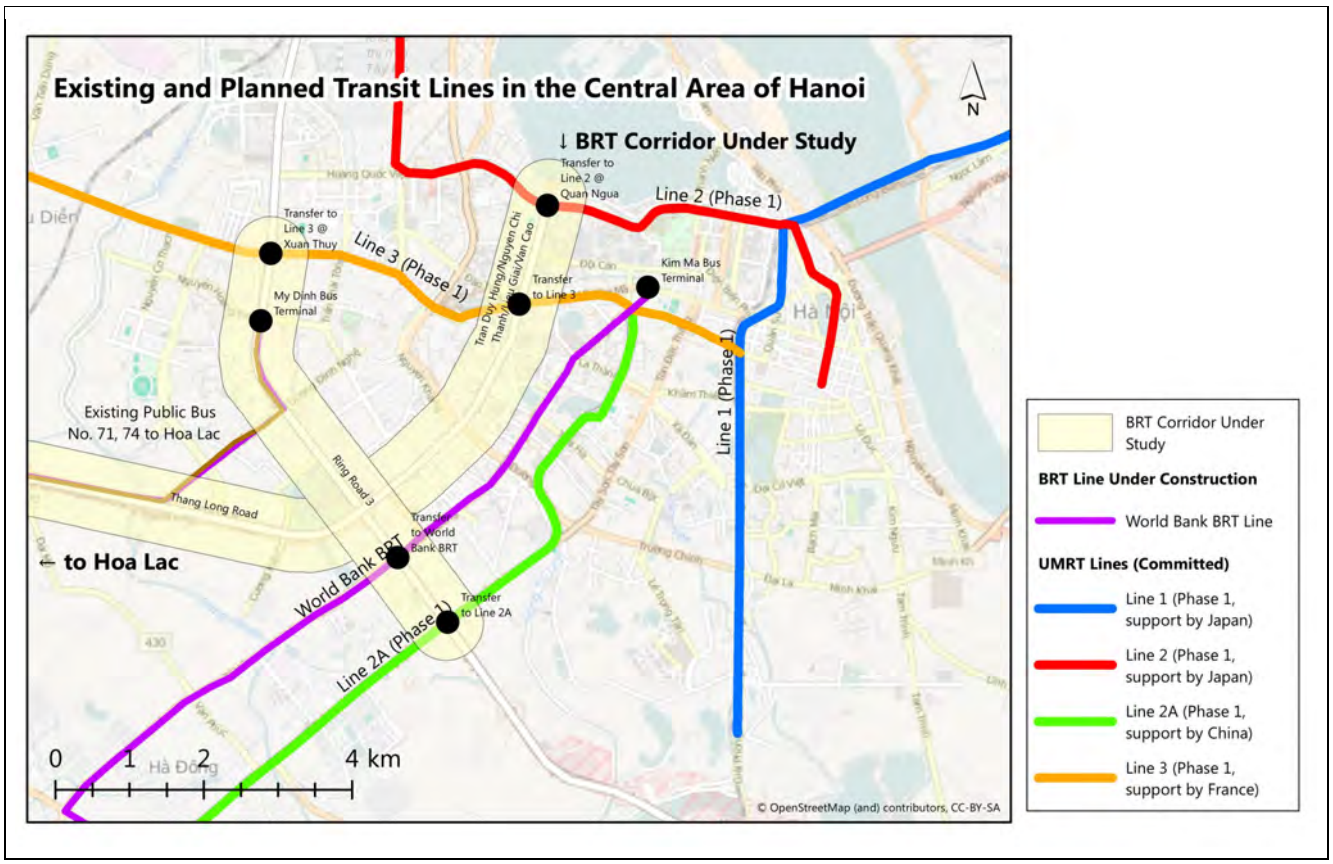


Source: Study Team

Figure 2.7.1 Relevant Transit Lines in the Study Area

The following figure shows the existing and planned transit lines in the central area of Hanoi. My Dinh Bus Terminal, located on Ring Road 3 in the western edge of the central area of Hanoi is the starting point of intra-city buses No. 71 and 74 which goes out to Hoa Lac as previously mentioned.

In addition to the UMRT Lines 2A and 3 which are under construction as previously mentioned, the World Bank BRT line (BRT-1) is also under construction and will terminate at the existing Kim Ma Bus Terminal.



Source: Study Team

Figure 2.7.2 Existing and Planned Transit Lines in the Central Area of Hanoi

2.8 Public Transport Hub Planning

2.8.1 Planning of Transit Oriented Development at Public Transport Hubs

In the "Project for Studying the Implementation of Integrated UMRT and Urban Development for Hanoi in Vietnam (HAIMUD2)" conducted by JICA in 2015, the study team studied ways to integrate stations on the planned UMRT lines with urban development using the transit oriented development (TOD) concept. In particular, the study team focused on the following:

- TOD concept plans for transport access improvement and integrated urban development were developed only for the 18 stations of UMRT Line 1 Phase 1 and UMRT Line 2
- Pre-feasibility studies were conducted for the following:
  - Transport access improvement for the 18 stations of UMRT Line 1 Phase 1 and UMRT Line 2 which included identifying projects such as pedestrian crossing improvement, station plaza development, etc.
  - Underground parking development at Tran Hung Dao station located in the French Quarter to estimate the demand supply gap of parking facilities and to assess the feasibility of building underground parking facilities at this station
  - Transit oriented development at the Giap Bat station area to formulate a comprehensive concept plan, to assess the viability from economic, financial and socioeconomic viewpoints and to study the possible application of the Japanese land readjustment and urban renewal systems

Among the general concept plans that were developed for the 18 stations for UMRT Line 1 Phase 1 and UMRT Line 2, the following stations were identified by the study team as major transport hubs.

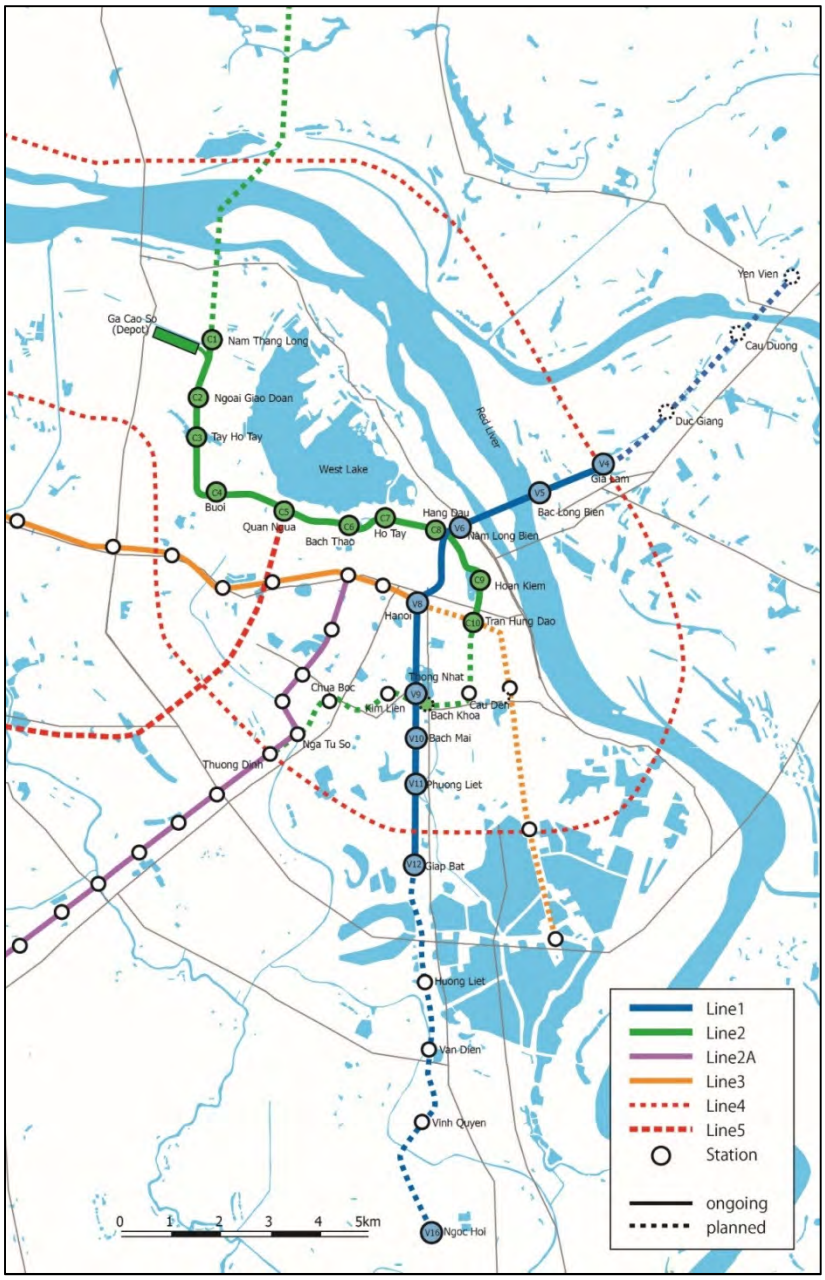
<u>UMRT Line 1 Phase 1</u>

- V4 – Gia Lam (elevated station)
  - This station will connect with UMRT Line 4, major trunk roads, National Highway 1 and 5 (QL-1 and QL-5) and feeder bus services
  - The study team suggested that the Vietnam National Railways (VNR) land adjacent to the station be redeveloped to provide urban and intermodal facilities
- V6 – Long Bien Nam (elevated) and C8 – Hang Dau (underground)
  - This station will connect with the UMRT Line 2 and the Long Bien Bus Terminal
  - Although the UMRT Line 1 station is elevated and the UMRT Line 2 station is underground, the study team proposes that the stations and the bus terminal be connected via underground and elevated walkways and be integrated with the Long Bien Market and underground parking of Hang Dau Park
- V8 – Hanoi (elevated station)
  - This station will connect with UMRT Line 3 as well as the intercity train services from VNR
  - The study team suggested that the VNR land and elevated structure of the station be utilized for urban redevelopment
- V9 – C. V. Thong Nhat (elevated station)
  - This station will connect with Bach Khoa station in UMRT Line 2 Phase 2 and will connect with National Highway 1 (QL-1) and Ring Road 1
  - Development of intermodal facilities are suggested enhance the station for park visitors and university students
- V12 – Giap Bat (elevated station)

- This station connects with the intercity trains services from VNR and a long distance bus terminal
- The station is proposed as the core of a new central business district south of the central area to promote balanced growth and the study team proposed implementing TOD and redevelopment on the VNR station complex land, long distance bus terminal and on the area west of the station

UMRT Line 2

- C3 – Tay Ho Tay (elevated station)
  - The study team proposes that a bus terminal be developed to expand the catchment area of the UMRT via feeder bus services
- C4 – Buoi (underground station)
  - This station functions as an important transfer point between the UMRT and roads heading towards the west
  - Development of intermodal facilities along Hoang Quoc Viet St. and integrated redevelopment of old apartments is proposed
- C8 – Hang Dau (underground station)
  - Refer to V6 – Long Bien Nam (elevated) above

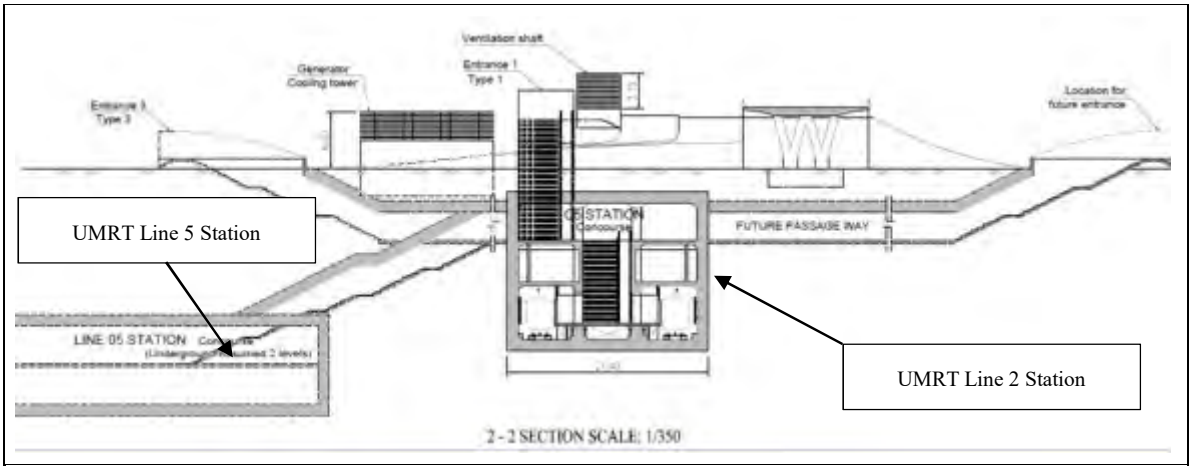


Source: Chapter 1, Project for Studying the Implementation of Integrated UMRT and Urban Development for Hanoi in Vietnam (HAIMUD2)

Figure 2.8.1 Main Study Area of TOD on UMRT Line 1 Phase 1 and UMRT Line 2

2.8.2 Concept TOD Plan at the Quan Ngua Interchange Station between UMRT Line 5 and Line 2

Quan Ngua station (C5) on the UMRT Line 2 will be an underground station located southwest of Ho Tay and will be the interchange station between UMRT Line 2 and UMRT Line 5. Currently, in this area there are traditional villages and high density residential areas. The underground station will be located under the intersection of two main roads, Van Cao St. (major north-south traffic corridor) and Hoang Hoa Tham St. (major east-west traffic corridor). The following figure from the METROS study shows a conceptual concept for the underground connection for the two stations of the UMRT Line 2 and Line 5.

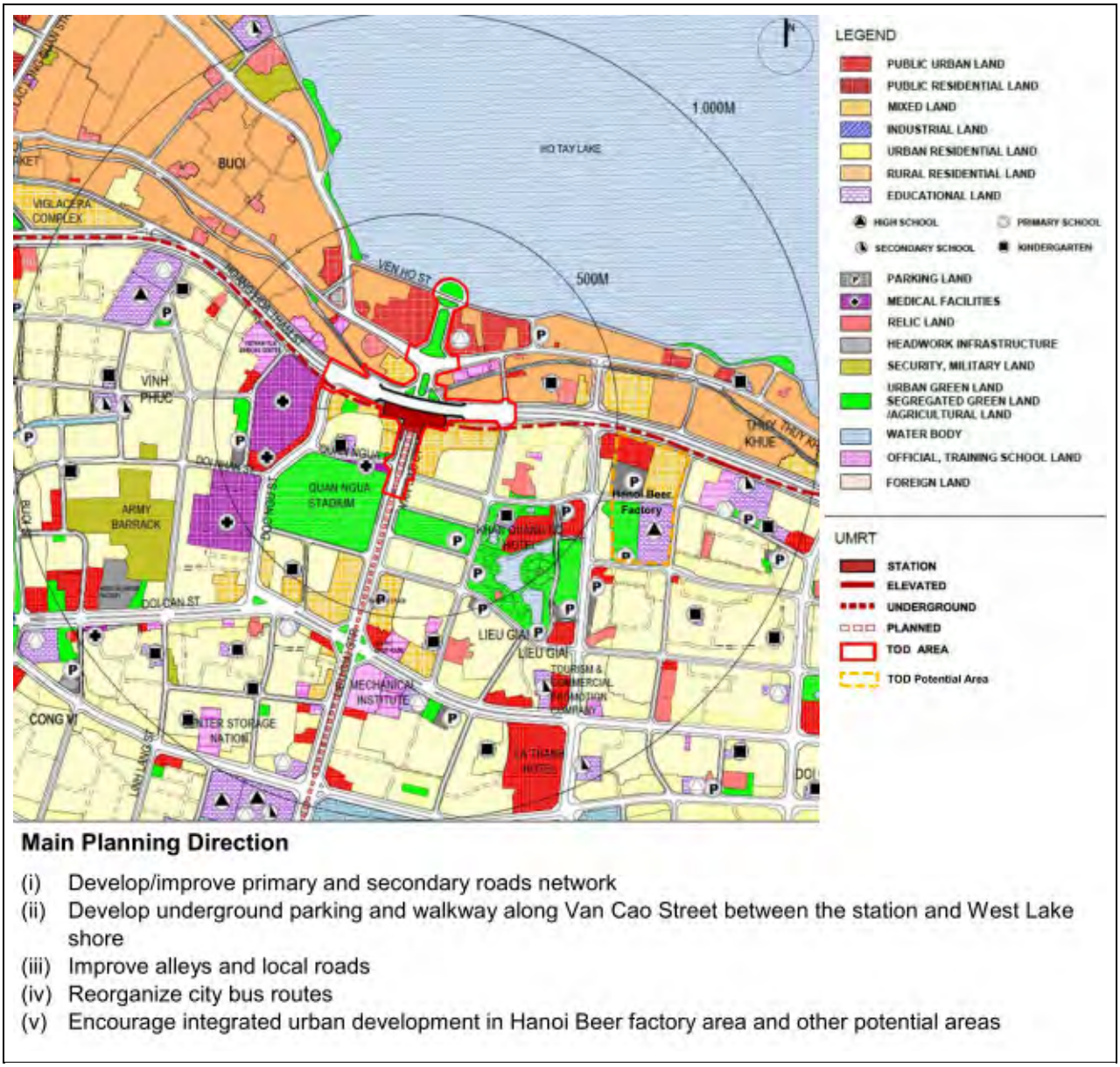


Source: Chapter 6, 6.6, Data Collection Survey in Major Cities in Vietnam (METROS), JICA, 2016

Figure 2.8.2 Conceptual Underground Connectivity between UMRT Line 2 and Line 5

With regards to transport access improvement, the HAIMUD2 study proposes that secondary roads connected to Van Cao St. and Hoang Hoa Tham St. be improved to articulate the traffic better. In addition, the study also proposes that alleys and local roads be improved with better pavement, drainage and safety because most of the area is made up of densely populated traditional urban areas. With regards to bus service improvement, after the UMRT Line 5 is opened, the study proposes to eliminate bus services that overlap with the UMRT Line 5 and to reorganize the bus services as feeder buses from the station.

With regards to integrated urban development, the HAIMUD2 study proposes that the road space between Hoang Hoa Tham St. and Ven Ho St. offers space for multi-purpose development and that an underground parking facility with an approximate scale of 7,300 m^2 along with an underground walkway from the station to the parking facility to Ho Tay should be developed.



Source: Chapter 3, 3.5.2, Project for Studying the Implementation of Integrated UMRT and Urban Development for Hanoi in Vietnam (HAIMUD2)

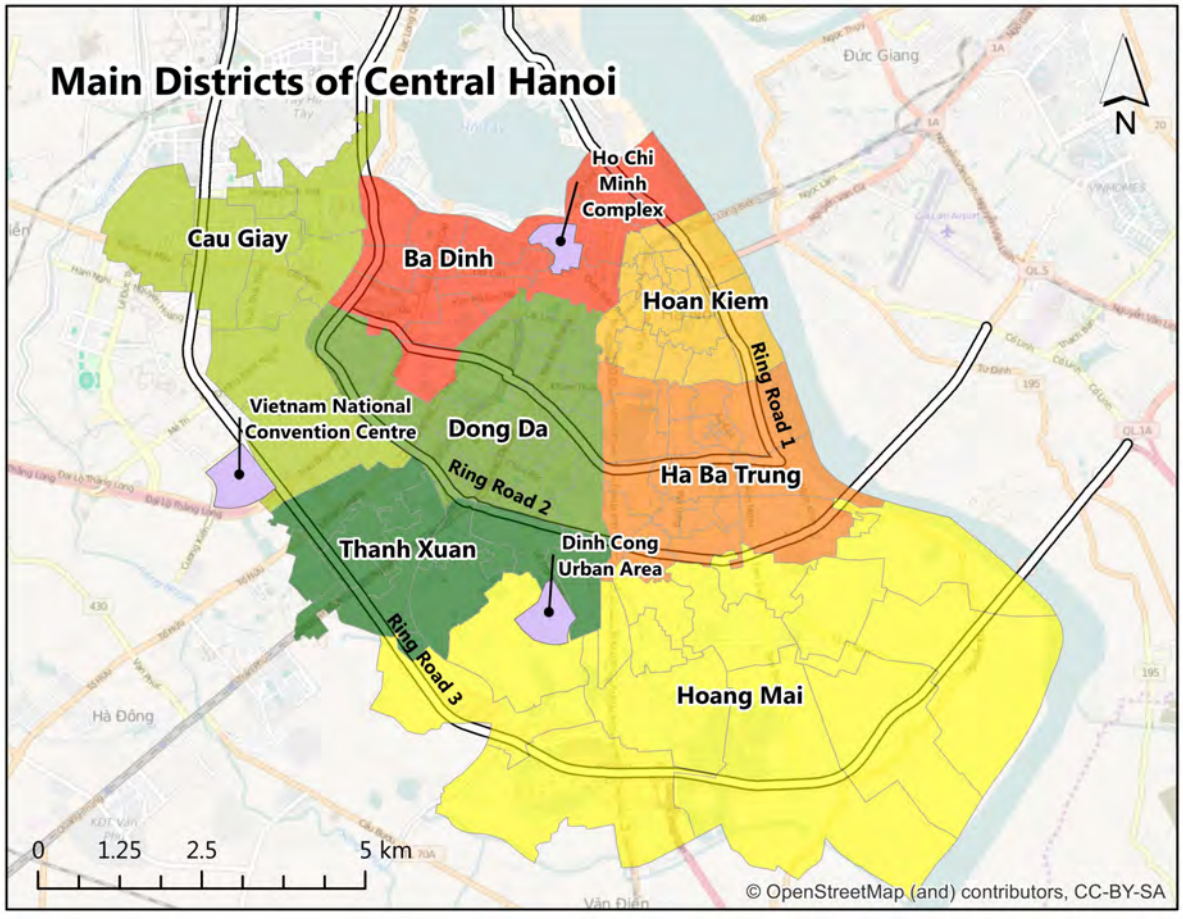
Figure 2.8.3 Concept TOD Plan in the Quan Ngan Station Area

2.9 Current Issues and Conditions of Urban Transport in Hanoi

2.9.1 Inadequate Road Infrastructure

The road transport network in Hanoi can generally be summarized by being incomplete and consisting of major radial roads converging into the central are of Hanoi and ring roads that link the radial roads. However, Hanoi still does not have a complete ring road system so many vehicles still have to go through the central area of Hanoi to reach their destination which increases the probability of traffic congestion in the central area.

In the central districts, such as Hoam Kiem and the administrative district of Ba Dinh, Hanoi has a well-developed network of local roads. However, in other districts of the city, the local roads are often short and narrow. In the urban area, around 70% of the existing roads are less than 11 m wide and some are even 5 m wide. In the following figure, the main districts of Hanoi are shown along with the locations of the ring roads, however, only Ring Road 3 is a true arterial road. Ring Roads 1 and 2 consist of sections of arterial roads and local roads.



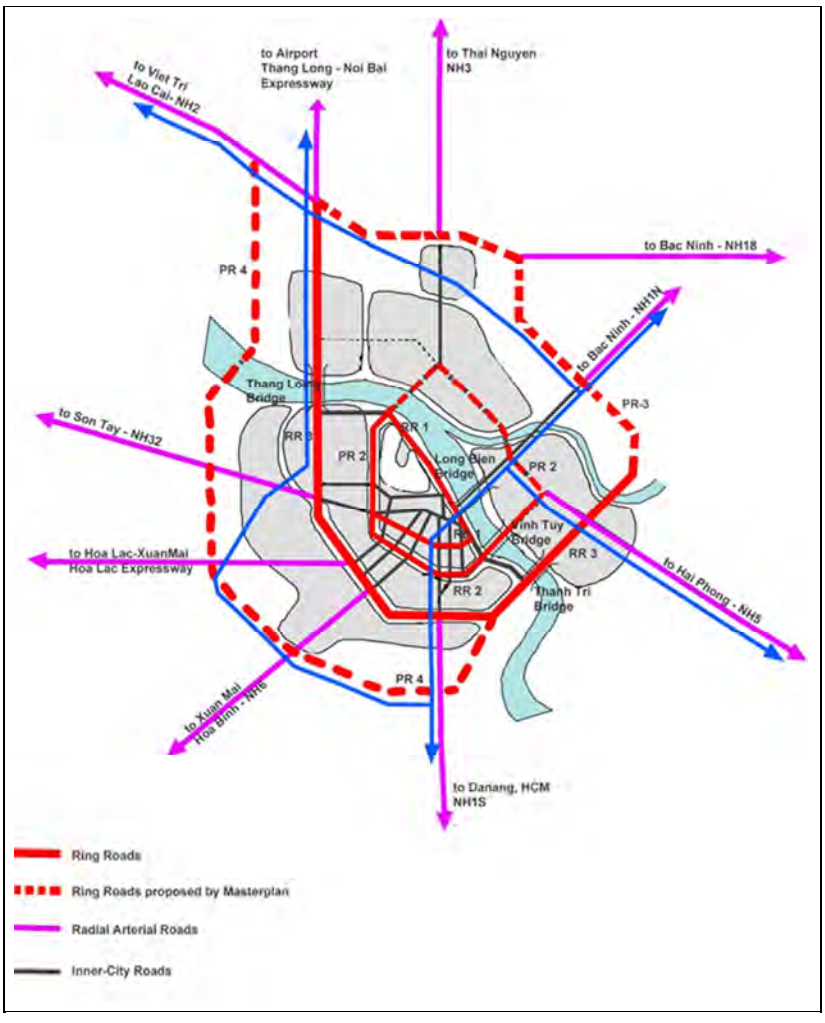
Source: Study Team

Figure 2.9.1 Main Districts in the Central Area of Hanoi

With regards to intersections, most inside the city between roads and railways and between major trunk roads are mostly at-grade which has a negative impact on traffic flow due to the lack of traffic management equipment and facilities. There are now grade separation projects for intersections but in the central area, due to narrow cross-sections and limited land, there are limited possibilities for grade-separation in the central area. While there are too many intersections in the area inside Ring Road 2 (one intersection every 380 m), there are not enough intersections outside of Ring Road 2.

The road density of Hanoi is 1.09 km/km^2 which is much lower than other capital cities in the region which have a road density of around 5-6 km/km^2. In addition, in the outskirts of the city, road density is small with inconvenient transport conditions so most of the population concentrates on the central area which seriously effects traffic.

Despite the inadequate road infrastructure in Hanoi, it is generally difficult to widen or build new roads and delays in such road projects are quite common. Delays on road projects are usually caused by land acquisition issues. The delays caused by land acquisition problems then leads to material prices changing and technical options changing. In addition, coordination must be done between different stakeholders and the review process consumes a lot of time.



Source: Tuyet L.T.A (2012) Sustainable Urban Transport Assessment - Evaluation opportunities for Asia cities: The case of Hanoi. Master's Thesis from the Politecnico Milano University.

Figure 2.9.2 Structure of the Hanoi Road Network

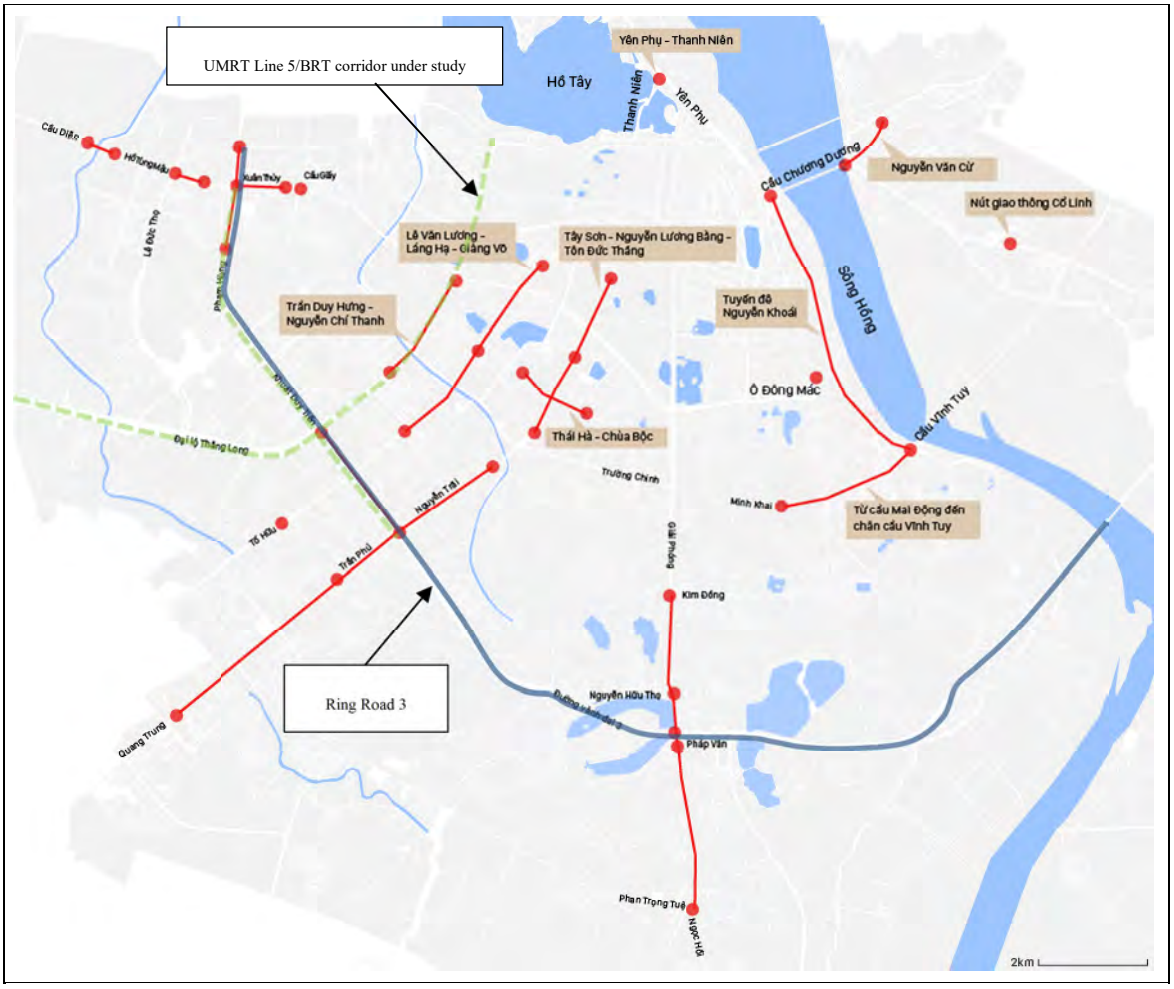
2.9.2 Serious Traffic Congestion Problems

According to a JICA funded survey of 20,000 households conducted by the Institute of Sociology, 63% of respondents agreed that traffic congestion is very serious and 53% think that congestion had gotten worse in the last 5 years.

Some of the characteristics of traffic congestion in Hanoi are as follows:

- There are 3 peak congestion periods: 6:30-8:30 in the morning, 11:00-13:00 in the afternoon and 16:30-19:00 in the evening
- High volume of heavy trucks and interprovincial buses in the central area of Hanoi and at night which increases the risk of traffic accidents because the ring road system is not yet complete and also because heavy trucks are only allowed to go through the central area of Hanoi during the night in the authorities' efforts to reduce traffic congestion. As a result of these traffic restrictions for trucks, there is increased probability of traffic police in taking bribes.

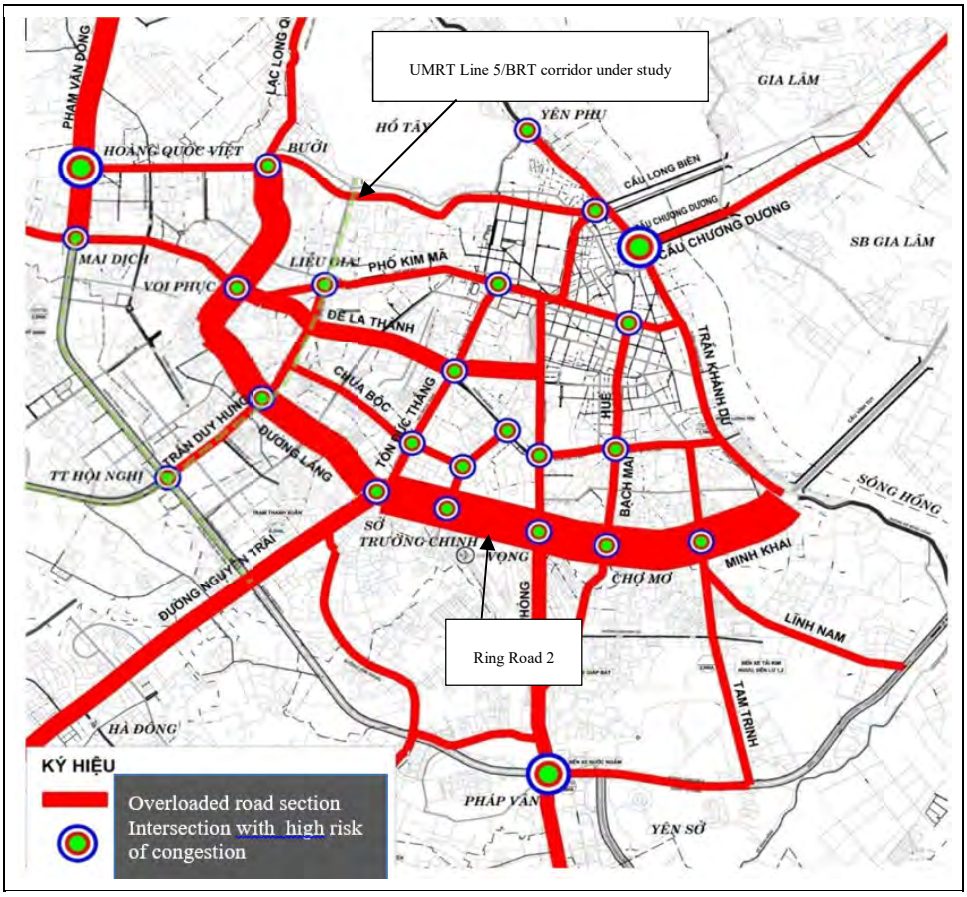
The following figure shows the current level of congestion on Hanoi roads. It shows that on the UMRT Line 5/BRT corridor under study in the central area inside Ring Road 3, it is one of the most congested road sections in Hanoi as of March 2016.



Source: http://vnexpress.net/infographics/giao-thong/ha-noi-con-bao-nhieu-diem-un-tac-nghiem-trong-3380605.html?utm_source=search_vne

Figure 2.9.3 Congestion Road Sections in Hanoi in March 2016

The following figure shows overloaded road sections in Hanoi with a high risk of congestion. The road in the UMRT Line 5/BRT corridor under study in the central area (Tran Duy Hung) is overloaded but not as severely overloaded as Ring Road 2 (Duong Lang to Minh Khai).



Source: www.goethe.de/ins/vn/pro/verkehr_hanoi/Le%20Vinh.pdf

Figure 2.9.4 Overloaded Road Sections with High Risk of Congestion

2.9.3 Motorcycle-Dominated Vehicle Fleet

After a period of growth from 2000-2005 of 24.6% on average of motorcycle ownership, the rate of motorcycle owners is now stable but the rate of automobile owners will increase rapidly in coming years as the economy further develops. According to TRAMOC, the modal share of motorcycles was estimated at 80.8% in 2008 while the modal share of cars still remained low at 4.0%. The heavy traffic conditions in the central area of Hanoi are mainly caused by the high percentage of motorcycles on the road.

The Vietnamese authorities have tried to control the rapid growth of private vehicles, especially of motorcycles, but they have generally not been successful. One of the reasons for the failure is the lack of understanding of the reasons behind the growth of motorcycle ownership. According to a study by Duc, N. H. et al (2015)[6], one of the reasons is the relation between socioeconomic conditions and the growth rate of motorcycle ownership. The study results show that there is a big difference on the growth rate of motorcycle ownership in the long term and in the short term. In the long term, socioeconomic indices show a very strong impact on the growth rate of motorcycles but in the short term, there is a very weak impact.

[6] See Duc N.H. et al (2015) Motorcycles in Vietnam: Essential Data Estimated until 2014 and Different Impacts of Socio-economic Conditions on Their Growth for Long- and for Short-term. Journal of the Eastern Asia Society for Transportation Studies Vol. 11.

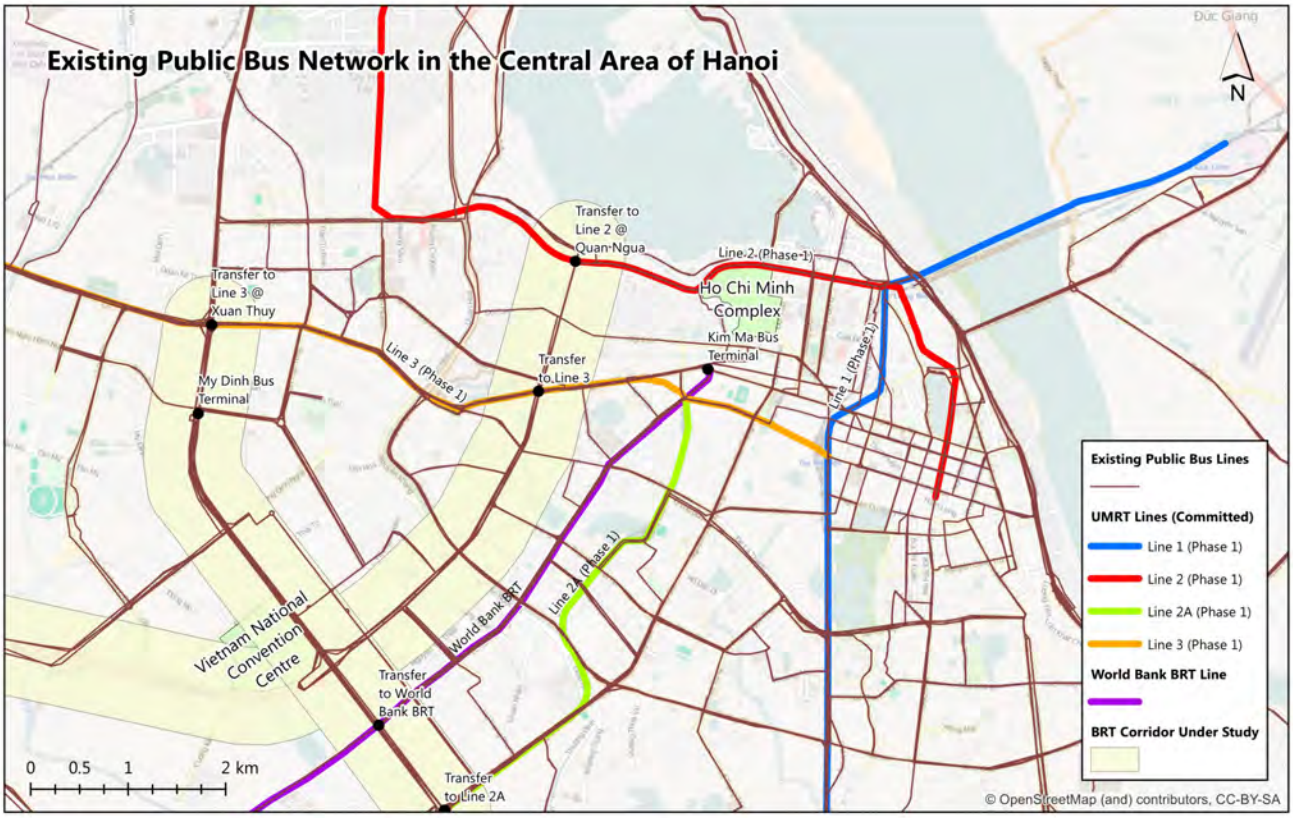
Therefore, according to the study, since socioeconomic conditions strongly impact the growth of motorcycles in the long term, long term policies or countermeasures should be considered such as the development of a multi-modal public transport system.

2.9.4 Improving but Inadequate Public Transport

Buses are the most popular means of public transport in Hanoi, however, although the number of buses and bus routes in Hanoi has increased, they cannot meet the increasing demand. The density of bus routes is only 0.5 km/km^2 and many routes do not connect well with other routes causing inconvenience for passengers.

Currently, the bus network is still mainly focused on intercity transport via the National Highways to interprovincial bus stations such as Gia Lam, Long Bien, etc. In addition, for the bus network inside the central area of Hanoi, most of the bus routes are quite short at less than 15 km. Also there aren't many circumferential routes to connect the radial bus routes to form a proper well connected bus network. As shown in Figure 2.9.5, wide areas of Hanoi outside of the densely populated Old Quarter (east of the Ho Chi Minh Complex) are underserved by public transport and these areas are where new urban developments are taking place.

Despite this, the authorities have encouraged people to use the buses by utilizing a subsidy policy. In 2015, the farebox revenue covered only 42.8% of the total operating cost of the buses while the rest of the costs had to be subsidized by the government. Although there is a subsidy policy, there is no formal process to determine the fares of buses. Instead there is just a general guideline as indicated in Decision No. 40/1998/QD-TTg dated February 1998 from the Prime Minister for the bus fare to be affordable and to be not more than 12% of the resident's average monthly incomes.



Source: Study Team

Figure 2.9.5 Existing Public Bus Network in the Central Area of Hanoi

In addition, a summary of the public bus data for 2015 is shown in the following table.

Table 2.9.1 2015 Hanoi Public Bus Data

Summary of the 2015 Hanoi Public Bus Data	
Total Number of Bus Routes	63
Average Bus Route Length (km)	22.4
Longest Bus Route Length (km)	49.9
Shortest Bus Route Length (km)	11.3
Total Bus Fleet (vehicles)	1,194
Total Bus Trips/Year	3,991,598
Total km Operated/Year	93,510,937.23
Total Passengers/Year	431,668,663
Total Operating Cost (VND)	2,122,770,714,520
Other Expenses (VND)	9,351,072,274
Total Farebox Revenue (VND)	913,600,413,257
Total Subsidies (VND)	1,218,521,373,537
Farebox Recovery Ratio	42.8%

Source: Data from TRAMOC, analysis by the Study Team

2.9.5 Ineffective Traffic Management

For utilizing existing road space to its maximum capacity, effective traffic management is necessary. However, in Hanoi, traffic management is a big problem. Traffic laws are not well respected, punishment for traffic law breakers are not serious enough and mixed traffic flow with motorcycles and cars with different traffic speeds have caused the road capacities to be decreased.

In addition to the inadequate road infrastructure, the quality of existing roads is poor. Traffic problems arise when the roads are too narrow while the sidewalks and bicycle lanes are too wide.

2.9.6 Unsustainable Urban and Transport Development Policies

At the moment in Vietnam, there are a large number of development plans on a different spatial scale (national, provincial, local, etc.). However, these plans are not interconnected with each other and there is no mechanism to ensure the consistency in plans between different spatial scales. As a result, there is confusion between what should be implemented and if core problems were tackled effectively.

In developed countries, development of transport results in the development of new urban areas. However, in Vietnam, it is the reverse. For example, the Dinh Cong urban centre (see Figure 2.9.1) has been developed for many years but there is still no main road from Hanoi to this new urban centre. As a result, people have to use old and degraded roads to access Dinh Cong which adds to traffic congestion.

2.9.7 Limited Physical Land for Transport

In Hanoi, the land reserved for transport is too small. The road area of Hanoi only makes up 7% of the total land area of Hanoi while in other capitals of the world, the road area usually makes up between 20-25% of the total land area.

To achieve the land area of 20-25% for transport, Hanoi would need 15 million square meters and the cost of the land clearance would cost around US$14 billion. Also, if focus is placed on developing transport infrastructure in the central area, the people would be discouraged from moving to the new urban areas and the current program of reducing the population density would not be effective and land prices would continue to remain high.

Therefore, Hanoi is investing in transport infrastructure in new urban areas and to develop these new urban areas with diversified services to provide lower cost housing. However, these developments are being concentrated in the West and Southwest directions from the central area but road infrastructure has not been properly developed so serious traffic congestion has developed at corridors entering the central area of Hanoi.

3 Travel Demand Forecast Methodology

3.1 Review of the Travel Demand Forecast Results in Related Studies

Travel demand was estimated for the UMRT Line 5 (the target corridor that is the focus of this BRT study) in Hanoi from the following 3 studies in the past.

1) Transportation Master Plan for Hanoi Capital to 2030 and Vision to 2050, TEDI, 2013 (hereinafter referred to as "TEDI-MP")
2) The Preparatory Survey on Hanoi City Urban Railway Construction Project (Line 5), JICA, 2013 (hereinafter referred to as "PPP-FS")
3) Data Collection Survey on Railways in Major Cities in Vietnam, JICA, 2016 (hereinafter referred to as "METROS")

The travel demand results from these previous studies vary due to differences in setting the target years and assumptions and also due to the use of different databases. The assumptions used in the previous travel demand models are shown as follows.

Table 3.1.1 Assumptions Used in Past Travel Demand Models for the UMRT Line 5

Past Studies for the UMRT Line 5 in Hanoi (Target Corridor for this BRT Project)			
	TEDI-MP (2013)	PPP-FS (2013)	METROS (2016)
Target Years	2020, 2030	2021, 2030, 2040	2030
Database	HAIDEP (The Comprehensive Urban Development Programme in Hanoi Capital City of the Socialist Republic of Vietnam, 2007, JICA) (hereinafter referred to as "HAIDEP")	HAIDEP	METROS (The database was redeveloped including the HIS[1] result conducted in METROS)
Common Setting	Implementation program includes approved projects up to 2030		
Setting by Study	1) HAIDEP database 2) Public transport modal share of 20-30% was targeted in HAIDEP 3) Station area radius wasn't applied	1) HAIDEP database 2) Public transport modal share was set as 10% in 2021, 15% in 2030 (based on assuming that the mode share will follow conditions experiences in other Asian countries) 3) Station area radius was applied for the demand forecast 4) Stations 1-11: 2 km radius、Stations 12-17: 6 km radius 5) Passenger couldn't take the UMRT Line 5 when they are out of the station area radius. 6) UMRT fare as set as a flat fare: US$0.50	1) METROS database 2) Public transport modal share was estimated by the mode choice model developed from the results of the traffic survey (the public transport mode share did not reach the targeted value as specified in HAIDEP) 3) Although the mode choice model was developed and the public transport O-D[2] trips was generated, it was assumed that Bicycle, Motorcycle and Car users could take the UMRT/railways 4) Station area radius wasn't applied. 5) UMRT fare was set as a distance-based fare: VND20,000 + VND1,000/km

[1] HIS: Household Interview Survey

[2] O-D: Origin-Destinations

The present public mode share in the HAIDEP and METROS studies is remarkably low. The modal split model created under this condition estimates a low public modal share for the future compare to other Southeast Asian countries. Therefore, the target public mode share was set at 20-30% by referencing the mode shares in Southeast Asian countries in the HAIDEP study.

In the PPP-FS, 10% in 2020 and 15% in 2030 were set for as the target future public mode share under the same methodology.

However, in the METROS study, the same methodology was not followed. In case the public transport routes including UMRT/railways has an advantage over the private transport route for private modes from generation to destination, private modes such as the Bicycle, Motorcycle and Passenger Car can use the UMRT/railway route in METROS. Park and Ride were considered in this setting and car parking, cycle parking should be considered as station facilities in this setting.

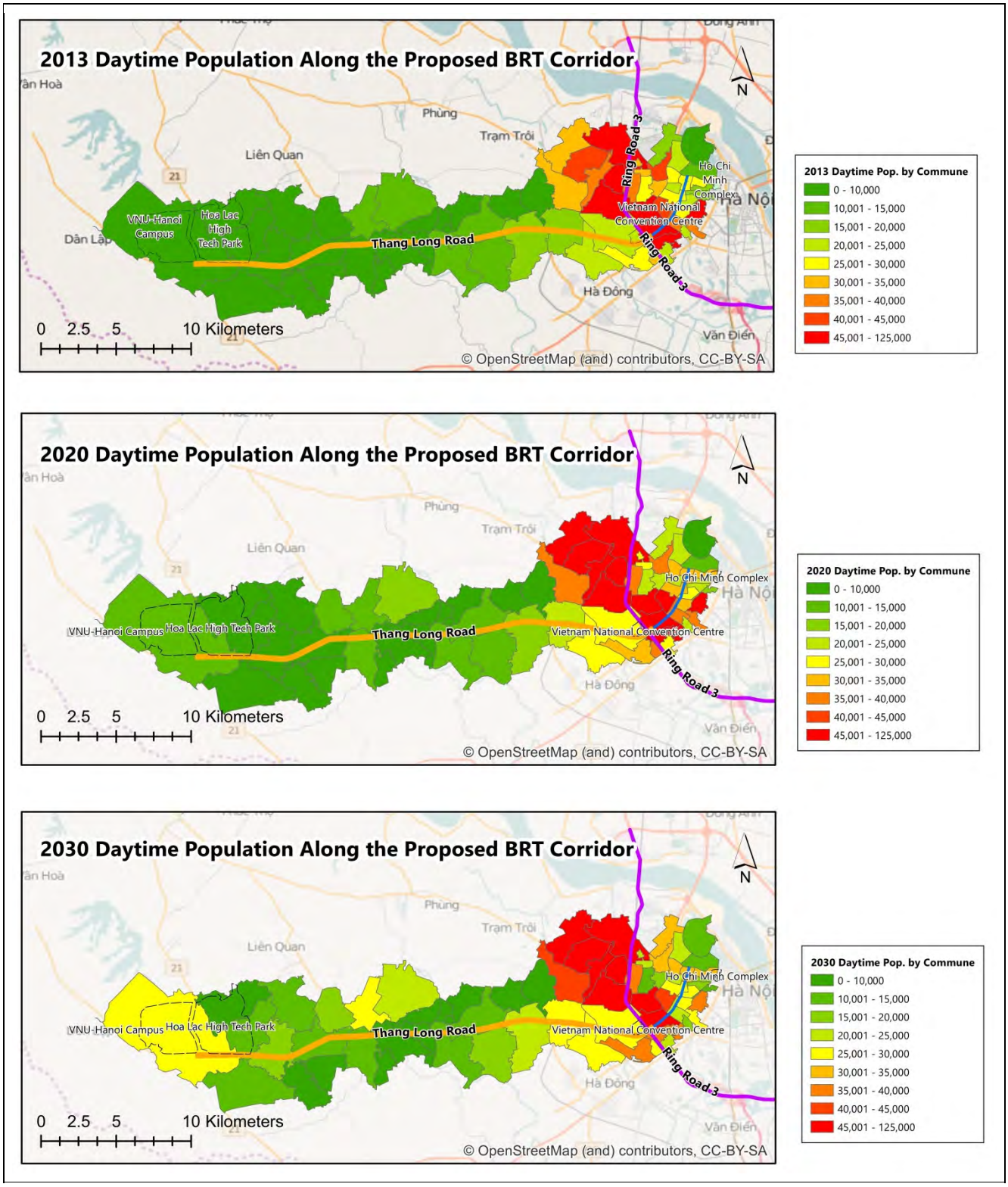
3.2 The Influence of Urban Development on the UMRT Line 5/BRT Corridor on the Travel Demand Forecast

The urban development along the UMRT Line 5/BRT corridor will be expanded by the development of the Hoa Lac High Tech Park, new campus of the Vietnam National University and the planned establishment of the Vietnam-Japan University on the campus of the Vietnam National University, all in the Hoa Lac area.

The passenger demand from the BRT line is significantly influenced from the socioeconomic conditions from these urban developments. The socioeconomic framework for estimating the public transport demand in this study was the same as utilized by the METROS study. In the METROS study, the socioeconomic framework set 2013 as the base year and 2020 and 2030 as the target years.

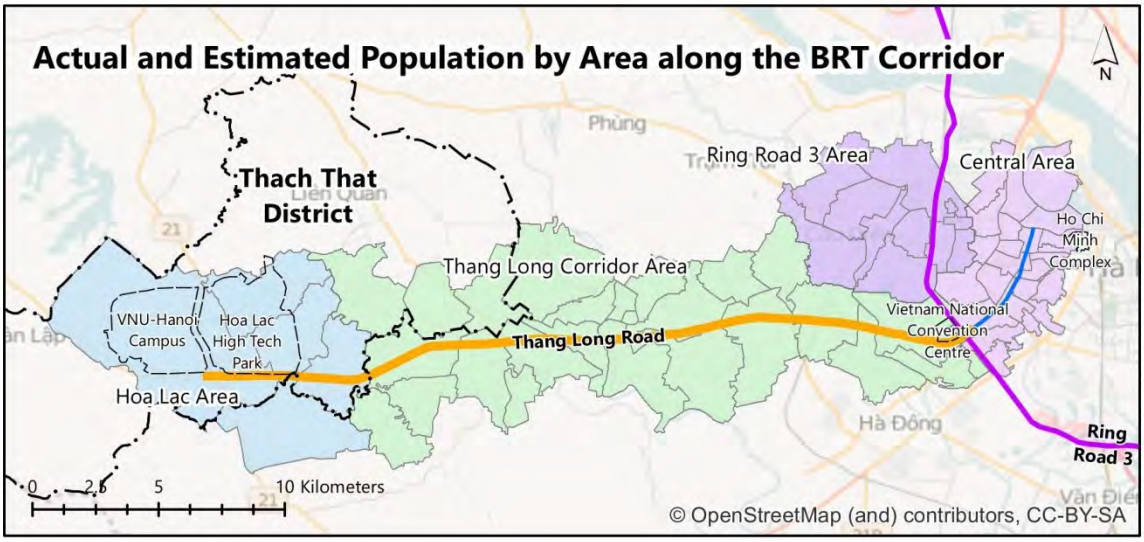
3.2.1 Population Growth Trend

The population growth trend is shown in Figure 3.2.1. The population in Hanoi is assumed to grow according to the existing master plan. The zones along the UMRT Line 5/BRT corridor are assumed to follow the same population growth trend. By 2030, the population in the Hoa Lac area is expected to grow to around 76,000 from 33,000 in 2013. The actual population for 2013 and the estimated populations for 2020 and 2030 for each major area of the UMRT Line 5/BRT corridor is shown in Figure 3.2.2 and Table 3.2.1.



Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.1 Daytime Population Trend along the UMRT Line 5/BRT Corridor



Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.2 Map of the Actual and Estimated Population by Area along the UMRT Line 5/BRT Corridor

Table 3.2.1 Actual and Estimated Population by Area along the UMRT Line 5/BRT Corridor

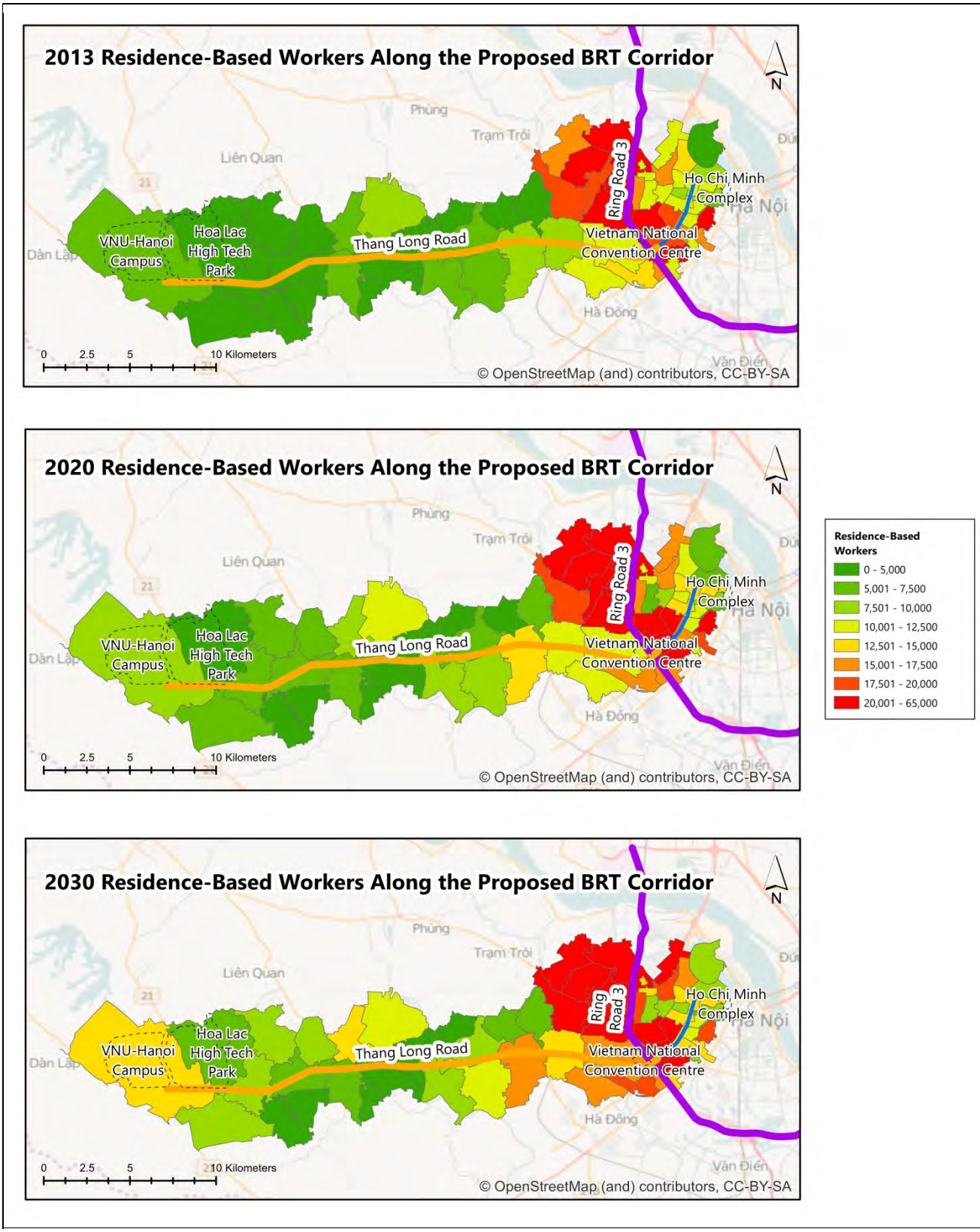
Area	2013 Actual Population	2020 Estimated Population	2030 Estimated Population
Hoa Lac Area	32,974	44,460	75,837
Thang Long Road Area	72,684	82,566	95,373
Central Area	717,167	785,104	703,172
Ring Road 3 Area	438,837	508,747	595,049
Total	1,261,662	1,420,877	1,469,431

Source: Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

The Hoa Lac area is comprised of the Hoa Lac High Tech Park and the Vietnam National University-Hanoi campus and is part of the Thach That District. According to the official Vietnam future socioeconomic framework, the Thach That District which includes the Hoa Lac satellite town is expected to have a nighttime population of around 662,000 by 2030.

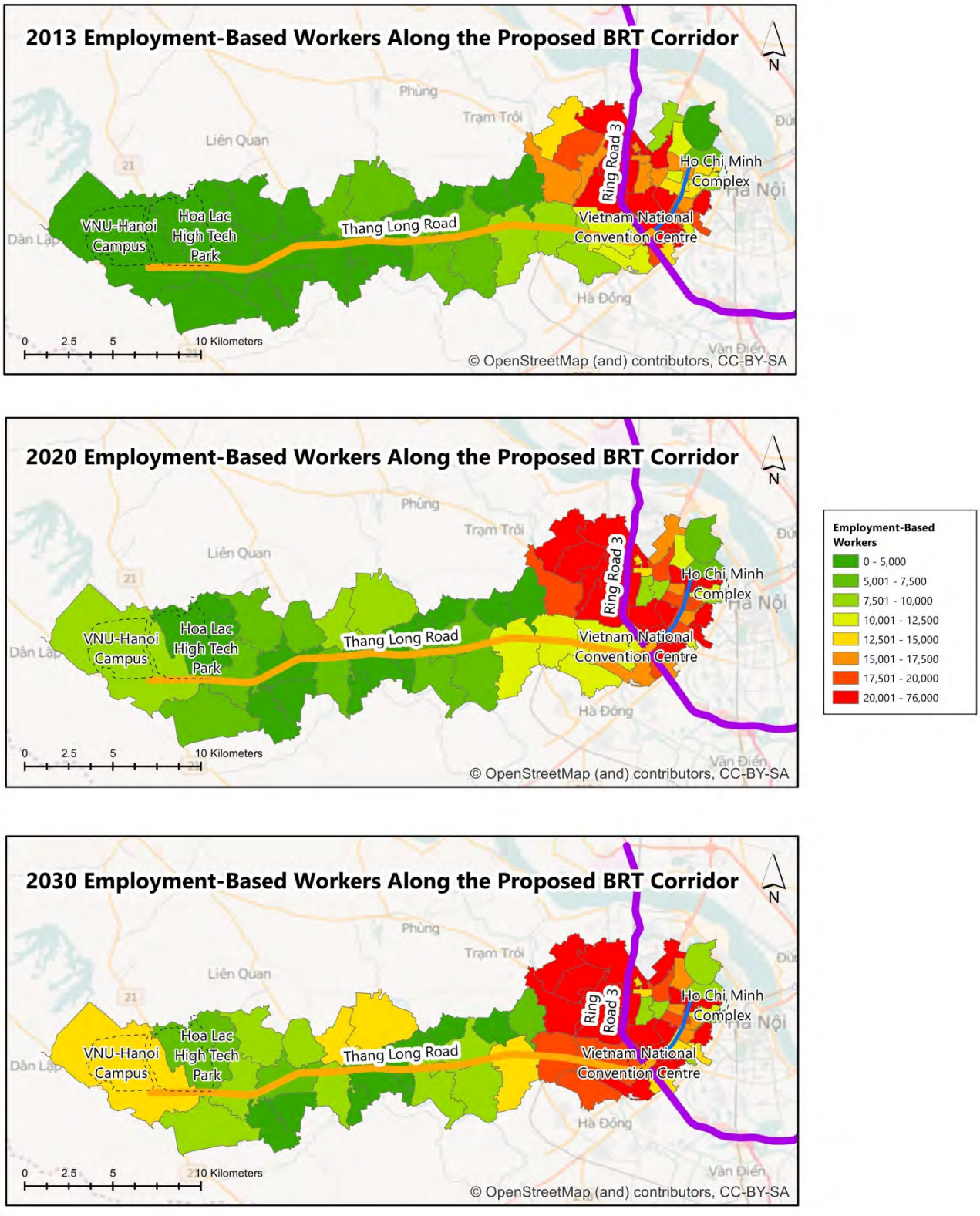
3.2.2 Employment Growth Trend

The growth trend of employees based on residence and employment based on working place are shown in Figure 3.2.3. In the Hoa Lac area, the numbers of residence and employment based workers are expected to grow moderately by 2030.



Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.3 Employment Growth Trend for Residence-based Workers along the UMRT Line 5/BRT Corridor

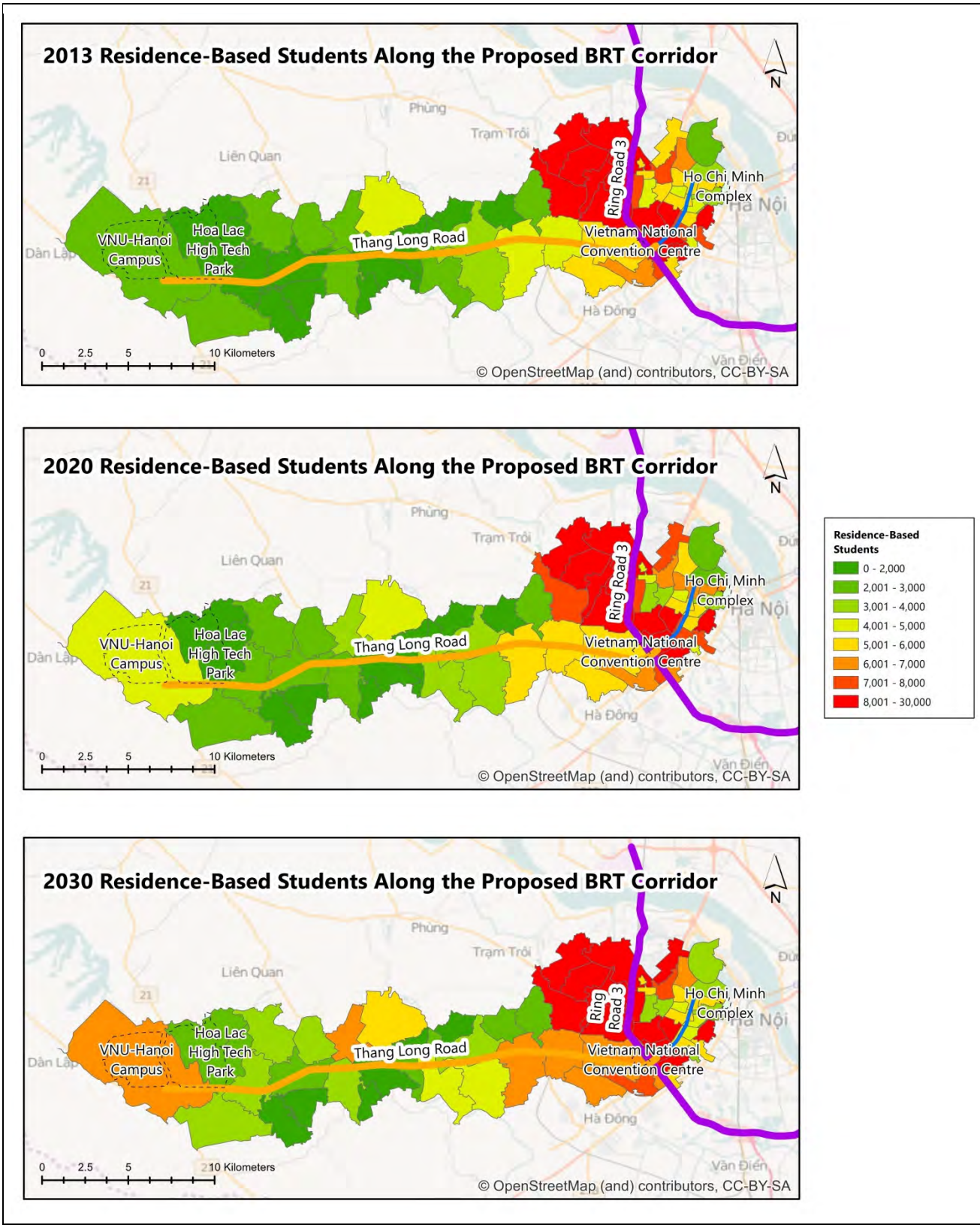


Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.4 Employment Growth Trend for Employment-based Workers along the UMRT Line 5/BRT Corridor

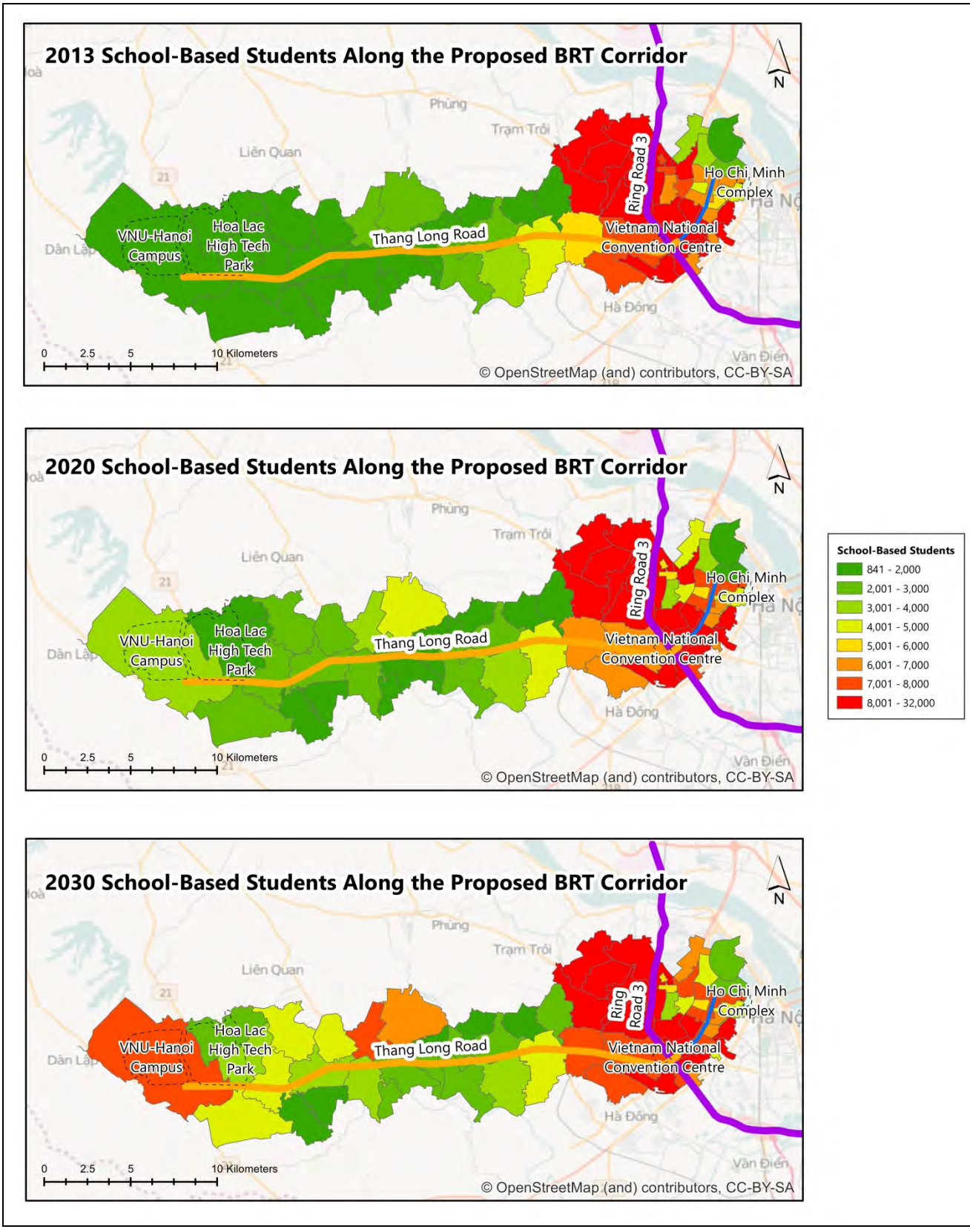
3.2.3 Growth Trend of Students

The growth trend of residence-based students and school-based students are shown in Figure 4.2.3. Due to the planned relocation of the Vietnam National University-Hanoi to the Hoa Lac campus, the number of residence-based students is expected to grow from around 2,000 in 2013 to around 6,000 in 2030. For commuting school-based students, the number of students is expected to grow from around 2,000 in 2013 to around 7,500 in 2030.



Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.5 Residence-Based Student Growth Trend along the UMRT Line 5 Corridor in METROS



Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.6 School-Based Student Growth Trend along the UMRT Line 5 Corridor in METROS

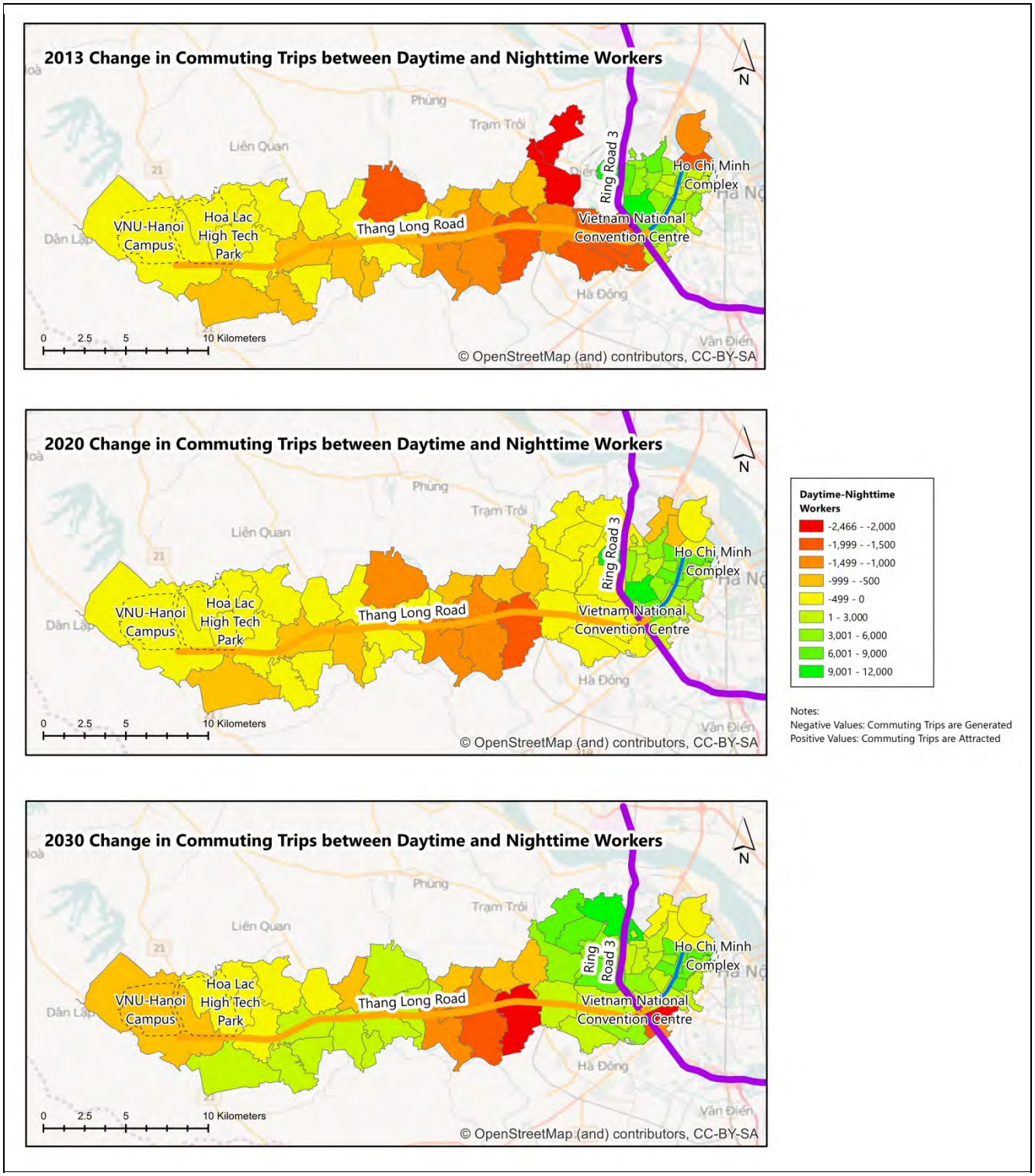
3.2.4 Change in Commuting Trips

The figures above explain the growth trend of each socioeconomic data, however, they don't exactly explain the change in the number of trips. The following figure shows the difference between the number of daytime workers and nighttime workers (daytime workers value – nighttime workers value).

Under the assumption that a majority of workers/students go to their workplaces/schools close to their residences, if the daytime value is lower than the nighttime value, the change in commuting trips is negative. If the change in commuting trips is negative, it means that commuting trips are generated. Conversely, if the change in commuting trips is positive, then it means that commuting trips are attracted.

From the figure below, in 2013, it can be seen that most of the trips in the Hoa Lac area and along the Thang Long Expressway are generated while most of the trips in the central area of Hanoi are attracted.

The employment density along the UMRT Line 5/BRT corridor does not have a large change between the present and the future. The factors that affect employment density should be reviewed including the effect that the Hoa Lac High Tech Park development has on employment density. Furthermore, in the next study, detailed demand analysis should be done on traffic zones which contain BRT stops and the population in these traffic zones should have a high population number set while other remaining traffic zones should have lower population numbers.



Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.7 Trend of the Difference between Daytime Workers and Nighttime Workers

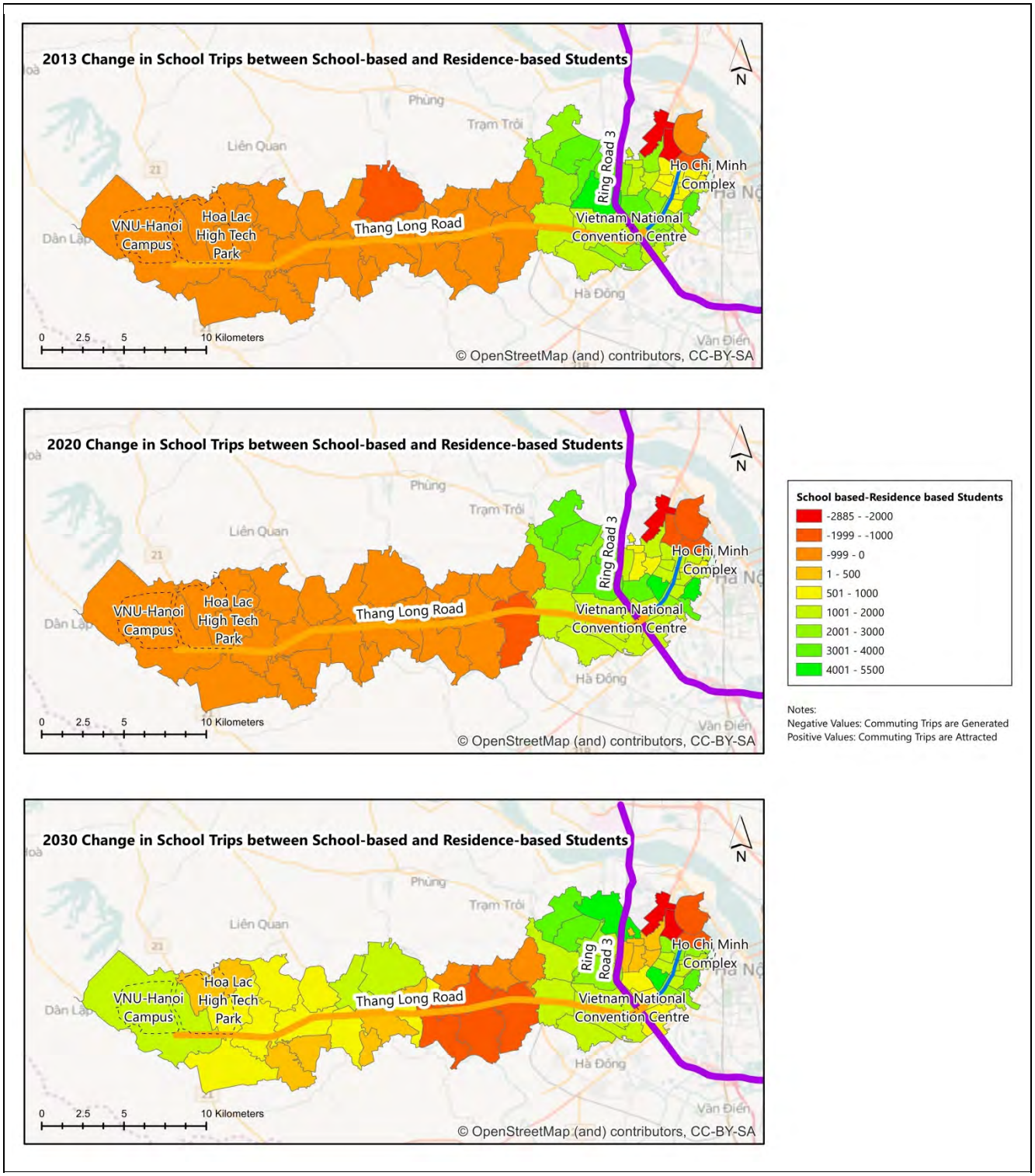
3.2.5 Change in School Trips

The trend in school trips was also visualized using the same method for calculating the change in commuting trips. For school trips, under the present condition, the majority of zones along the UMRT Line 5/BRT corridor are a generator of trips to school.

In the target year of 2020, a majority of zones along the UMRT Line 5/BRT corridor will still be a generator of trips to school. However, by the target year of 2030, the majority of zones will be attractor of trips, in other words, trips will be incoming.

This figure below explains that educational facility development along the UMRT Line 5/BRT corridor will be expanded and not just in the new campus of the Vietnam National University in the Hoa Lac area.

On the other hand, in the next study, the daytime student population should be taken into detailed consideration as the development of the Vietnam National University-Hanoi campus will cause an expansion in the number of daytime students that will be concentrated in the Hoa Lac area.



Source: Study Team based on data from the Data Collection Survey on Railways in Major Cities in Vietnam (METROS), JICA, 2016

Figure 3.2.8 Trend of the Difference between Daytime Students and Nighttime Students