4 LONG-TERM DEVELOPMENT STRATEGIES FOR YEAR 2020

4.1 Rationale

The road subsector development plans which were earlier prepared with technical assistance from JICA, French ODA and other donor agencies provided a framework for future development of the road network in the country but covered only specific regions. Further, despite the number of existing transport sector studies and development plans, there is still a need to build a consensus between transport agencies and departments in the government and the JICA Study Team for VITRANSS to develop a more practical and development strategy for the road and road transport subsector in the future.

As one of the priority subsectors in the overall transport infrastructure network, the road subsector's long-term development strategy shall be formulated with the objective of introducing changes and reforms to make it more responsive to the infrastructure needs of the expanding economic sectors such as agriculture, industry and services. In the formulation of future development goals, the period up to year 2020 is considered as long term and year 2010 as the medium term. These development goals should meet the needs not only of the physical infrastructure, but also the institutional and financial aspects of the subsector.

Roads play a "multiple" role in the socio-economic development of Vietnam and their developmental effects are so extensive that these are not only limited to transporting goods and people but they also act as "catalysts" in developing the economic sectors of their influence areas. If strategically planned, managed and developed properly, roads provide mobility and sustain both the social and economic gains of a market-led economy.

The long-term goals and objectives of the road subsector in Vietnam are as follows:

- to complete a hierarchical road network that will ensure an effective transport of goods and people at major international, interprovincial, urban, and even rural centers;
- to establish a sustainable institutional and funding mechanism for road development and management of the subsector that covers planning, financing, construction, maintenance, and monitoring;
- to establish a competitive environment that will encourage both public and private transport operators to provide the people with an efficient, high-quality domestic and international passenger and cargo freight services, at the same time ensure minimum safety and environmental standards;
- to establish appropriate road and bridge standards based on hierarchical function of roads;
- to establish an approach for evaluating road infrastructure projects which require an environmental assessment of road impact on physical, natural and human environment and population movement; and,

- to provide an integrative function for the territory network system with the primary and secondary road networks and thus support rural development in remote areas.

4.2 Road Sector Development Strategies

Due to the existing and future transport requirements for an efficient national transport network, it is projected that the road subsector will continuously require the largest share of public funds allocated to the transport sector. Thus, major strategies should be formulated to maximize the use of these limited funds to effectively respond to the increasing demands of the expanding economic sectors of Vietnam.

Major strategies that have been identified include the following:

- strengthen the maintenance, financing, management, and administration of the national road network;
- improve the regulatory guidelines of road transport services;
- develop and implement road safety programs;
- strengthen the VRA and PTAs;
- develop and improve the legal and regulatory framework;
- improve urban transport linkages; and,
- establish road and bridge design standards.

1) Strengthen Maintenance, Financing, Management, and Administration of the National Road Network

The core of the long-term strategy of improving the road transport infrastructure is to upgrade the existing road network through a more cost-effective road maintenance program. Major components are increasing the road capacity and quality of construction and reduction in the overall transport costs (which include vehicle operating costs (VOCs), other user costs and the costs of new road construction). Based on the "World Bank Transport Sector Report, April 1999", this program should be complemented with a long-term, sustained institutional development strategy with the following objectives:

- establishing a systematic road management program on a more commercial basis through a road fund from which routine and periodic expenditures on road maintenance works can be sourced[1];
- gradually increasing toll fees and charges over a 10-year period (possibly between 5%-20%) to raise the maintenance standards and quality of the existing road network;
- preventing vehicle overloading;
- investing on major road projects that will respond to current maintenance backlog and emergency repair requirements; and

[1] The MOT has recommended to the government, the establishment of a Road Fund for Infrastructure Maintenance and Development. There will be six identified sources of funds.

- improving the existing road network condition and accessibility to major urban centers.

One of the most recent developments in the road transport subsector is the initiative taken by the government to establish the road maintenance fund. It is envisioned that the maintenance fund can be sourced from the following:

- *Transport fees in the form of fuel charges.* This is the main source of the road maintenance fund. TDSI has proposed two options: (1) present charges of VND 500/liter, which would generate VND 2,500 billion annually; (2) an addition of VND 200 would be charged for 1 liter of fuel, which would result in VND 4,000 billion per year. A higher transport fee may thus increase fuel price, which may have an impact on the price of other products, especially transportation charges (since fuel used by the transportation sector accounts for 70% of the total fuel consumption in the country). The increase was acceptable, according to TDSI, since the proposed transport fee will have minor effect only on transportation charges (a 2% annual increase on the average).

- *Road and bridge toll fees at strategically located tollgates and/or along foreign-funded, newly constructed routes.* Existing toll rates/fees shall be maintained.

- *Transport fee for each motorized vehicle, considered a direct charge to road use by vehicle owners.* This fee serves not only as an income source for the maintenance fund, but it can be a management tool to restrict the use of motorized transport particularly in urban areas where transport infrastructure is limited and to encourage greater use of existing public transport services. This transport fee will be collected once the (new) vehicle is purchased, the fee being a percentage of the vehicle price. In the case of transfer of ownership, there will be no fee to be charged. The proposed percentage ranges from 5% to 10% of the selling price for the more popular motor vehicles and 15% would be applied to the price of heavy vehicles.

- *Charges on tires*. It is proposed that a certain percentage of the tire's selling price, about 5-10%, be charged to road users for the use of road infrastructure.

- *Increased fees in the issuance and renewal of driving licenses for all vehicle types.* Since the existing fees are too low without considering inflationary effects, it is proposed that these fees will be increased by 5 to10 times of existing rates. For example, in the case of automobile, from the present VND 30,000 per unit or USD 2.14 to VND 350,000 or USD 25 per unit; for motorcycle, from VND 40,000 or USD 2.85 to VND 200,000 or USD 14.25 per unit. The proposed increases may be implemented on a phased basis, as in other Asian countries to cushion the socio-political effects of such proposal.

- *Increased fees for road motor vehicle technical inspection.* It is proposed that new fees should be charged equivalent to twice the amount of existing fees, from VND 180,000 or USD 12.85 to VND 350,000 or USD 25 per inspection. If this can be implemented, about VND 7,343 billion can be realized, which is thus sufficient to cover 60% of the proposed investment requirements for road maintenance and road network development. The other 40% should then be sourced from the State Budget (which includes ODA funds).

The VITRANSS has sponsored a number of workshops involving various stakeholders from the government, private and donor agencies to obtain their support to determine an appropriate and implementable strategy for the road transport subsector. A workshop on road maintenance fund was conducted by the government to develop a consensus on the introduction of maintenance fund in Vietnam and to rationalize the road maintenance expenditure program based on the road users' priority needs for a more efficient road transport system.

One related aspect of this development strategy is to undertake measures to further develop and promote a more competitive road construction and maintenance industry to minimize the costs of new road construction and/or major rehabilitation works. This aspect of the strategy must be accorded the "highest priority".

If possible, within the short to medium term, priority must also be given to equitizing road and bridge construction enterprises which are still state-controlled and managed. Eventually, when the equitization of some SOEs prove to be feasible and successful, the road maintenance units which are presently under the different RRMUs can be considered as potential candidates for equitization and as such, will be forced to compete for maintenance contracts with private organizations.

2) Improve the Basis for the Regulation of Road Transport Services

To improve the quality of transport services and reduce its adverse effects, such as physical damage to road infrastructure due to overloading, road accidents and environmental pollution, substantial improvements on how the government regulates the road transport subsector must be undertaken. This involves a development strategy, which will:

- make the MOT regulatory policy clearer and firmly based on the principle of minimizing total transport costs to users and government agencies (which should take into account social costs such as road accidents) and introduce regulations where the economic benefits outweigh the economic costs to the country (which include administrative costs and costs imposed on the transport industry), and the implementation of necessary enforcement measures;

- review existing regulations and regulatory practices to: (i) modify regulations which cannot be justified, (ii) introduce new regulations that are more appropriate and responsive to changing demands of the economy, (iii) simplify administrative procedures to reduce the cost of regulation to government and road users; and (iv) more cost-effective and a streamlined regulatory system with adequate sources of financing;

- review licensing and inspection regulations in terms of cost effectiveness in enhancing road safety. This shall involve road safety experts in close coordination with road users who can advise on what needs to be improved in the implementation of existing regulations as well as ensure that regulations support the overall road safety program;

- removal of existing restrictive policy to "entry" or franchise and fare controls on bus operations to: (i) stimulate competition and efficiency as well as provide a more extensive network of bus transport services, (ii) empower bus passengers to uphold their rights, (iii) strengthen the ability of regulatory agencies to promote licensing conditions and to monitor existing bus services, and (iv) remove current restrictive policies on the importation of second-hand buses and trucks to enable operators to have greater access to more modern vehicles with better safety features and that meet passenger needs.

3) Develop and Implement Road Safety Programs

A comprehensive action plan on road safety was proposed to provide solutions to the most urgent problems on road safety. Such action plan can be implemented on National Road No. 1 within the short term. If successful, this action plan can also be applied to other national roads in Vietnam within the next five years to serve as the "core" of the 10-year road safety strategy, which is projected to:

- improve the quality and accuracy of a national traffic accident database and formulate appropriate road safety improvement measures based on the analysis of the traffic police database gathered by relevant institutions and agencies on national, provincial and local levels;
- strengthen the capability of the NTSC to coordinate and implement road safety programs by training a permanent technical staff in charge of implementing road safety programs;
- introduce improved techniques and procedures on planning for better road safety awareness, design and operation of roads, road safety audit, and training of Vietnamese road engineers on these issues; and,
- strengthen the capability of traffic police and inspectors with respect to traffic enforcement and introduce on a pilot basis the use of highway patrols and more modern enforcement techniques and practices.

In the long term, once the computerized road accident database and the basic institutional capability to analyze relevant safety information are developed, the next step is to introduce priority safety improvement measures. The road safety program can be further enhanced with better use of modern technology and stricter enforcement of safety measures.

4) Strengthen the VRA and PTAs

To implement the proposed improvements in the management and financing of road infrastructure, both the VRA and the PTAs need substantial institutional strengthening and capacity-building in transport planning, management planning/information systems, effective implementation of operations manual, modern maintenance management systems (contracting out maintenance on a larger scale), formulation of more effective financing mechanisms, management and financial accounting systems, and more effective skills training for transport staff on national and local levels. It is projected that there will be more training programs to be undertaken in formulating road transport regulations.

The technical assistance project that was funded by UK-ODA[2] has initiated efforts aimed at strengthening the capability of the VRA to manage the entire road network covering all aspects such as infrastructure, road safety and road transport regulation. Thus, management responsibilities in road infrastructure can be addressed through the following activities:

- review of the existing arrangement of sharing responsibilities based on VRA's new regulations defining responsibilities and assigning implementation of design standards and manuals and administering construction contracts (in order for the PMUs to report to VRA and not to the MOT);
- continue work with the MOT to define a concrete and clear policy direction to monitor project implementation using computer-based management information system;
- develop a workable mechanism for VRA to assume specific planning and project implementation tasks as delegated by the MOT, which require substantial external assistance to enable VRA to assume these responsibilities;
- develop a number of practical manuals and procedures for VRA to manage the road infrastructure network more effectively, particularly in defining new technical standards and work methods; and
- define functions, such as provincial road maintenance, which the VRA delegates to other organizations and to establish a more effective monitoring mechanism.

The VRA's road safety and road transport regulatory responsibilities can be further strengthened by:

[2] Study of Investment and Maintenance Strategy of National and Provincial Roads: Vietnam, July 1996.

- improving information management by clearly defining information requirements and introducing a centralized computer database to be used by all staff (of the MOT and relevant agencies), and giving clear responsibility/ authority to VRA personnel to manage such information, monitor existing transport conditions and develop more effective road safety programs;
- improving vehicle registration procedures by improving cooperation with the traffic police and VRA's access to vehicle registration database;
- improving vehicle testing by reviewing testing procedures and standards to set enforceable minimum standards in road safety and allow licensed private workshops (that perform repairs and maintenance) to undertake vehicle testing;
- updating geometric design standards of roads to allow modern and heavier vehicles on major road categories (based on the functional system in the VITRANSS) and to introduce geometric design standards for road junctions;
- strengthening enforcement of safety, size and weight standards of vehicles by improving cooperation with the police on on-road inspections and by using better equipment;
- improving traffic safety programs by producing better manuals and developing road safety specialists based in local road safety institutions and consultancy firms;
- carrying out more effective public education on road safety, especially through cooperation with the Ministry of Education in disseminating quality information; and,
- improving safety information systems, particularly in assisting the NTSC in organizing research on traffic safety.

5) Develop and Improve the Legal and Regulatory Framework

To support this strategy, there is a need to implement improvements in the legal framework in the road sector, which should include the following:

- review of the latest version of the Road Act (which covers current transport policy and legislation and "encompassing" law on transport);
- review of the current transport rules and regulations to identify where changes are required (a) to implement the new Road Act and (b) to remove or modify inappropriate or unnecessary regulations (whose costs of administration may outweigh the intended benefits, particularly the licensing of buses);
- review of the legal requirements to introduce a Road Fund and include not only maintenance/construction but also the general administrative functions on a sustainable financial basis (once the Road Fund is agreed upon and administration of the road sector is streamlined);
- review of the broader legislation including the rules relating to import controls, which have a great impact on road transport, and identification of changes where justified such as restrictions in the importation of second-hand vehicles

and rules relating to private sector involvement in road construction and maintenance; and,

- implementation of further laws and regulations which define administrative responsibilities, particularly with regard to cooperation and coordination between the VRA and the traffic police (e.g. provision of vehicle registration statistics) and to further improvement of the financial and management control by the VRA of PTA activities (e.g. related to its role in national road maintenance and in planning and management of provincial road maintenance).

6) Improve Urban Transport Linkages

It is expected that the urban population in the Red River delta and in coastal areas will rapidly increase, with Hanoi and Hai Phong as urban centers comprising 3.1 million and 2.3 million population, respectively. Industrialization will continue to concentrate in these cities, resulting in a rapid growth of inter-urban and intra-urban traffic. The development of urban transport infrastructure within the framework of a comprehensive road transport plan and management system is urgently needed to accommodate increasing demands of urban transport.

4.3 Establishment of Road and Bridge Design Standards

One of the basic objectives of road infrastructure development is to develop a network of roads that exhibit a configuration based on hierarchical function and linking national roads to local roads. Since roads play a multiple role from directing traffic to influencing the land-use characteristics of its influence area, a hierarchical function of roads must first be developed to formulate a more effective and well-coordinated road geometry and structure as well as appropriate road and bridge standards[3].

Geometric Design Standards

Vietnam has its own established geometric design standards but these are not always followed by road engineers. There is no definition for the inner shoulder and no design standard for an expressway. The four-lane national road from Hanoi to Hai Phong was planned based on modified design standards derived from current design standards of Vietnam, Japan and the United States. The recommended geometric design standards are shown in Table 4.3.1. The class of road is defined based on design speed, traffic volume and terrain (flat, rolling or mountainous). Road geometry is prescribed based on the design speed. Appendix E discusses the proposed road classification and design standards.

[3] See Appendix D and E on design standards proposed by VRA and modifications proposed by the Study Team, respectively.

Table 4.3.1
Recommended Geometric Design Standards

	Road Class	Design Speed (km/h)		Design Traffic Volume (Vehicle/day)					
				More than 30,000	30,000-10,000	10,000-6,000	6,000-1,000	1,000-300	Less than 300
Expressway (Access controlled)	1	120	100	Flat					
	2	100	80	Mountainous					
	3	80	60						
Regional Road	4	100	80	Flat	Flat	-	-	-	-
	5	80	64	Flat	Flat	Flat	Flat	-	-
	6	60	40	-	Mountainous	Mountainous	Flat	Flat	-
	7	40	30	-	-	Mountain	Mountainous	Flat	Flat
	8	20	15	-	-	-	-	Mountainous	Mountainous

	Design Speed (km/hour)							Remarks
	120	100	80	60	40	25	15	
Width of lane (m)	3.5 (3.75)	3.5 (3.75)	3.5	3.25 ~3.00	3.25 ~3.00	2.75	2.75	
Width of Outer Shoulder (m)	3.0 ~2.5	3.0 ~2.5	2.5	1.5 ~0.5	1.5 ~0.5	1.5	1.5	
Width of Inner Shoulder (m)	0.75	0.5	0.5	0.5	0.5	-	-	
Width of Roadway (m)	-	-	-	Min. 6.0	Min. 5.75	Min. 5.75	Min. 5.75	Applied to one lane road
Min. Horizontal Radius (m)	600	400	250	130	60	25	10	
Max. Gradient (%)	4	5	6	7	8	9	10	

Note: The lower value of the design speed in each class of road will be applied in case terrain or other factors require lower speed travel.

(i) Road Geometry: Design speeds of 40-80 kph will be applied as standards which shall be met by improvements to national roads, depending on the terrain they traverse. A speed of 100-120 kph is similarly set to be design-speed standards for expressways.

The six types of typical cross-sections to be employed for reconstruction or improvement of national roads are shown in Figure 4.3.1.

(ii) Pavement: Road pavement components and their thickness should be determined based on such factors as (1) traffic, (2) strength of the subgrade and (3) construction materials used as pavement layers.

In the prevailing pavement design guidelines, traffic is expressed in terms of the cumulative number of standard axle loads of 8.20 kg over the design life of the road. The number of equivalent axles is computed from the number of commercial vehicles, in particular heavy vehicles such as buses and trucks. The truck factor per one vehicle computed from the equivalent standard axle is assumed to be 1.0 up to year 2000 since an axle load of 6.0 tons is the acceptable maximum load on Vietnamese roads, and a total vehicle weight of more than 13 tons is allowed but only with permission from the MOTC. It is expected that limitations will be lifted by year 2000 due to the ongoing improvement of roads and bridges. The truck factor is expected to increase to 3.0 by year 2000.

The strength of the subgrade will contribute to the necessary thickness of pavement. It is most commonly expressed by the California Bearing Ratio (CBR) value determined thru laboratory testing. A CBR value of 2.5% to 5% is adopted in this study in calculating pavement thickness.

Either asphalt concrete or portland cement concrete is considered appropriate for the pavement surface of most roads. However, asphalt concrete is recommended due to its lower initial investment cost. Double bituminous surface treatment can be applied to roads handling less traffic volume, or less than 0.5 million equivalent standard axles over the road's service life. Three types of materials are suitable as base course, i.e. asphalt treatment, cement treatment and graded crushed stone. River gravel is usually used as subbase course.

Road Traffic Capacity

For the road capacity analysis, the methodology used is based on the "Highway Capacity Manual of the Highway Research Board, USA". There were some adjustments made to reflect Vietnam's local conditions based on studies undertaken by the Highway Research Board of Japan, since there is a similarity in types and sizes of vehicles and operating conditions between Vietnam and Japan. To calculate the daily design capacity of the roads, the basic capacity, potential capacity and service levels were considered. The results of the traffic capacity analysis are shown in Table 4.3.2. Appendix B discusses the methodology used to determine the traffic capacity of each link of the road network and are discussed here in detail.

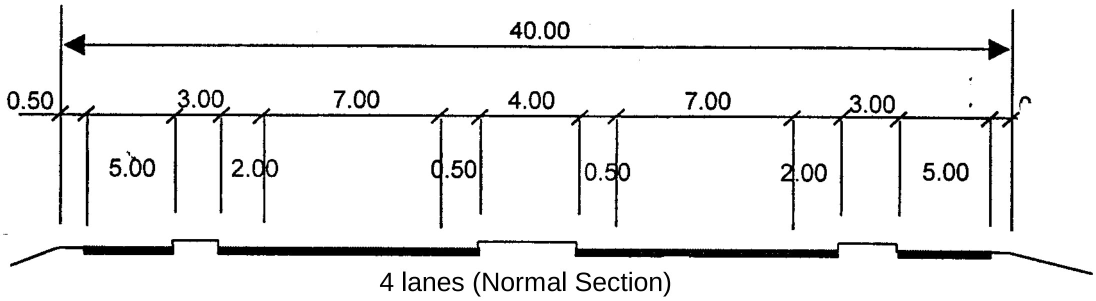
1) <u>Peak Hour Ratio (K)</u>: Actual traffic flow on the roads is not always constant, but changes by year, season, month, day, and hour depending on the nature of the road. The 30th highest annual hourly traffic volume is normally applied to estimate capacity. The conversion factor from daily to hourly "K" is defined as the ratio of the 30th highest annual hourly traffic volume against the average annual daily traffic volume (AADT). The "K" value of 9% is used for regional roads and expressways.

2) <u>Heavy Direction Ratio (D)</u>: Generally speaking, traffic volume is shown by total volume in both directions. However, the traffic volume in each direction is not usually the same, especially in the morning and evening peak hours. A "D" value of 60% is adopted in accordance with survey results.

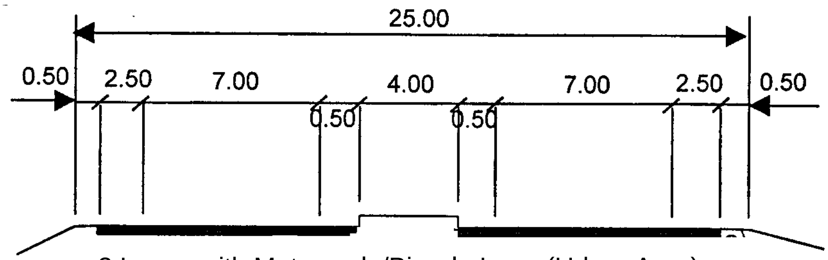
3) <u>Design Capacity</u>: Design capacity per day and per lane is therefore equal to 5.0 x Design Traffic Capacity per hour ÷ (K x D). Table 4.3.2 shows the result of the calculations based on the design concept and procedure presented above in the case of Service Level I.

Figure 4.3.1
Proposed Cross-sections
(Primary Road System)

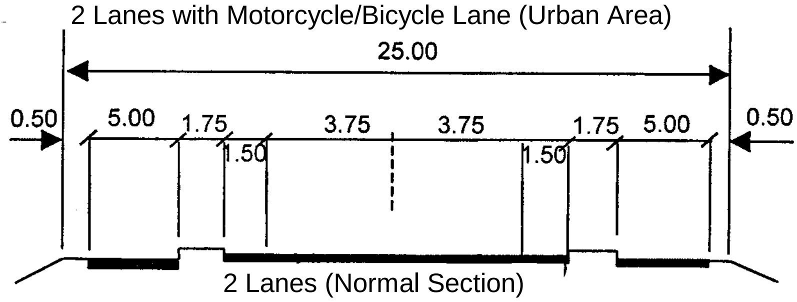
4 Lanes with Motorcycle/Bicycle Lane (Urban Area)



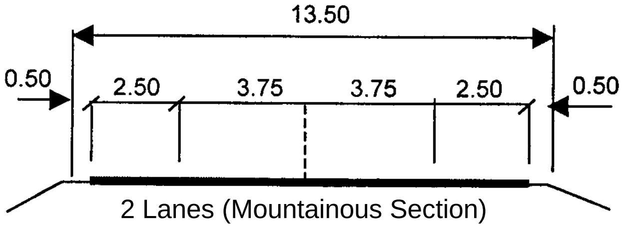
4 lanes (Normal Section)



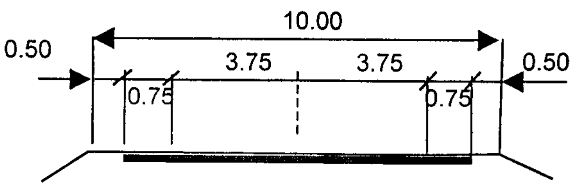
2 Lanes with Motorcycle/Bicycle Lane (Urban Area)



2 Lanes (Normal Section)

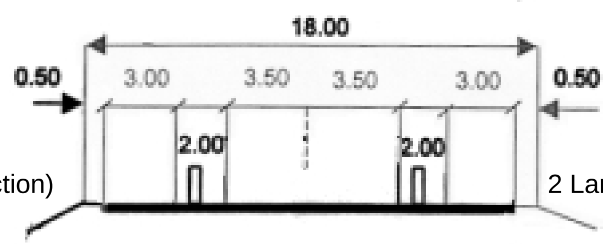


2 Lanes (Mountainous Section)

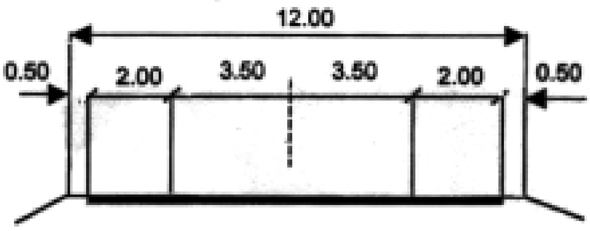


(Secondary Road System)

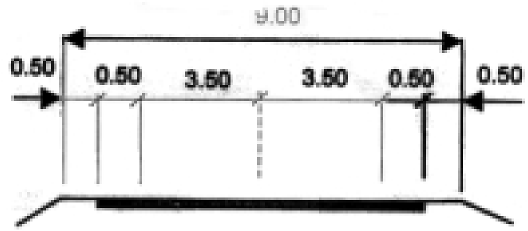
2 lanes with Bicycle Lane (Urban Area)



2 Lanes (Normal Section)

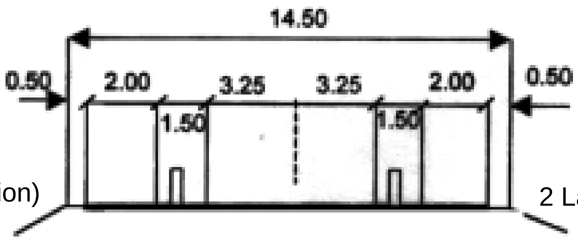


2 Lanes (Mountainous Section)

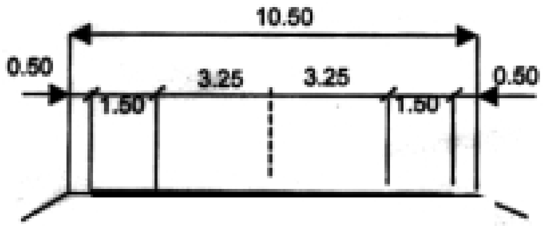


Tertiary Road System

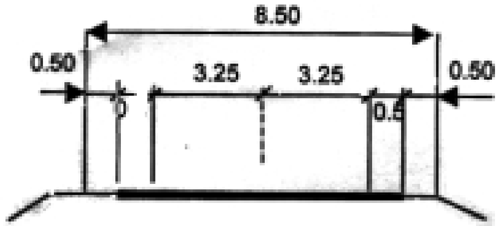
2 Lanes with Bicycle Lane (Urban Area)



2 Lanes (Normal Section)



2 Lanes (Mountainous Section)



Bridge Design Standards

1) Design Standards and Specifications for New Bridges

The MOTC has decided that the existing Vietnamese Bridge Design Code conforming to the Limit State Design Method, which was introduced from the former Union of Soviet Socialist Republic (USSR), should be utilized nationwide in the construction of new bridges. The Allowable Stress Method is generally utilized in the calculation of the bearing capacities of existing bridges.

Table 4.3.2 Road Traffic Capacity Analysis

ITEM	DESIGN SPEED (km/h)	LANE WIDTH (m)	LATERAL CLEARANCE: Right	LATERAL CLEARANCE: Left	HEAVY VEHICLE: % of H.V	HEAVY VEHICLE: Passr. Car Equiva.	COEFFICIENT OF ADJUSTMENT: Lane Width	COEFFICIENT OF ADJUSTMENT: Lateral Clearance	COEFFICIENT OF ADJUSTMENT: Heavy Vehicle	COEFFICIENT OF ADJUSTMENT: Cond. of Sight	COEFFICIENT OF ADJUSTMENT: Total	BASIC CAPACITY (P.CU/h)	POSSIBLE CAPACITY (veh/hr)	SERVICE LEVEL	ADJUSTMENT OF SERVICE LEVEL	DESIGN CAPACITY (veh/hr)	PEAK FACTOR (%)	RATE OF DIRECTION (%)	DESIGN DAILY FACTOR (veh/hr) PER LANE
			(m)	(m)	Pt	Et	L	C	T	I		CB	C			CD	K	D	ADT
2-lane 2-way (Typical National Road)	60	7.0	0.5	0.5	25	2.56	1.0	0.75	0.71	0.80	0.426	2,500	1,605	1	0.7	745	9.0	-	8,200
2-lane 2-way (Typical National Road)	80	3.5	3.0	0.5	25	2.56	1.0	0.9	0.71	0.80	0.51	2,500	1,275	1	0.7	892	9.0	60	8,200
2-lane 2-way (Typical National Road)	120	3.5	3.0	0.75	25	2.56	1.0	1.0	0.71	1.0	0.71	2,500	1,775	1	0.7	1,242	9.0	60	11,500

Note:

(1) $T = \frac{100}{100 - Pt + Et * Pt}$

C = CB * L * C * T

$$ACT(MULTIPLELANE) = \frac{5000 * CD}{K * D}$$

(2) The figure with asterisk indicates design daily capacity of 2-lane / 2-way road.

WHERE:

T: COEFFICIENT OF ADJUSTMENT FOR HEAVY VEHICLES
Pt: PERCENTAGE OF HEAVY VEHICLES
Et: PASSENGER CAR EQUIVALENT OF HEAVY VEHICLES
L: COEFFICIENT OF ADJUSTMENT FOR LANE WIDTH
C: COEFFICIENT OF ADJUSTMENT FOR LATERAL CLEARANCE
I: COEFFICIENT OF ADJUSTMENT FOR CONDITION OF SIGHT
K: PEAK FACTOR (%)
D: RATE OF DIRECTION (%)
CD: DESIGN CAPACITY (VEH/HR)
CB: BASIC CAPACITY (PCU/HOUR)

Service Level 1: In the design year, the annual maximum peak hour traffic volume is less than the road's attainable capacity per hour. Vehicles in the 30^{th} highest annual hourly volume can maintain stable flow at certain speeds, but selection of speed is restricted

Service Level 2: In the design year, the 10^{th} highest annual hourly traffic volume reaches the road's attainable capacity and this sometimes causes serious traffic jam during these peak ten hours. Vehicles in the 30^{th} highest annual hourly traffic volume are unable to keep uniform speeds and the attainable speed changes at random

Service Level 3: In the design year, the 30^{th} highest annual hourly traffic volume exceeds the road's attainable possible capacity and this causes serious traffic jams during these peak 30 hours. Vehicle flow of the 30^{th} highest annual hourly traffic volume is continually forced to change speed and sometimes is forced to stop.

These regulations apply to new bridge construction which are funded by the government only. If the representatives of international funding sources request for an exception to the current Vietnamese design standards and specifications, the government may accept alternative standards proposed by the funding agency, but only with concurrence of the MOTC and the Transport Engineering and Design Incorporated (TEDI). The design loads specified by the alternative standards must in principle be equal to or higher than those specified in the Vietnamese Bridge Design Code.

However, the agencies sponsoring the projects must exercise restraint in requesting such exceptions, because the quality control of bridge construction may become difficult if there are different design standards and specifications for each project financed by different external agencies.

To ensure uniformity of bridge standards in Vietnam, a general adoption of the Standard Specifications for Highway Bridges adopted by the American Association of State Highway and Transportation Officials, Inc. (AASHTO) for all new bridge construction projects financed by international sources must be necessary. Specifically, 125% of the AASHTO loadings are considered to be representative of appropriate international standards for roads.

The AASHTO standard has been adopted by other countries and is already used in the southern part of Vietnam. Further, 125% AASHTO loadings have already been adopted for Lai Vu Bridge located at Km 59+164 and for Phu Luong bridge located at Km 54+210 both on National Road No. 5. Design loadings should be linked to design traffic volumes. The recommended design loadings are as follows:

Table 4.3.3
Recommended Design Loadings

Design Traffic Volume (Veh/day)	Design Loading
Freeway	H30 - XB80 or 125% of AASHTO
More than 10,000	H30 - XB80 or 125% of AASHTO
6,000 - 10,000	H30 - XB80 or 125% of AASHTO
1,000 - 6,000	H25 or H20 - X60 or 100% of AASHTO
300 - 1000	H13 - X60
less than 300	H10 - X60

In the case of roads handling between 1,000 and 6,000 vehicles per day, H25 or H20 loadings are recommended due to the large difference between H30 and H13 loadings. In regions where earthquakes may be anticipated, structures should be designed to resist earthquake motion. In Vietnam, the seismic intensity as indicated by the Modified Mercalli scale is significant. However, no allowance for earthquake stresses have been so far incorporated in bridge design standards, but this should be done in the future.

Bridge width including carriageway, shoulder, strip, and/or footway should be linked to design traffic volume. The recommended bridge width is as follows:

Table 4.3.4
Recommended Bridge Width

Design Traffic Volume (Veh/day)	Bridge Width (m)
Freeway	10.50 x 2
More than 10,000	10.50 x 2
6,000 - 10,000	10.50 or 13.00
1,000 - 6,000	7.00
300 – 1000	5.50
less than 300	5.50

2) Criteria for Evaluating Existing Bridges

Existing bridges should be evaluated according to their widths and loading capacities. The recommended criteria to evaluate existing bridges are presented in Table 4.3.5 below.

Table 4.3.5
Criteria for Evaluation of Existing Bridges

Design Loadings	H30-XB80 or 125% of AASHTO		H25-X60 or 100% of AASHTO	H30-XB80	H25-X60
	4-lane	2-lane	2-lane	1-lane	1-lane
Bridge Width					
Less than 3.0 m	C	C	C	C	B
3.0 - 4.5m	C	C	C	B	A or B
4.5 - 6.0m	C	B	B	A	A
more than 6.0 m	A and B	A	A	A	A
Loading Capacity					
30 tons	A	A	-	-	-
25 tons	B	A	A	-	-
13 tons	C	B	B	A	-
10 tons	C	C	C	B	A
8 tons	C	C	C	C	B

Notes: A - to be used as it is
B - to be used for the time being with minor rehabilitation
C - to be replaced by new bridge

3) New Bridge Design Concept

In Vietnam, bridge materials such as steel plates, H-beams, steel pipes, reinforcing bards, PC cables, and anchorages are being used but there are imported high-strength cement for PC structures. Considering the bridge materials produced domestically and the domestic technology, concrete structures should be given priority for new bridge construction. Use of steel structures should be restricted mainly for long-span bridges, bridges on soft ground or temporary bridges.

The present type of rail-cum-road bridge of steel truss construction with a central track for railway and two side tracks for vehicles, such as Ham Rong Bridge located Km 320 + 240 on National Road No. 1 and 170K478m on Hanoi - HCMC rail line, is not recommended for new bridges on national roads. Precast reinforced concrete slabs for carriageways are supported by brackets and stringers on both sides of the main truss of the bridge. Due to the lack of rigidity of floor systems, deflection and vibration of carriageways are rather severe and carriageways have been heavily damaged. Since the road is separated on the bridge, one lane of traffic has to cross the railway twice. To avoid level crossings, two bridges are necessary at the crossing points of road and railway, and the road alignment in this segment worsens. A similar type of bridge was constructed on National Road No. 2, but there are separate bridges for road and railway, which is a more preferable situation. New standards must be established for prestressed concrete beams for a:

- span length of 10 - 20 m: Pre-tension Hollow Core Beam
- span length of 20 - 40 m: Post Tension T Beam

The previous fabrication method of prestressed concrete beams produced by a number of Union of Enterprises are not appropriate from the engineering point of view and PC beams must exhibit the following features:

- No sheathing;
- Unturned PC cables without curbed section; and
- Insufficient reinforcement, in terms of both diameter and arrangement of bars.

An established jacking system such as the Freyssinet system, VSL system, etc. should be adopted, and for post tension T Beams, rigid cress beams should be used at the center of the span at both ends of the main beams. Lateral prestressing is recommended for both cross beams and deck slabs. Details of bearing strength, expansion joint, drainage, and other features should be reviewed.

Prestressed box girders erected by the center-hinged cantilever system are recommended for new bridge construction to replace existing ferry services. In general, in these sites which are presently served by ferries, the bridge length is more than 500 m and the distance between pier to pier is 70 m to 150 m, because of the river width and the requirement for navigation clearance.

Cast-in-situ concrete piles of 1.0-m to 1.5-m diameter constructed by the reverse circulation drilling method are generally recommended for the foundations of long-span bridges to get a high bearing capacity from materials available in the domestic market.

4.4 Long-term Road Transport Network Plan

Planning Considerations

Compared with other transport modes such as port, airport and railway, it is expected that road transport will play a more significant role not only to facilitate movement of people and goods, but as an indispensable infrastructure for facilitating trade and commerce between regions of the country (refer to Figure 4.4.1).

As has been discussed in Chapter 3, as of year 2000, there are more than 15,000 km of national roads and 17,500 km of provincial roads in the country. But, the quality, alignment, structure, pavement type, and physical conditions still need to comply with established standards. Further, the vehicle traffic demand on the road transport network is relatively low, particularly in inter-urban linkages. There are only sections in the metropolitan areas of Hanoi and HCMC that exhibit comparatively higher vehicular traffic demand, although there is a substantial volume of motorcycles and bicycles along major urban and town areas.

Based on the existing and future economic development in the country, road network development has the following objective:

> *"To develop an appropriate road network in order to achieve a balanced economic development throughout the country and to alleviate poverty in remote and rural areas."*

On transport facilities planning, supply and demand analysis usually provides an economical solution. However, to attain this global objective, the following issues need to be examined for future transport network building:

1) *Understanding of the regional characteristics and needs of the road network development.* Based on topography, urban development and population distribution, Vietnam is divided into three major regions, namely: northern, central and southern. The northern region is further divided into Hanoi economic growth area and northern mountainous area while the central region has its own northern and southern areas. The southern region is divided into HCMC economic growth area and the Mekong Delta region (refer to Figure 4.4.2). To have an initial understanding of the road development needs in each area, Table 4.4.1 presents a breakdown of the significant regional characteristics of each area.

   In terms of topography, a very low elevation of 0-50 m and 5-200 m is mostly found in the Mekong Delta region. Thus, inland waterway is the more significant means of transport, since roads and bridges are too costly to construct (which have to be elevated) and not economically feasible. Further, flooded road sections along the coastal area are common, particularly between Dong Ha and Danang. Elevating these road sections require substantial investments (refer to Figure 3.2.2).

Table 4.4.1
Regional Characteristics of and Needs for Road Network Development

Region	Characteristics
1. Hanoi Economic Growth	The most significant economic growth pole in the county and the national capital region. Due to rapid urbanization and industrialization, a high-density road network will be required.
2. Northern Mountainous Area	Minority ethnic groups are scattered in this region and due to the steep terrain, difficulties are expected in the further improvement, development and expansion of road network in the area. The main objective of providing road access to this area is to deliver at least the minimum services needed by the rural people to improve their quality of life.
3. North Central Region	Narrow strips of road with approximately 10-km width are common. Several major towns are along the coastal lines. Danang, the third economic growth pole, is located south of this area, so that relatively faster industrial development is taking place there. Further, strengthening of the North-South corridor to improve accessibility from the Hanoi growth pole is being undertaken to encourage industrialization in the region.
4. South Central (Coastal Area and Highlands)	This area had so far been isolated from economic development, except for major towns, which are linked by NR1 in the coastal area. Ongoing rehabilitation project on NR1 is expected to improve accessibility of the towns. Recent road improvement projects in the highlands such as NR14 and NR20 have stimulated economic activities including agro-industrial activities in the region. Further strengthening of the road network system will encourage modern agro-industrial activities and improve the level of income of the population in the area.
5. HCMC Economic Growth	The most developed area in the country will require “greater mobility” in the existing transport network to further enhance urbanization and industrialization of the region.
6. Mekong Delta	Inland water transport system is well developed in this area. However, an improved economic situation will encourage people to seek a modern lifestyle.
7. National Boundary Area	Due to the difficult terrain and some political sensitivity as a national boundary, this area has been isolated resulting in very high poverty incidence. There is an urgent need to provide road access to manage the national boundary, as well as to alleviate extreme poverty in the area.

Vietnam’s road network and existing land use (refer to Figure 3.2.4) shows that the extensive system of national roads mainly serves urban areas, and in some provinces, they are in forest lands which might not be environmentally sound. Provincial roads in northern Vietnam are more extensive in geographical coverage compared to those in central Vietnam. The population density in Vietnam is heavily concentrated in Hanoi and HCMC with above 1,000 persons per sq km, which thus requires more roads to facilitate mobility. Hence, where there are very high population densities and wherever it is possible to provide a contiguous road network, the road network is noticeably more developed.

2) *ASEAN economic cooperation and international traffic.* Economic globalization is strengthening the international economic cooperation among ASEAN countries. This issue has been discussed in a series of official ASEAN meetings. Vietnam is adjacent to two other ASEAN countries – Laos and Cambodia – and to China. At present, the volume of cross-border trade is not so significant due to the relatively small size of economic activities between these countries and Vietnam. However, as economic growth in the region is expected to improve, cross-border trade is likewise projected to grow. Access to ports is a major issue particularly in the case of Laos.

3) *Coordination among port, airport and other transport infrastructure development plans.* Rapid motorization experienced in ASEAN cities, such as Bangkok, Manila and Jakarta, have resulted in tremendous traffic congestion and air pollution, adversely affecting economic activities and degrading the quality of life of the population in these areas. Therefore, it is important to plan ahead and provide for adequate and strategic intermodal linkages within and between major urban areas.

4) *Traffic demand and functional classification.* Even if the traffic demand will not justify the construction of a road network, it will still provide significant information to help evaluate the appropriate transport network for Vietnam. A functional classification of the road network is a major reason for establishing an efficient road transport system, which should be well coordinated with the existing land use, urbanization and industrialization, as well as developments in remote areas.

5) *Ongoing and committed plans and projects.* There is a substantial amount of required investments in the road transport subsector which is provided not only by the Government of Vietnam, but also by international financing organizations, such as the WB, ADB and JBIC, and through ODA from many developed countries as discussed in Chapter 2. Thus, it is necessary not to overlook the considerable effort and resources, which are being provided by these international donor agencies. This Study has thus carefully reviewed ongoing, committed and proposed plans and projects for road transport.

Conceptual Network Development Plan

This Section presents the process of road network building within the framework of a long-term conceptual development plan, which takes into account the major planning issues that were discussed above. In the metropolitan areas of Hanoi and HCMC, an outer ring road connecting the major radial roads in the city's outskirts must be planned effectively. A major arterial system in urban areas should be established based on the results of their respective urban transport studies. The result of the network examination are discussed as follows:

Figure 4.4.1
Conceptual Framework of the Future Road Network

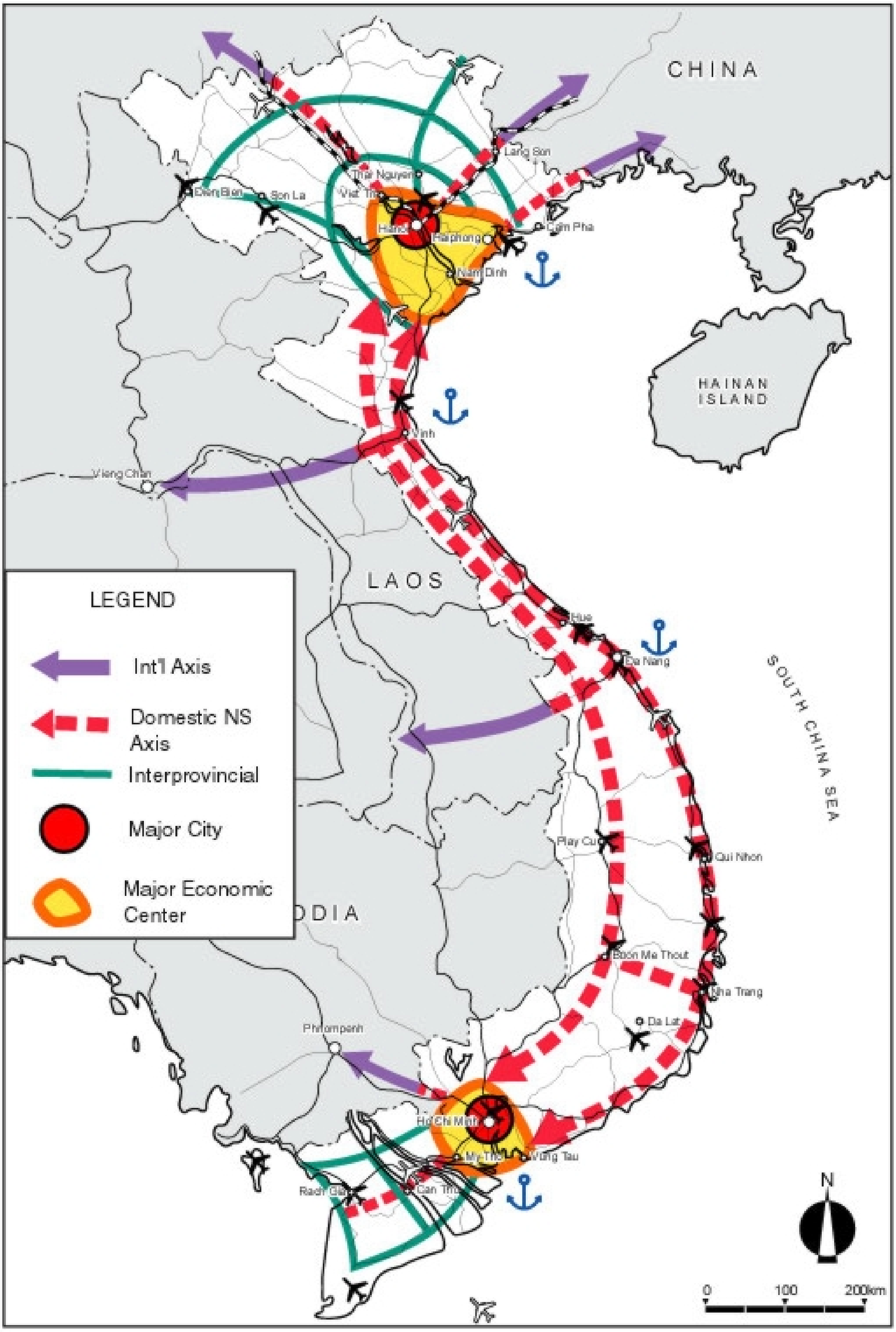
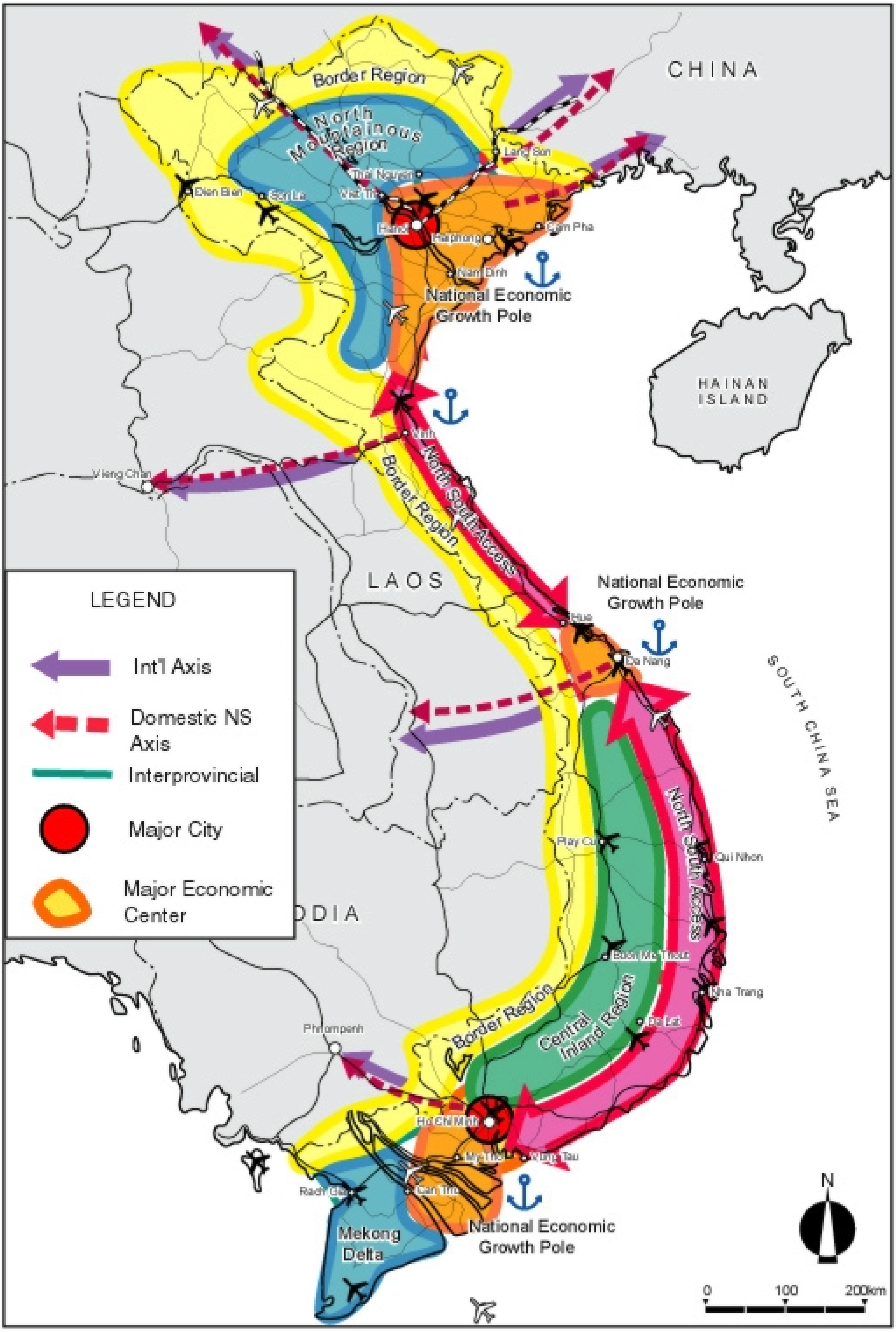


Figure 4.4.2
Economic Growth Centers of Vietnam



1) Basic Framework from Existing Road Network Configuration

Although the quality of existing road transport facilities is poor based on the existing road and bridge network, network configurations exist such as the radial-circumferential pattern in the north, the ladder pattern in the central region and the grid pattern in the south, including the Mekong Delta. The latter, however, is not applicable to roads but only to inland waterway transport. The existing road or transport network pattern will serve as the basis of the future road network.

2) North-South Axis

Developing and strengthening the north-south corridor between Hanoi and HCM City is an important issue that needs to be considered to achieve a balanced economic development in the country. The distance of 1,700 km of road between the two economic growth poles might be too far to exert economic influence on this stretch. Thus, their integration will be a long-term economic goal.

For the short and medium term, the objective of developing the north-south axis is necessary to improve accessibility between urban areas located along this axis to integrate regional economic development. At present, the government is rehabilitating NR1 with international assistance from the WB and JBIC. A large improvement is expected from the rehabilitation project.[4] The start-up of the project was delayed and moved from 1997 to end of 1999 due to delay in the preparatory work. Besides, the Vietnamese seems to be very prudent in developing the project. However, to provide a reliable network, another north-south highway (National Road No. 1A) is necessary.

This new north-south highway was already studied and planned by the government.[5] NR14 and NR15 will serve as the backbone of this new corridor. Further, it is planned that the following projects will be undertaken: Phase 1 – to be carried out in three years (2000-2003) over 1,690 km of road length from Ha Lac (Ha Tay) to Binh Phuoc (HCM City) consists of upgrading and restoring 1,094 km of existing roads (83% of the total network to be strengthened in phase 1), building 220 km of new roads to get through the bottleneck from Xuan Mai (Ha Tay) to Ngoc Hoi (Kon Tum) and 341 new bridges with a total length of 15,985 km. Participating in the project are construction companies of the MOT, Ministry of Defense and the youth labor force from the Young Volunteers and underemployed farmers. Supervising consultants from Cuba will participate. Once Phase 1 is completed the section from Ngoc Hoi (Kon Tum) to HCM City will be

[4] For National Road No. 1A or North-South Line, VND 4.912 billion or US$ 350 million is estimated and consists of three phases: Phase 1 – making full use of and linking available roads including National Road No. 21A, 15A, 71, 14, and 14B to build a two-lane highway; Phase 2 – widening the highway to 4-8 lanes to meet the traffic demand, depending on the availability of capital; and Phase 3 – expanding the highway in the Sino-Vietnamese border and in the south to Ca Mau to form the second trans-Vietnam highway.

[5] A second route will be developed to ensure normal traffic conditions even in the worst weather, i.e., to make most sections and bridges higher than the peak flood level in 1999 to ensure normal traffic flow throughout the year.

developed on the existing National Road No. 14. It is reported that this section will be upgraded to a four-lane highway through ODA from the JBIC.

Although a new trans-Vietnam road is essential and economic justification seems strong, the efficiency of the investment required is still uncertain. Considering the design of the road, transport experts noted that these roads still face the risk of landslide. Further, after Phase 1, investment in the succeeding phases seem to be very high because the expansion of existing roads include large amounts for site clearance and compensation for land acquisition.

Further, the MOT cannot measure the efficiency of this road investment since it is impossible to determine the road’s traffic density. People started naming the road “Truong Son road of industrialization” since it is expected to facilitate the development of an economic zone in the west of the Truong Son range. If it is linked to Danang and Dung Quat, the road might be a new feature in central Vietnam and may create positive impact on labor redistribution, creation of new cities and residential areas.

3) Radial and circumferential network in the north

The northern region covers the Hanoi metropolitan area and the large mountainous areas to the north up to east of Hanoi. The entire area forms an elliptical shape, which is 600 km wide and 300 km long. There are some trunk roads starting from Hanoi to the mountains, such as NR1, 2, 3, 6, and 32 and two circumferential lines, NR379 and NR279. In the future road network development, the axes of the radial and circumferential road network will be NR1, 3, 6, 18, and 70. Among them, NR1, 18 and 70 will serve as cross-border routes to China and Laos. For circumferential routes, NR279 will be upgraded.

4) Central Highlands

The central highlands are a of focus area for poverty alleviation. To encourage agro-industrial activities here, a road network configuration will be developed to form a grid pattern based on the two north-south axes, NR1 and the North-South Highway.

5) Role of road transport in the Mekong Delta

Rivers and channels run north to south and east to west in the Mekong Delta. Among all transport modes, the water transport system plays a major role in this region. For the time being, this situation is projected to remain the same. However, to expand the economic activities and improve the quality of life, it would be necessary to establish a more efficient road transport network in the area.

Ideally, this future network will link all major towns in the region, but the high construction cost for building structures crossing rivers and channels will be a major constraint. In some cases, there are foreign donors, such as the AusAID, which built a bridge in Vinh Long province to further promote trade among provinces in the Mekong Delta.

6) National boundary area

There is a need to focus on undertaking road development in the country's major boundaries taking into account the projected cross-border trade, which is expected to grow, and some political considerations (management issues must be considered). Development of this area will benefit many cultural groups living here and who do not have efficient and adequate road access. At present, there are road projects, which are being constructed, such as NR14C in the central region and NR4D in the north, which will form part of the future road network of the country.

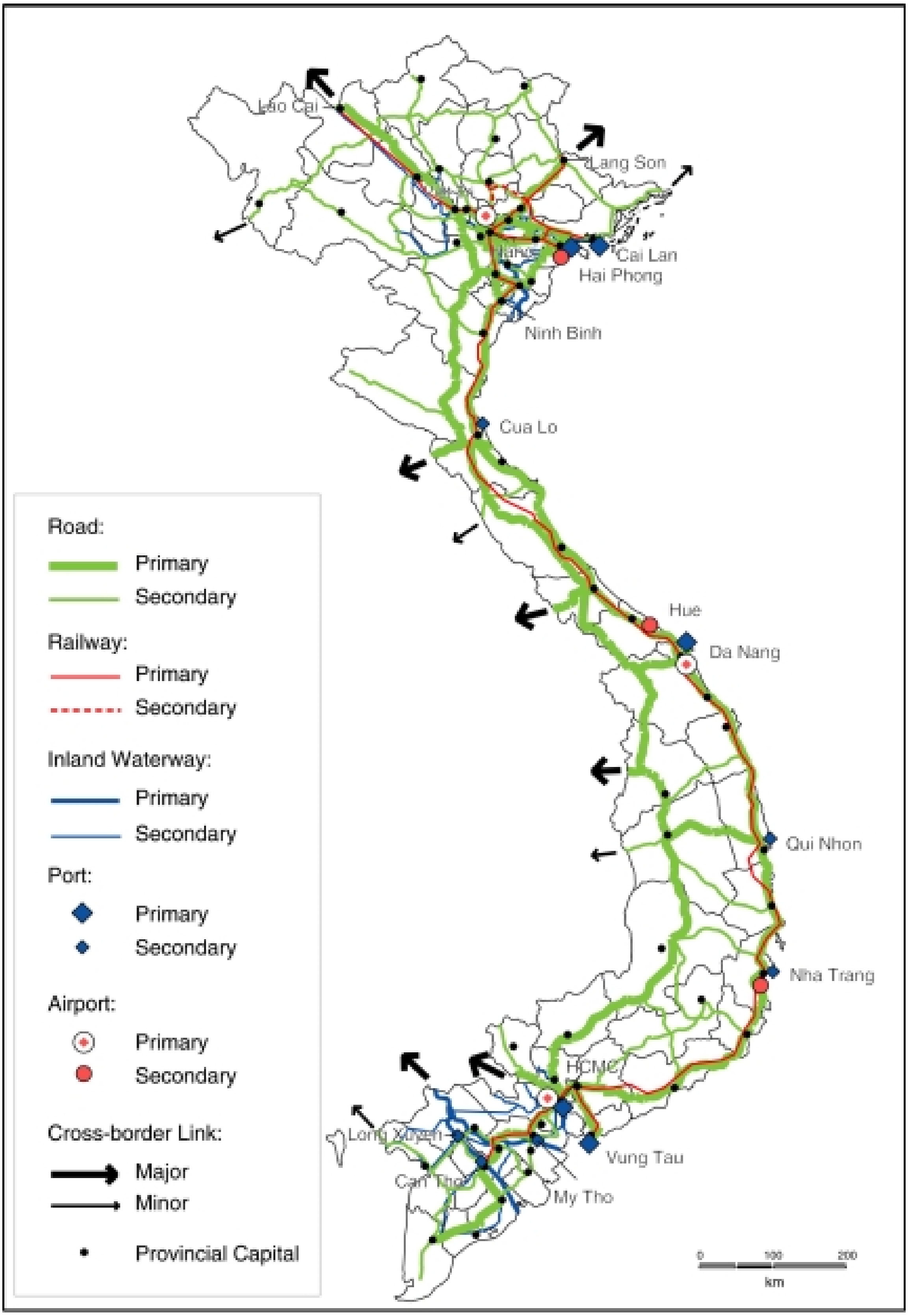
Results of the analysis are shown in Figure 4.4.3. The primary road system basically consists of two north-south axes, the NR1 and Ho Chi Minh Highway (NR14 and 15), which link the Hanoi and HCMC economic growth areas. In the two economic growth areas, NR5 between Hanoi and Hai Phong and NR51 between HCMC and Vung Tau will play a significant role as a primary road system. For international primary roads, NR70 to China, NR8 and 9 to Lao and NR22 to Phnom Penh, Cambodia will be justified.

Other national roads are classified as part of the secondary road system, which provides road transport access to provincial capital cities. The conceptual road network development plan will be discussed for the primary and secondary road systems. There are several national roads that are not yet classified and are neither primary nor secondary roads. These roads are located mainly in less developed areas, such as the cross-border areas from north to south. Others provide intraregional linkages, providing direct access to lower levels of the road network system, which include provincial and district roads.

Environmental Impact of Road Projects

In responding to the road transport requirements of the economic sectors, road subsector projects must first address any environmental impact either during or after construction. This Section presents an approach to evaluating road infrastructure projects which thus requires environmental assessment of proposed roads prior to implementation and must be based on the following:

Figure 4.4.3
Long-Term Road Network Development Plan



- the 1:500,000 scale map of Vietnam showing the major characteristics of terrain, agricultural areas (rice fields), hydrographic systems, and forested areas;
- data collected from various bodies: MOSTE, International Union for Nature Conservation, etc.; and
- existing environmental assessment of various development projects in Vietnam.

The potential impact of the road development program refers to the general impact on the regional level; specific impacts, by project, from maps drawn for each project. However, this work does not in any way constitute the full environmental impact assessment (EIA) of each road project. It simply enables the identification of:

- major environmental issues in an upstream phase;
- the most environmentally relevant which requires a full EIA.

A road project aims to improve the economic and social conditions of users or the local population in the influence area to be served by the road. Upgrading a road surface reduces travel time and vehicle operating costs which comprise the direct economic benefits. Indirect economic benefits include improved access to markets, places of work and educational and health services and reduction in the transport cost of goods and passengers.

However, despite the positive effects of these road projects, there may be equally important negative effects on the natural environment and communities living along the project road. It is essential to identify potential negative impact at an early stage in the planning process and to take necessary steps to avoid or mitigate such effects.

Major considerations related to potential impacts of road projects include:

- indirect and induced effects of a road development scheme may be more significant than the direct effects, which include risks of deforestation, resettlement, in-migration, etc. which represent the “real” environmental costs;
- cumulative or synergistic effects, where the “global” impact might even be greater than the sum of the individual impacts;
- impact assessment must be for the whole road project to include other associated effects such as material extraction or dumping areas, material processing and treatment areas, diverted water courses, etc.

Thus, any environmental impact of the road project relate to the following aspects:

- physical environment,
- natural environment,
- human environment, and
- population movements.

(1) ***Physical Environment*** - This refers mainly to erosion which can be the result of the interaction between flowing water and soil, disturbed by road construction work. The problem is common on road mounds, in dumping or extraction areas, quarries, etc. A series of impacts may affect the environment such as risk of landslides, pollution of water courses, modification of flood levels, etc. Ground contamination, by heavy metals in particular, may not be a major environmental problem since daily traffic volumes are relatively low. Effects are often localized to within a few meters on either side of the road. Roads can also alter the flow and quality of both surface and groundwater, increased risk of flooding, erosion or deposition, or a sudden change in the dynamics of groundwater levels. These changes may affect the natural vegetation and wildlife, and even human activities.

(2) ***Natural Environment*** **-** The direct effects on the natural environment are linked mainly to the use of road footprints, areas for material extraction and dumping areas, quarries, etc. and to the effects of segregation (the ecological value of the two areas created by passage of the road is less than that of the whole road). Indirect effects refer to access provided by the new road which allows human mobility. Two types of ecosystem that are particularly sensitive to road projects are forests and wetlands which are found in Vietnam. These areas, in their existing state, are already considered sensitive areas since they have been subject to “severe conditions” in the past.

Forest cover is significant, particularly in western Vietnam, along the Lao border, where no major road project is proposed, and in the southern part of the central region, in particular along the section of NR1 from Buon Ma Thuot to Chon Thanh (i.e, project RD 6).

(3) ***Human Environment*** - The impacts of road projects on the social and economic environment can be extremely diverse and complex. One objective of a road project is to develop the local community and vitalize economic activities by improving access, lowering transport costs and developing markets for local products and services. But any road improvement can generate impacts which are prejudicial to the interests of the communities affected by it and if not mitigated at the project or conceptualization stage, may lead to opposition of the local communities and thus delay project implementation.

In the case of road widening, increased traffic may reduce access to activities that are close to the road, thus disrupting the daily economic and social activities and existing trade patterns. These segregation (or isolation) effects are difficult to quantify and may thus lead to community opposition particularly in densely populated areas. It is possible to integrate mitigating measures to balance and compensate for such changes.

A new road or improved road can bypass a community, causing reduction in traffic or commercial activities. Even if its impact on the bypassed area may be positive, the isolation effects can be prejudicial to the welfare of communities living in this area. Thus, it is essential that consultation with stakeholders from the local community must be undertaken to identify problems and define appropriate measures.

The introduction of a new road in a rural area will affect agricultural activities since it might disrupt the natural connections between the fields. The main food production areas in Vietnam must be integrated with the proposed road program to maximize investments in both the agricultural production intensification program and road infrastructure projects. Therefore, the government must carefully study the environmental implications of new road projects related to major production areas.

The impact of a road project on the human environment depends on the population densities of the project area it affects. The risk of population movements increases when the road passes through more populated areas but generally this is not the case in most of the proposed road projects.

(4) ***Population Movements*** - Road projects may require population movements, especially in the rehabilitation of existing roads or when the road passes through highly populated areas. In the case of the North-South Highway project, certain sections may require that the local population be resettled. These problems can become extremely complex since they involve cultural, social, economic, and environmental concerns.

Potential negative impacts may include:

- loss of employment,
- loss of ethnic identity,
- loss of social links,
- risk of reduced health,
- food risk, and
- loss of local association, etc.

When resettling local population, a true resettlement program for displaced persons must be carefully planned and must study the (1) modalities of population movement and (2) formation of a way of life. Failure to take account of these concerns may result in uncontrolled influx of migrants, increased poverty and environmental damage. The impact assessment of road projects must thus take this social dimension into account. A sociologist should be assigned and tasked with detailed design for resettlement activities. Modalities proposed in resettlement of population must follow existing regulations (i.e. the Vietnamese Civil Code adopted by National Assembly in October 1995, Part V including Articles 690-774).

(5***) Impacts –*** In summary, the potential negative impacts of road projects include:

- water contamination, increased sediments in streams, alteration of hydrological regimes;
- erosion, landslides in road cut;
- destruction of vegetation and wildlife; and
- destruction of rice fields and other agricultural areas.

In the detailed design stage of road infrastructure projects, appropriate measures should be identified and a full EIA be undertaken to mitigate these potential negative impacts. Such an EIA is required in accordance with Decree 175/CP of 18 October 1994 which provides that an EIA related to a road project longer than 50 km has to be appraised by the MOSTE, while that for a road project under 50 km has to be appraised by the Department of Science, Technology and Environment (DOSTE) under the People's Provincial Committee. This relates to the identified environmentally critical areas and hotspots as shown in Figure 4.4.4 and 4.4.5, respectively.

The following table summarizes the major constraints related to each road project such as:

A. topographical constraints which increase the risk of erosion and landslides,
B. presence of forests which require mitigation measures on possible vegetation and wildlife destruction;
C. presence of protected areas requiring appropriate mitigation measures;
D. presence of rice fields and other food crop areas; and
E. high population density requiring resettlement measures.

Table 4.4.2
Examples of Main Environmental Constraints of Road Projects in Central Vietnam

Project No.	Location		Road No.	Total Length	Type of Constraint				
	From	To			A	B	C	D	E
RD 01	Hoa Lac	Ha Tinh	21/15	458	*	*	*	*	*
RD 02	Phuc Dong	Dong Hoi	15	187	*		*	*	
RD 03	Dong Son	Cam Lo	15	103		*		*	*
RD 04	Cam Lo	Phu Loc		116			*	*	*
RD 05	Danang	Kon Tum	14B/14	310	*	*	*	*	*
RD 06	Kon Tum	Chon Thanh	14	504	*	*	*		*
RD 07	Vung Ang Port	Mu Gia Pass	12	136	*	*	*		*
RD 08	Dong Ha	Lao Border	9	84	*	*			*
RD 09	Ngoc Hoi	Lao Border	40	21	*				
RD 10	Kon Tum	An Chau	24	164	*		*		*
RD 11	Pleiku	Quy Nhon	19	168		*			*
RD 12	Buon Ma Thuot	Ninh Hoa	26	151		*			*
RD 13	Da Lat	Dau Giay	20	232	*	*	*		*
RD 14	Da Lat	Phan Rang	27	110	*	*	*	*	*

Source: Various Studies

Another example is the case of Ho Chi Minh Highway, where the Ministry of Agriculture and Rural Development (MARD) requested a change in the direction of an 8.5-km section of the highway that will pass through the Cuc Phuong Park based on the premise that the ecosystem and wildlife in the country's oldest park, which is home to several unique species of fauna and flora, will be adversely affected.

Figure 4.4.4
Environmentally Critical Areas in Vietnam

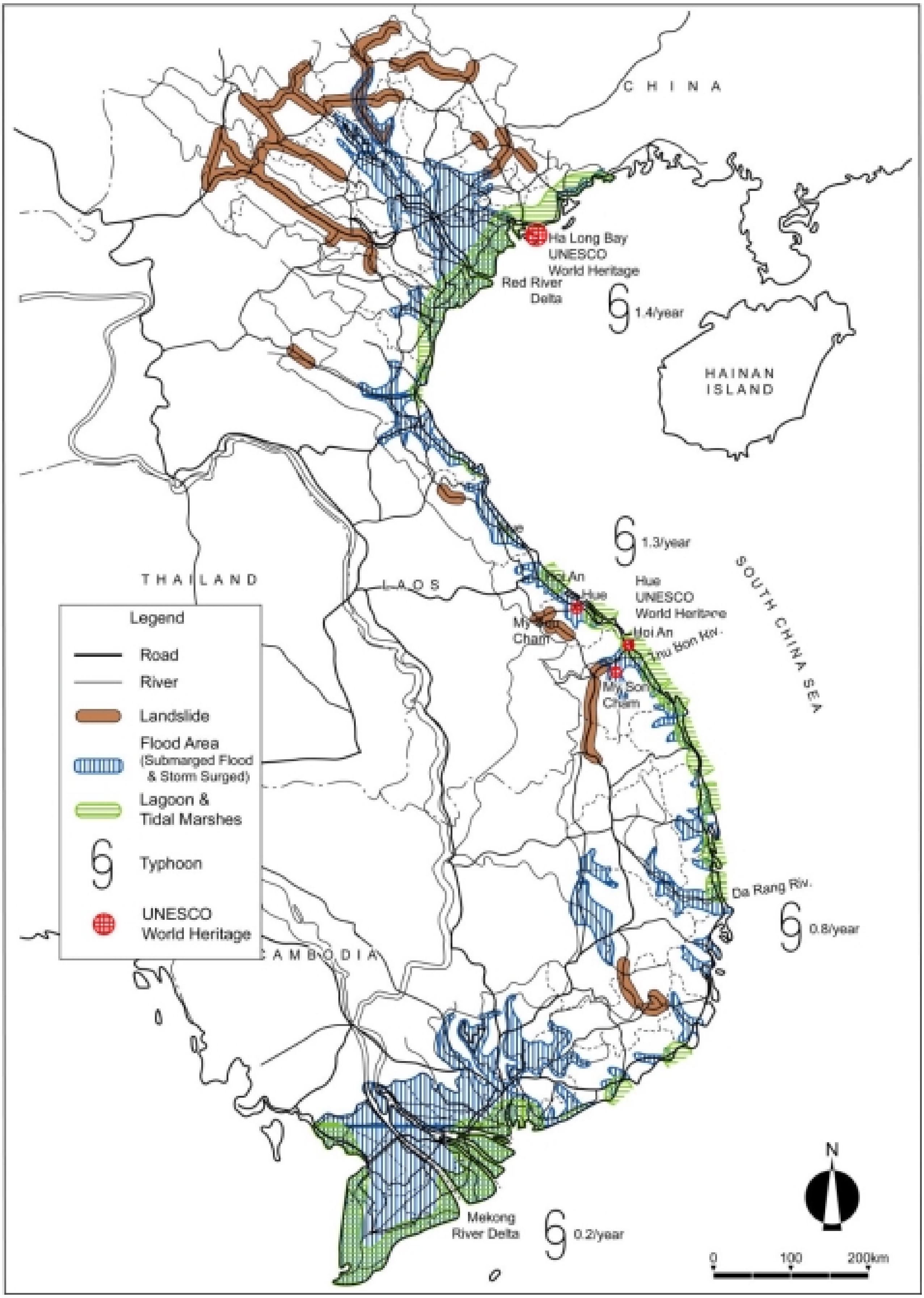
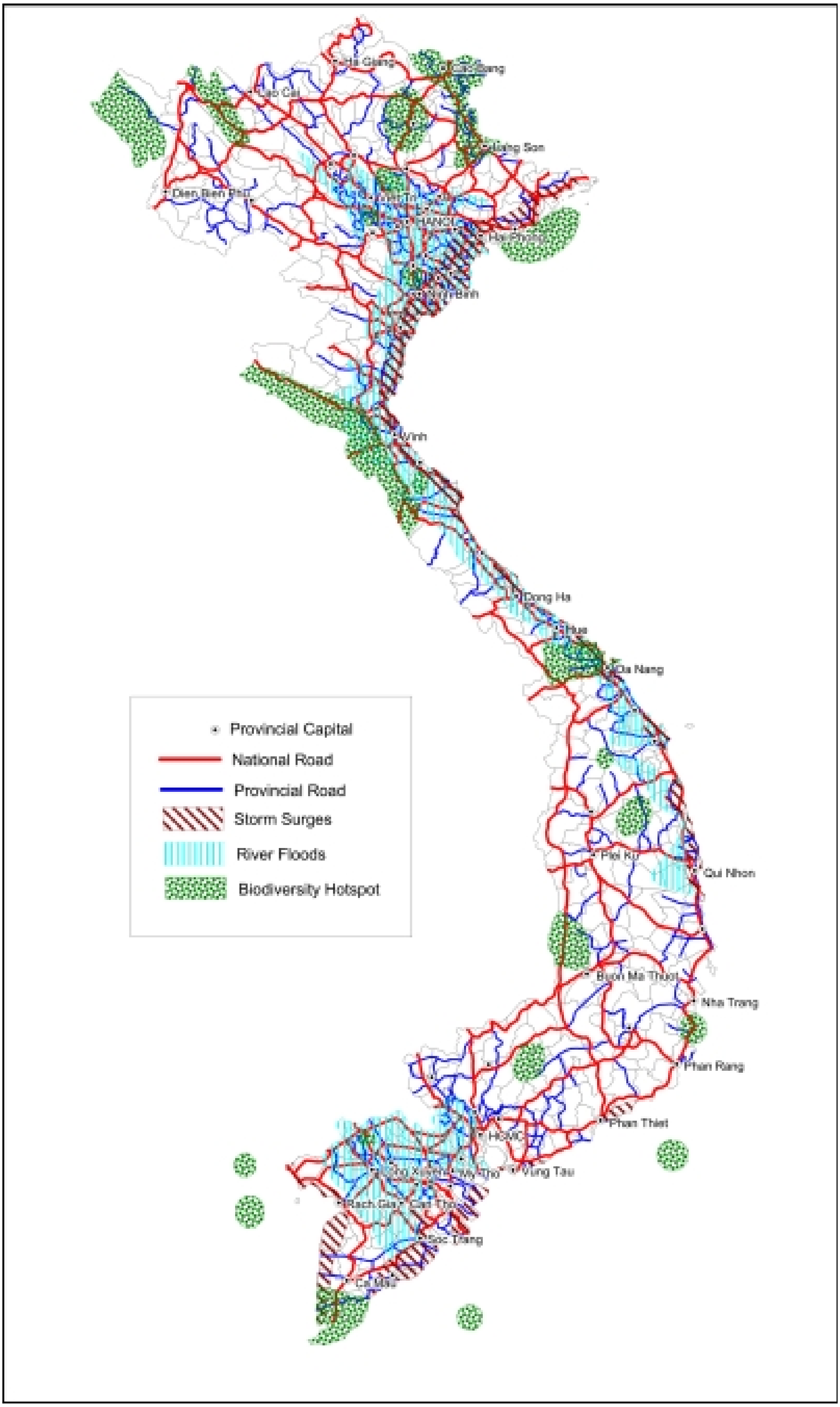


Figure 4.4.5
Environmental Hotspots in Vietnam



The proposed Ho Chi Minh Highway (1,690 km from the northern province of Ha Tay to Ho Chi Minh City in the south), which requires a huge investment amounting to VND 5,300 billion is feared to divide the park in the northern provinces of Ninh Binh and Thanh Hoa. It was difficult to change the direction of the road because there was only one mountain gorge from Ninh Binh to Mai Chau in Thanh Hoa.

If the road were to be built through the park, mitigating measures would be adopted to protect the ecology, such as building walls to prevent noise and underpasses or flyovers to allow wild animals to roam the two parts of the park. Interprovincial road 437 was the only route parallel to the west bank of the Buoi River in the mountain gorge. Previously, there were considerations relating to this road: (1) initial recommendation was to build the section in the eastern direction but this was turned down in 1996 since the section is near the existing NR1A. The foundation must be 3 m to 4 m high if the road is designed to withstand floods, but this will prevent flood water from the western region to flow to the sea in the east; (2) the second was to build the section in the western direction, but the terrain was too rough to establish communications, so this solution was not feasible. Seminars are normally organized to get expert advice from scientists. It is proposed as part of the road.