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CHAPTER 1
INTRODUCTION

1.1 PROJECT BACKGROUND

The Thai-Cambodian Ban Khlong Luek – Poipet border crossing points are located in both Aranyaprathet District, Sa Kaeo Province of Thailand and Banteay Meanchey Province of the Kingdom of Cambodia (Cambodia). It is considered a gateway to Indochina Region with high trade values, in comparison with other border crossing points in the country, and high economic growth potential. However, with the limitations of the Ban Khlong Luek – Poipet border crossing points, which are rather narrow with no possibility of road expansion to accommodate the higher volumes of both transportation and travelers; the visa and cargo examination processes have been delayed. Apart from that, not only the Cambodian customs procedures are complicated with lots of steps to follow, but also the equipments and tools for cargoes examination are out of date while the infrastructures in Cambodia are much far from services, all these cause each goods transport to spend over 5 hours for the process through Ban Khlong Luek – Poipet Border Crossing Points. This initiated an idea of a new border control facility development, under the concept, "People-Goods Separation", by making Ban Khlong Luek – Poipet Border Crossing Points reserved specifically for travelers and local trading purposes while the new border control facility merely for import-export purpose.

Regarding this, the governments of the 2 countries agreed theoretically to have a new border control facility developed. The related survey and location have been set at both Ban Nong Ian, Aranyaprathet District, Sa Kaeo Province in Thailand and Stung Bot, Banteay Meanchey Province in Cambodia, which is approximately 5 km. away from Ban Khlong Luek – Poipet Border Crossing Points southward. There is a small 20-metre wide watercourse located between Thailand and Cambodia. The co-ordinates for the development of a new border crossing point have been fixed at TA414064 WGS 84 in Thailand and CL 241394:1506503 in Cambodia.

Apart from that, all the concerned sectors/authorities in both countries have also made ready for necessary preparations. For Sa Kaeo Province of Thailand, it is under project feasibility study for the border control facility development in Ban Nong Ian, Aranyaprathet District, Sa Kaeo Province. For Cambodia, the Ministry of Public Works and Transport, on behalf of the government, has requested for an academic assistance from the Neighboring Countries Economic Development Cooperation Agency (Public Organization) – (NEDA) on the feasibility study and detailed design for Stung Bot Border Control Facility Development Project and the connected roads to highway no. 5 in Cambodia. After consideration, the Neighboring Countries Economic Development Cooperation Agency (Public Organization) – (NEDA) has agreed to give assistance to Cambodia as this project can release the service burden of the Ban Khlong Luek – Poipet border crossing point which still has some limitations as previously stated (Services at Ban Khlong Luek – Poipet Border Crossing Point). Moreover, the project can also effectively increase the carrying capacity of the cross-border import-export volumes between Thailand and Cambodia, which is expected to

be of higher values. It will also reduce Thai-Cambodia customs and immigration times and procedures. This project is a bilateral cooperation between Thailand and Cambodia in basic infrastructures development for the Southern Economic Corridor economical activities promotion, to make it more tangible and effective in order that an international trade transportation capacity can be increased with convenience allowed. Apart from that, it also supports economical and industrial expansions as well as improve the qualities of lives of the people in both countries, which are in relation to:

1. Thai government's policy regarding the intra-Great Mekong Subregion (GMS) connectivity enhancement;
2. Foreign policy on relationship building with neighboring countries which is expected to bring prosperity to GMS.
3. The Policy of Neighboring Countries Economic Development Cooperation Agency (Public Organization) – (NEDA) about lending assistances to the neighboring countries in communication and transport systems, including an improvement of people's living in the project area.

1.2 PROJECT OBJECTIVES

1. To conduct project feasibility study in the areas of engineering, economical, social and environmental, including the project pros and cons and public participation of the people in the project area.

2. To conduct a survey and detailed design, make cost estimation and prepare for tender documents.

The feasibility study and detailed design of the Stung Bot border crossing facility area is about 600 x 300 meters or 180,000 square meters (112.50 rai or 18 hectares) and composed of border crossing facility, office, container yard and access road to national road No.5, Kingdom of Cambodia. The location of project is shown in **Figure1.1**

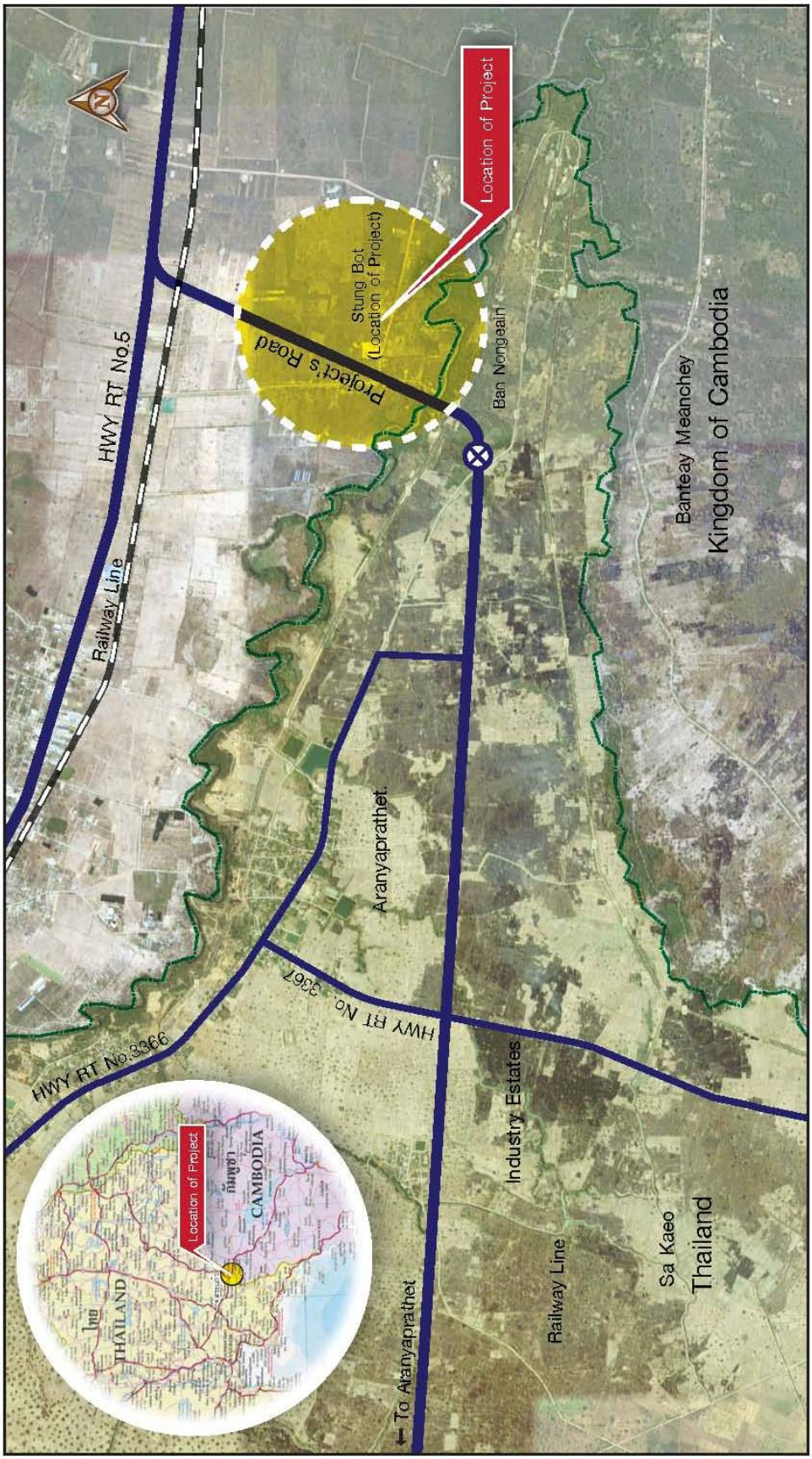

Figure 1.1 Location of Project

1.3 SCOPE OF CONSULTANCY SERVICES

The Consultant's work will be performed based on good governance principles and focuses on the long-term benefits of all the stakeholders which include the following:

1. Economical and Social
2. Engineering
3. Project Pros and Cons
4. Environmental
5. Public participation of the people in the project area

The Consultant's scopes of work and duty are as follows:

1.3.1 Project Feasibility Study

1. Project-related Data and Documents Collection
2. Economical and Social Data Collection and Analysis
3. Traffic and Transport Studies
4. Project Feasibility Study and Evaluation
5. Initial Environmental Examination (IEE)
6. Studies on the Project Value Adding Guidelines and the Expected Mutual Benefits of Both Countries
7. Engineering Feasibility Study
8. Public Relations and Public Participation

1.3.2 Detailed Design

1. The Designs of Border Control Facility, Office Buildings, Utilities System and All Other Facilities
2. Goods transfer Station and Container Yard Designs
3. Soils and Materials Survey and Examination
4. Alignment and Leveling Surveys
5. Preparations of Right of Way, Land Use and People Relocation Plans
6. Detailed Designs on Roads, Intersections and Railroad Crossing
7. Pavement Structural Design and Roadside Slope Stability and Settlement Analysis
8. Bridge Structure, Drainage System, and Other Structural Designs
9. Electricity System
10. Construction Quantities and Cost Estimation
11. Tender Documents Arrangement

1.4 PROJECT DURATION

The Consultant will carry out the work according to the Term of Reference and has it accomplished within 270 days (9 months) as stipulated in the contract. The project commencement date is 1st October, 2013 and project completion date is 27th June, 2014. But during April 2014 to June 2014 is the period that the consultant has presented stung bot project (master plan layout, border control facility and access road to NH5), to Ministry of Public Works and Transport (MPWT), Kingdom of Cambodia. The consultant has revised border control facility (BCF) from the comments and send back to MPWT and consultant received the approval from MPWT within June 2014. The consultant has proposed the adjusted schedule plan (the extension 150 days) to complete TOR 6.5 draft final report and 6.6 final report and completion date of project is on 25 November 2014.

CHAPTER 2
PROJECT RELATED DATA AND DOCUMENTS

2.1 INTERNATIONAL ECONOMIC COOPERATION IN TERM OF ASEAN

International economic cooperation in term of ASEAN including ASEAN Comprehensive Investment, Service, Finance and other agreement, as following

1) ASEAN Comprehensive Investment Agreement (ACIA)
ASEAN Comprehensive Investment Agreement (ACIA) initial operated in 2008 to support a free, open, transparent and integrated investment regime in the Association of Southeast Asian Nations (ASEAN) region. This aims to assist potential businesses and investors, and adopting the principles of National Treatment.

2) ASEAN Framework Agreement on Services (AFAS)
ASEAN Framework Agreement on Services under The ASEAN Free Trade Area (AFTA) has been established to lower limitation in trading, create effective economic and competitive environment leads more efficient trade in services.
In addition ASEAN has signed Mutual Recognition Agreement (MRAs) on professional services for the purpose of licensing or certification of service suppliers and distribution of skilled labour to work within ASEAN for instance, engineer and architecture which expecting to finish in 2004.

3) ASEAN Framework Agreement on Finance
The agreement aims to strengthening and support members in finance which cover (i) improving capital market (ii) financial liberalization (iii) capital account liberalization and (iv) cooperating ASEAN currency. These operations will support trade and investment within ASEAN.

4) Other cooperation
   (1) ASEAN Industrial Cooperation Scheme (AICO)
   (2) ASEAN Transportation Cooperation, provide the convenience transport through crossing, and other alternative cooperation
   (3) Trans- ASEAN Gas Pipeline Network cooperation

2.2 THAILAND ECONOMIC COOPERATION WITH NEIGHBORING INDO-CHINA NATIONS

The Cross-Border Transport Agreement (CBTA) was originally a trilateral agreement aim at reducing both physical and non-physical transport barriers for instances, provide single stop/Single Window Customs inspection, diminishing physical customs inspection, bond deposit, escort. Also provide adequate/standard infrastructure (road and bridge design standard, road signs and signals) to enhance the transportation system among GMS nations. The Economic Corridor was expanded as North-South Economic Corridor, and East-West Economic Corridor as shown in **Figure 2.1.**

Retrieve: www.npu.ac.th

Figure 2.1 Economic Cooperation Program in Greater Mekong Sub-Region (GMS)

2.3 AYEYAWADEE–CHAOPHRAYA–MEKONG ECONOMIC COOPERATION STRATEGY (ACMECS)

The Ayeyawady - Chao Phraya - Mekong Economic Cooperation Strategy or ACMECS is a cooperation framework among Cambodia, Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam to utilize member countries' diverse strengths, to promote balanced development and to promote prosperity in a sustainable manner in the Sub-region (**Figure 2.2**).

2.4 ASEAN ECONOMIC COMMUNITY

Purposes of AEC mainly aim of

- Be region of "single market and production base" especially in free trade area, investment and trade.
- Be the highly economic competitive region (promoting competitive policy, consumer protection, copyright, electronic commerce: e-commerce, tariff policy, infrastructure/transportation/information technology and energy)
- Consistency economic development, lowering the economic and development gap between ASEAN member nations
- Integrate into world trade under world Free Trade Area (FTA), bilaterally agreement between ASEAN and another negotiated nation, create macro supply chain.

2.5 CAMBODIA INVESTMENT AND SPECIAL ECONOMIC ZONES

Cambodia has been preference-receiving by developed countries and ASEAN countries; export, duty-free goods, the beneficiaries can be summarized as follows :

- ASEAN Integration System of Preferences (AISP)
- Beneficiaries in quota and tariff treatment for selected agricultural products
- Beneficiaries under ASEAN Trade in Goods Agreement (ATIGA)

Sisophon has geographically Poipet cross-border and Poipet O'Neang special economic zones as front gate for transport goods to Siem Reap and Phnom Penh which are the vital economic zone of the Kingdom of Cambodia. Majority of trade and investment is imports and exports to domestic consumers; therefore several transportation and distribution activities existed within Sisophon which operated by local entrepreneurs and investors from Phnom Penh. Cambodia has provided investment promotion for investment in Poipet O'Neang special economic zones investment incentives in zone, such as tax incentives (**Table 2.1**).

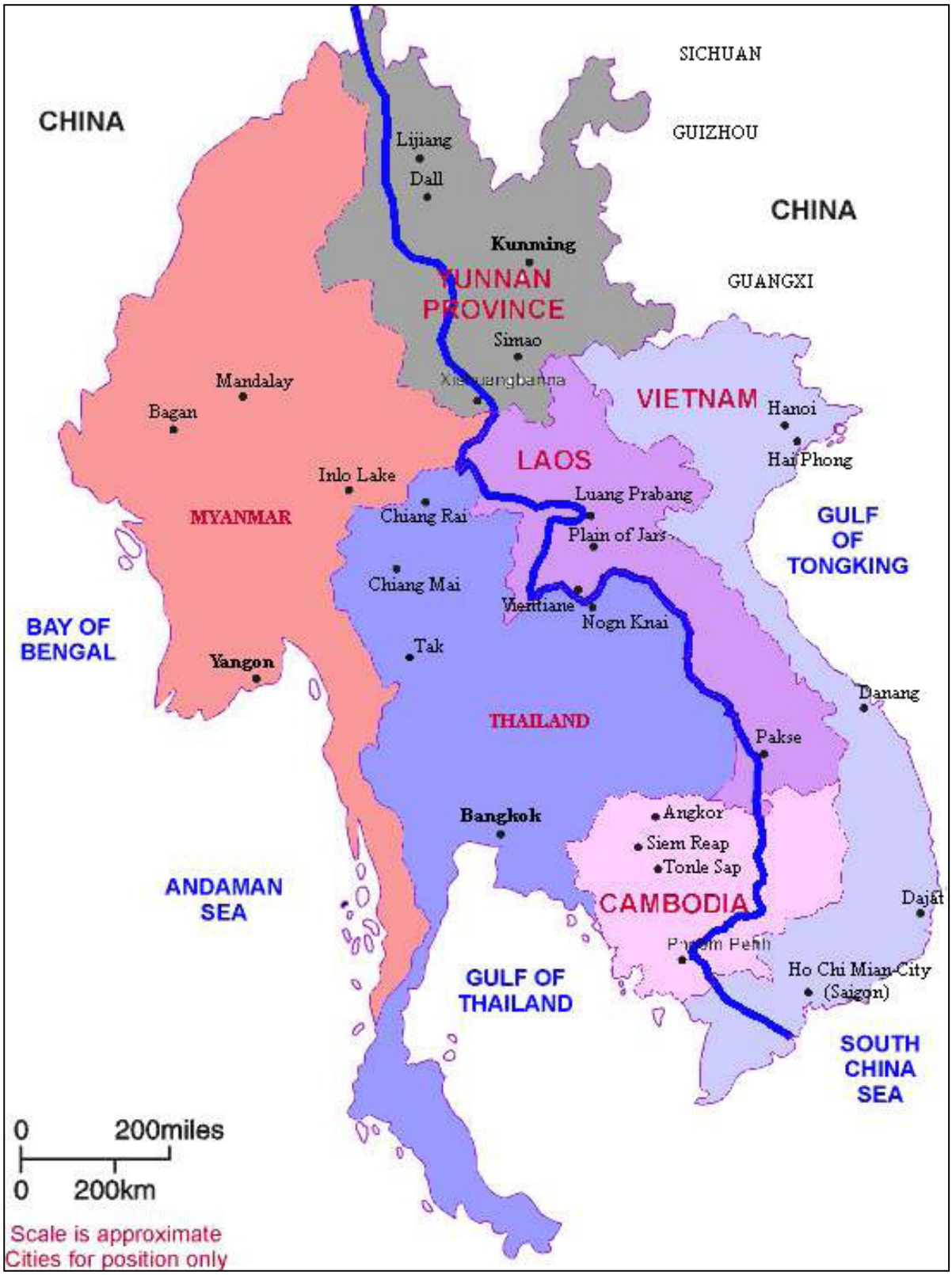

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Figure 2.2 ACMECS Member Countries Map

Table 2.1 Investment Incentives

Beneficiary	Investment incentives
Zone developers	- The maximum exemption period of 9 years - The import of equipment and construction materials to be used for infrastructure construction in the zone shall be allowed and exempted of import duties and other taxes. - The Zone Developer may obtain a land concession from the State for establishing the SEZ in areas along the border or isolated region in accordance with the Land Law
Zone investors	- The same incentives on customs duty and tax as other Qualified Investment Project shall be entitled. - The Zone Investor entitled to the incentive on Value Added Tax (VAT) at the rate of 0% except Production Outputs are imported into the domestic market. Zone Investor shall refund the amount of Value Added Tax as recorded in comparison with the quantity of export.
Common	- Zone developers, investors or foreign employees have the right to transfer all the income derived from the investment and salaries received in the zone to banks located in other countries after payment of tax. - Non-discriminatory treatment as foreigners, non-nationalization and no-fixing price.

Source: Royal Thai Embassy, Phnom Penh, Cambodia (2012)

2.6 SPECIAL ECONOMIC ZONE DEVELOPMENT IN ARANYAPRATHET, SA KAEO PROVINCE

Sa Kaeo Province is located along the Southern Economic Corridor, directly linked to Southern Vietnam. Aranyaprathet is significantly important border trade between Thailand and Cambodia; served as consolidation center and travel trade activities. Meanwhile, it can develop a Special Economic Zone for industrial energy plants and processed fisheries products such as ethanol production, electronic components, and shrimp production by employed lower wage workers from Cambodia. In addition of provide special workplace for foreign workers.

Therefore, a reasonable approach is the integration of economic activities using Special Border Economic Zone as Supply Chain Network, imported materials for the base production that not require high production skills, but demanding labors. Preliminary processing in the Poipet O' Neang Special Economic Zone continued to Battambang. While Aranyaprathet will be the skills labor manufacturing in packaging design and require advanced technology or highly accuracy equipment for processing those products, and import into the east of Thailand (**Figure 2.3**).

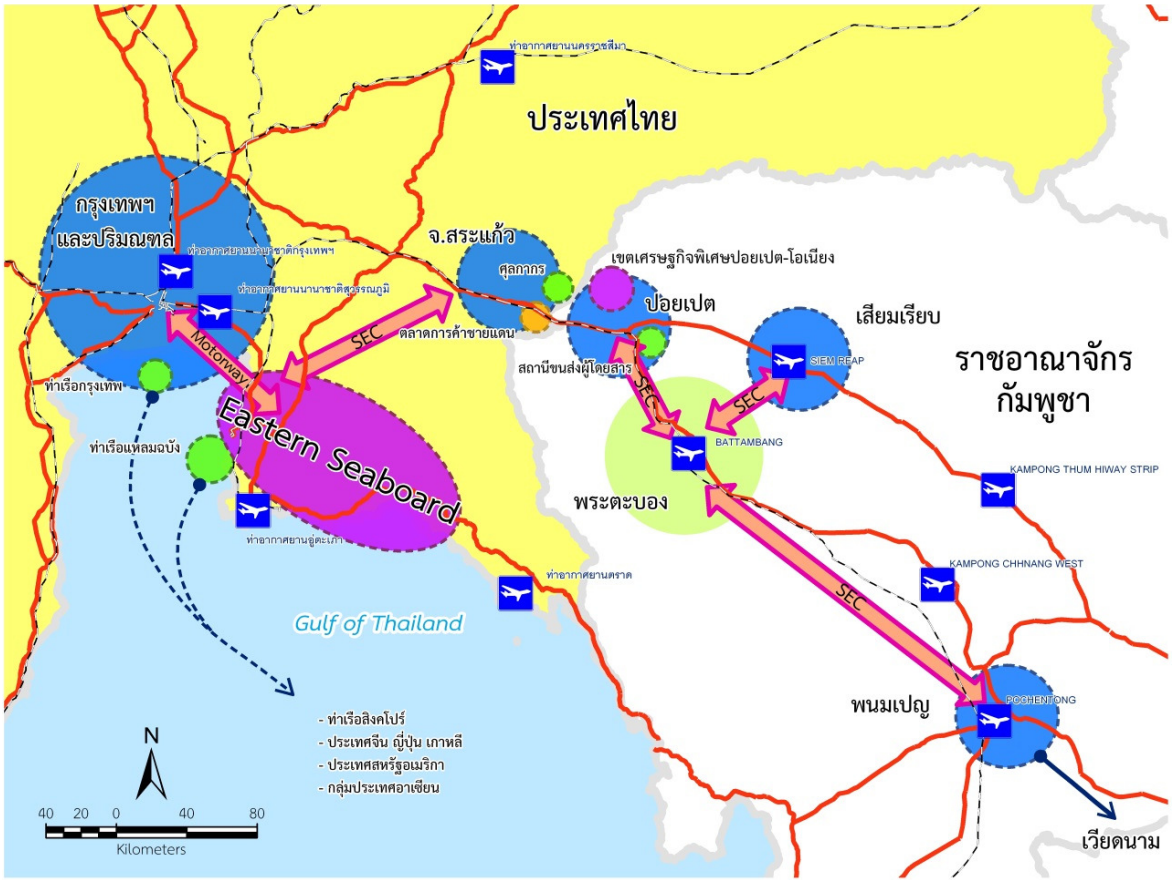


Figure 2.3 Activities linking in the target area Aranyaprathet, Sa Kaeo Province

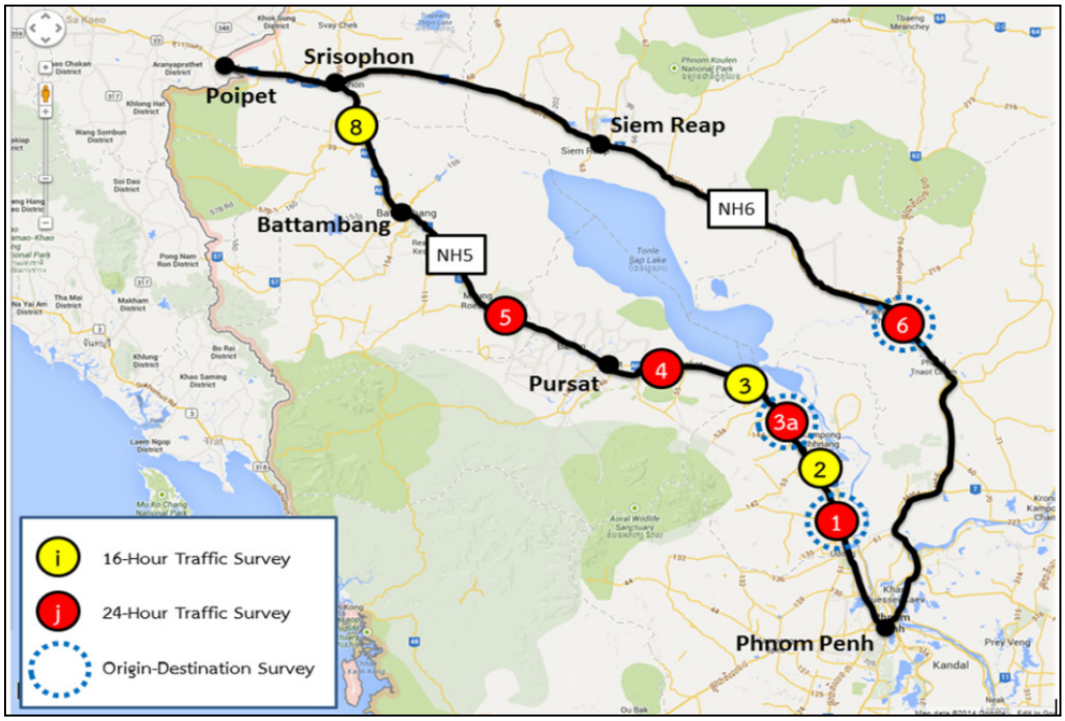
2.7 LOGISTICS SYSTEM, COMMUNITY PLAN OF PROJECT TO SUPPORT BORDER CROSSING

Department of Public Works and Town & Country Planning, Sa Kaeo had considered the importance of area development responding to the provincial development policy as trade gateway to South Vietnam, Cambodia and Thailand along South Economic Corridor (SEC) under Greater Mekong Subregion (GMS) cooperation. The community logistics will be developed to support logistics in the border crossing (2012). The vital objective is to create development plan of border community and land use, including infrastructure, transport management in Aranyaprathet.

2.8 LOGISTICS DEVELOPMENT IN CAMBODIA

The Ministry of Public Works and Transport, Royal Government of Cambodia was supported by the Japan International Cooperation Agency (JICA) to study and plan development project for transport infrastructure and logistics of the country "Overview on Transport Infrastructure Sectors in the Kingdom of Cambodia" (2010). The report includes a review of the basic infrastructure from the past to the present including the preparation of development plans of transport infrastructure in the future for instance, development of road, rail, marine, air and border transport.

Continuously in 2012 the Organization for International Cooperation of Japan (JICA) conducted a study traffic volume on Highway 5 (NR5), in total of 8 points, as shown in **Figure 2.4**, and the traffic volume survey was showed in **Table 2.2**.



Source: Japan International Cooperation Agency, 2012

Figure 2.4 Study Point on the National Highway 5

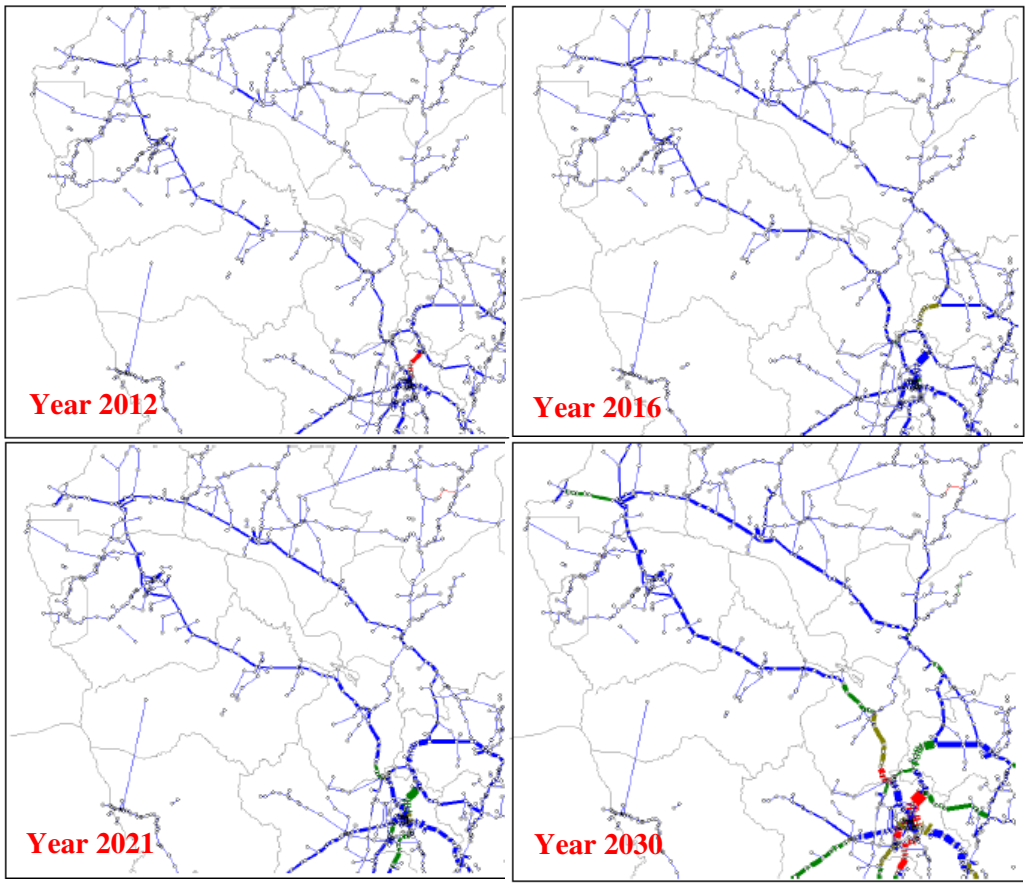
Table 2.2 Traffic Volume on National Highway 5 in Cambodia, 2012

Location	MC	LV	HV	Total	PCU
1	5,727	3,788	1,285	10,800	10,308
2	5,637	2,964	1,096	9,697	8,684
3a	15,947	3,569	1,204	20,720	12,857
3	3,303	2,123	943	6,370	6,474
4	867	1,738	910	3,514	5,162
5	1,583	1,660	1,189	4,432	6,117
6	2,873	2,470	895	6,239	6,635
8	3,897	2,282	776	6,955	6,350

Source: Japan International Cooperation Agency

Note: MC Motorcycle (unit: volume/day)
LV Light vehicle 4 wheels car or mini truck (unit: volume/day)
HV Heavy vehicle (unit: volume/day)
PCU Private Car Equivalent Unit; traffic volume equivalent light car (unit: PCU/day)

In spite data from field surveys, JICA had developed a model to forecast the traffic volume in the year 2016, 2021 and 2030 as shown in **Figure 2.5**



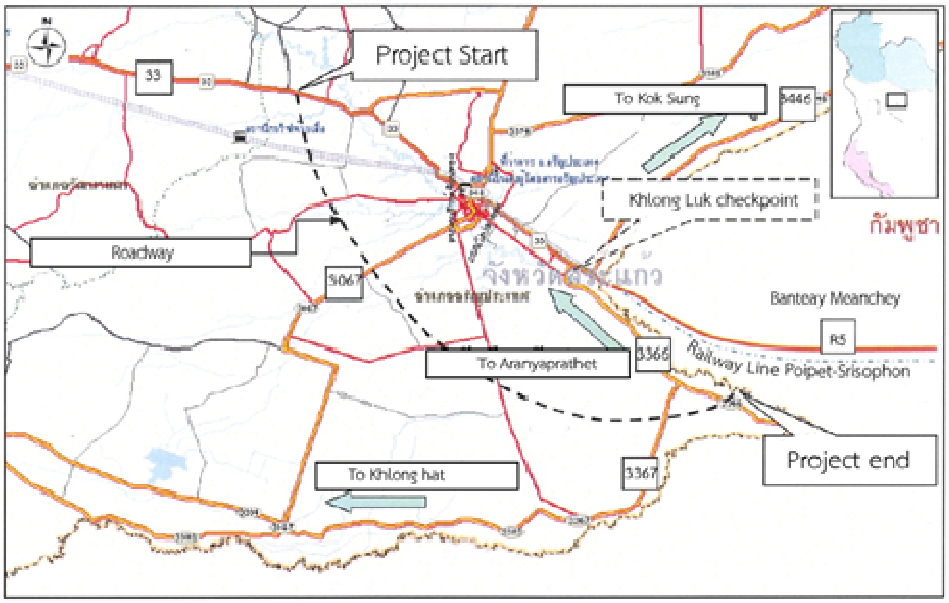
Source: Japan International Cooperation Agency, 2012

Figure 2.5 Estimated Traffic Volume in 2016, 2021 and 2030

2.9 SURVEY AND DESING OF NETWORK LINKS NONG-IAN CROSS BORDER, DEPARTMENT OF HIGHWAY

In the fiscal year 2014, the Department of Highways have studies and designed the highways network links Ban Nong Ian – Stung Bot cross border to improve potentiality of new border crossing and mainly support import- export activity.

Initially, National Highways links Nong Ian – Stung Bot originate in National Highway 33 southward to Aranyaprathet district through Eastern Railroad, take Highway No. 3067 heading southeast intersect Rural Road SK No.4001, Highway No.3367, Highway No. 3511 and Highway No.3366 to Phrom Hot which is boundary between Thailand and Cambodia in Ban Nong Ian, Thakham sub-district, Aranyaprathet district, Sa Kaeo (**Figure 2.6**).



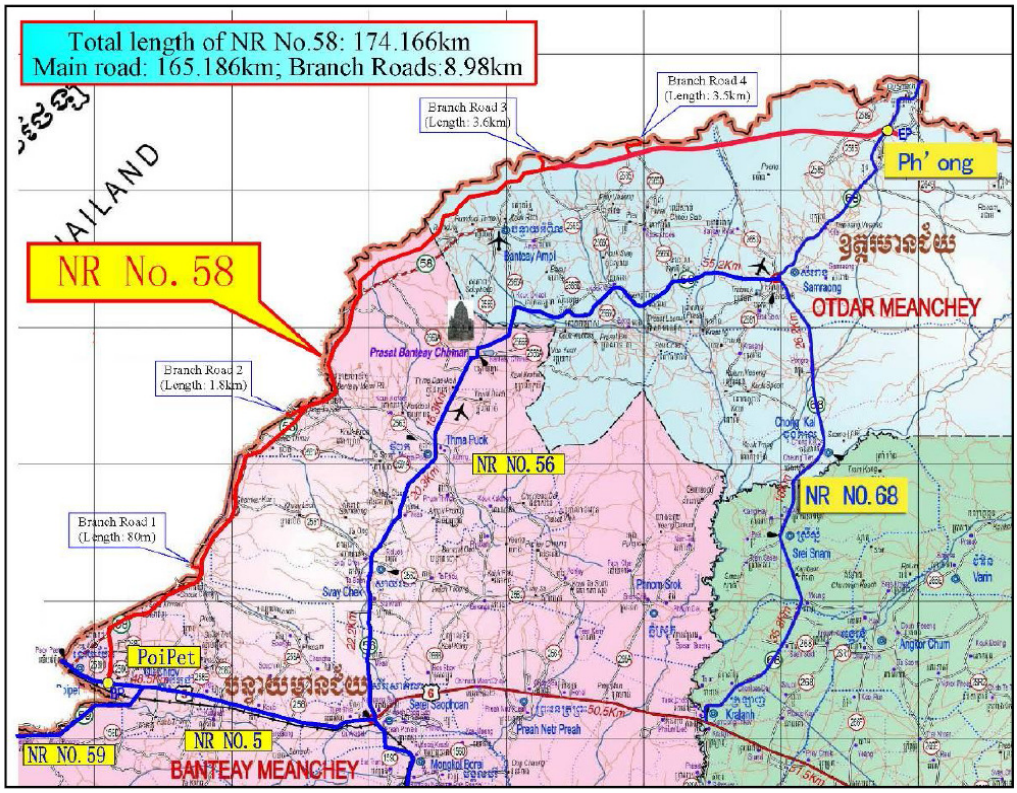
Source: Survey and design highway network links Nong Ian-Stung Bot cross border, Department of Highway 2014.

Figure 2.6 Highway Network Project Links Nong Ian- Stung Bot Cross Border by Department of Highway.

2.10 DEVELOPMENT OF NATIONAL ROAD NO. 58 (NR58)

Ministry of Public Works and Transport of Cambodia plans to reconstruct the National Road No.5 8 and collaborates with Chinese government studying "Feasibility Study Report on Reconstruction Project of National Road No.58 in Cambodia, finish by June, 2014. The traffic lane was designed in 2 traffic lanes with 3.5 meters wide each, include 1.5 meter of sidewalk, asphalt pavement. The traffic lane including Refuge Island and sidewalk is 30 meters wide. The road stretches from NH5 at Krong Paoy Paet, Banteay Meanchey province, which shares an international border with Thailand, to neighboring Samraong, Uddor Meanchey province to the east. The distance of 174-kilometer road will be constructed with 4 Spur Route (1-4 kilometers) stretch to Cambodia-Thailand border **(Figure 2.7 and 2.8)**. The road is cost approximately 122 million U.S. dollars.

The project will be support of soft loan from China. The construction is expected to be completed in August 2018. The construction would be very important to facilitate special economic zone development in northwest of the country. In 2018, the NR No.58 is expecting to facilitate 853 PCU/day and increase continuously to 3,320 PCU/day by 2032.



Source: Feasibility Study Report on Reconstruction Project of National Road No.58 in Cambodia, 2014

Figure 2.7 Reconstruction Project of National Road No.58 in Cambodia

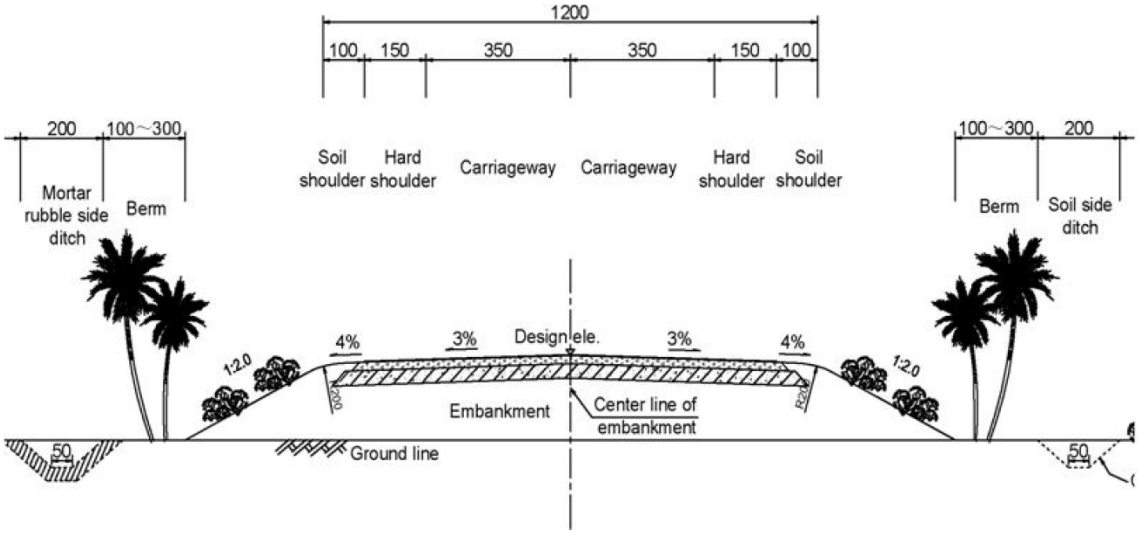


Figure 2.8 Cross Section of National Road No. 58, Cambodia

2.11 POLICIES AFFECT STUNG BOT

The Stung Bot border crossing has been agreed under the international agreement to minimizing problem in the area, congested of border using, including benefit in trading, and transportation. Additionally, long development plan in mentioned agreement correspondingly support Stung Bot development (**Table 2.3**).

Table 2.3 Plans and Policies on Project Development

Development Plan	Benefit (Supporting Stung Bot development)	Briefly detail
AEC	• Single market and common production • Improve capacity in ASEAN competitiveness • Economic development • Integrate into world economic	Support a free, open, transparent and integrated investment regime, including reducing goods tariff
Thailand Economic cooperation with neighboring countries In Indochina region: GMS	• Infrastructure • Transport and Logistics • Production and agriculture • Tourism and services • Services and Logistics • Regional competitiveness • Public service	Support and invest in infrastructure to enhance the transportation system among GMS nations. Stung Bot border is in South Economic Corridor of GMS development plan.
Ayeyawadee -Chao Phraya - Mekong Economic Cooperation Strategy: ACMECS	• Production and agriculture • Tourism and service	Enhance agricultural processing from Thailand to Cambodia
Special Economic Zone development, Cambodia	• Production and agriculture • Services and Logistics	Support investment in Cambodia for advanced processing in Thailand or export through Laem Chabang Port.
Greater Mekong Subregion Cross-Border Transport Agreement (GMS-CBTA)	• Services and Logistics • Transport and Logistics	Support Stung Bot Cross-Border in border transport, transportation, custom ceremonies, or border trade to third nation
Special Economic Zone Development in Aranyaprathet, Sa Kaeo Province	• Manufacturing and agriculture • Services and Logistics • Transport and Logistics	Integrate economic activities using Special Border Economic Zone as Supply Chain Network to attract more investment in production, goods collection & distribution, and border trade.

CHATPER 3
SOCIO-ECONOMIC STUDY

3.1 SPATIAL ANALYSIS IN SOCIO-ECONOMIC AND POPULATION STRUCTURE IN KINGDOM OF CAMBODIA

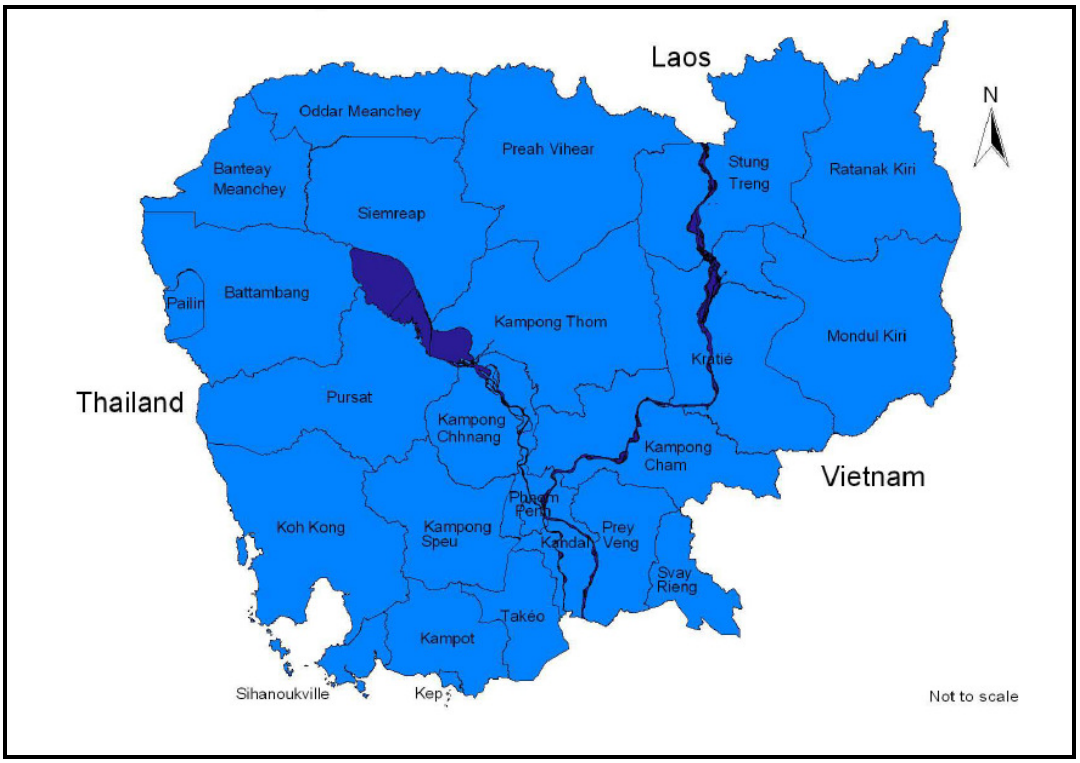


Figure 3.1 Kingdom of Cambodia

1) Infrastucture

Cambodia has total landmass of 181,035 square kilometers or (3 times smaller than Thailand's landmass). The kingdom borders to Thailand extends from north to south of approximately 803 kilometer as be shown in **Figure 3.1**.

2) Population

Cambodia has population of approximately 13.4 million with similar ratio of male and female is 6.5 to 6.9 million respectively. Cambodia population is increases by approximate 1.54 annually which is highest portion compares to 1.3% annually population increase of averaged Southeast Asia (Thailand is 0.5% annually population increase) as be shown in **Figure 3.2**.

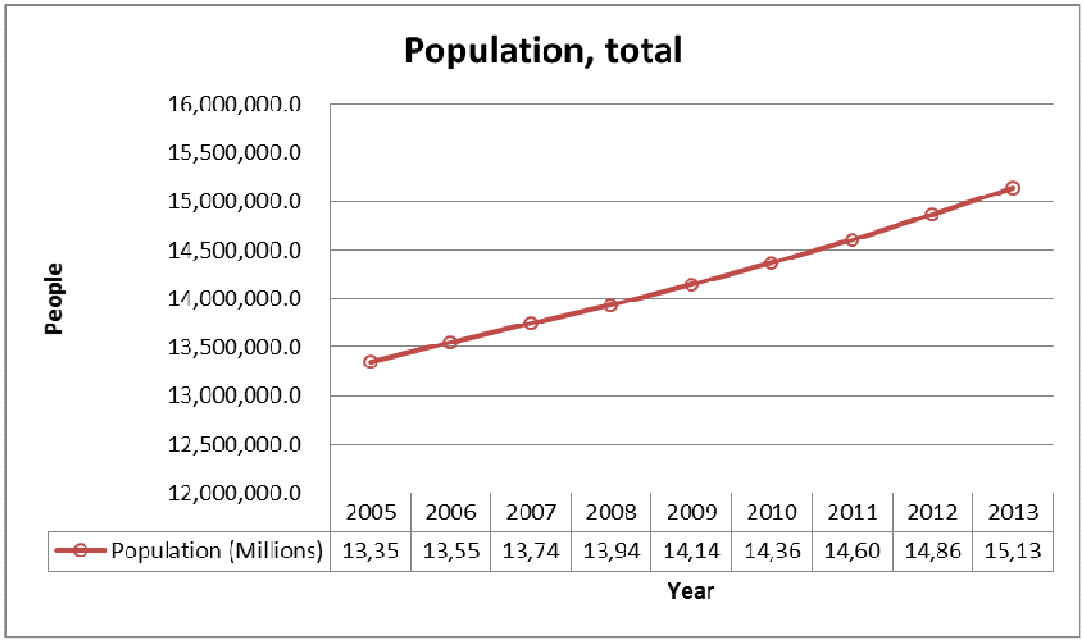


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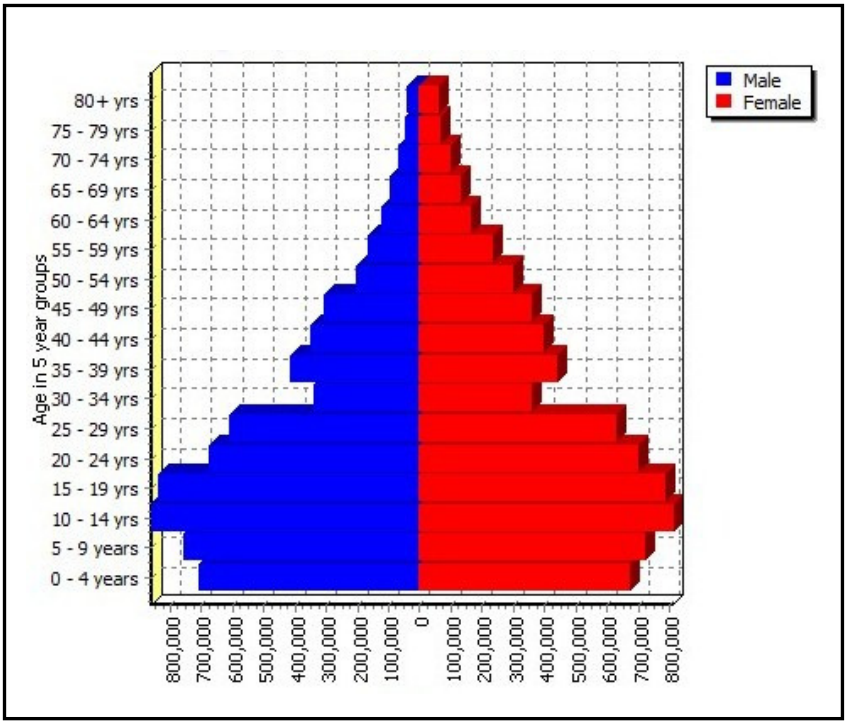
Figure 3.2 Total population of Cambodia, 2003-2013

3) Family structure

In 1988 the average household size of Cambodia had been steadily decreased from 5.2 to 4.7 persons per household. In 1998, the division in the urban and rural district lowered from 5.5 to 5.0 and 5.1 to 4.6 persons per household respectively. In the past Cambodian family adopt the extended family system. Currently nuclear families have been rapidly adopted, regarding economic effeteness.

4) Population structure

The Age structure of Cambodia reveals the great portion of labor force age 15-64 years accounts of 63.8% compete to not in the labor force of age 0-14 years calculated as 32.6%, and the ages 65 and over as 3.6%. Country birth rate is counted of 25.3 infants per 1,000 populations, whereas death rate is calculated of 8.08 died person per 1,000 populations and life expectancy at birth is 62.1 years **(Figure 3.3).**



Source: National Institute of Statistics of Cambodia, 2008

Figure 3.3 Populations Structure of Cambodia

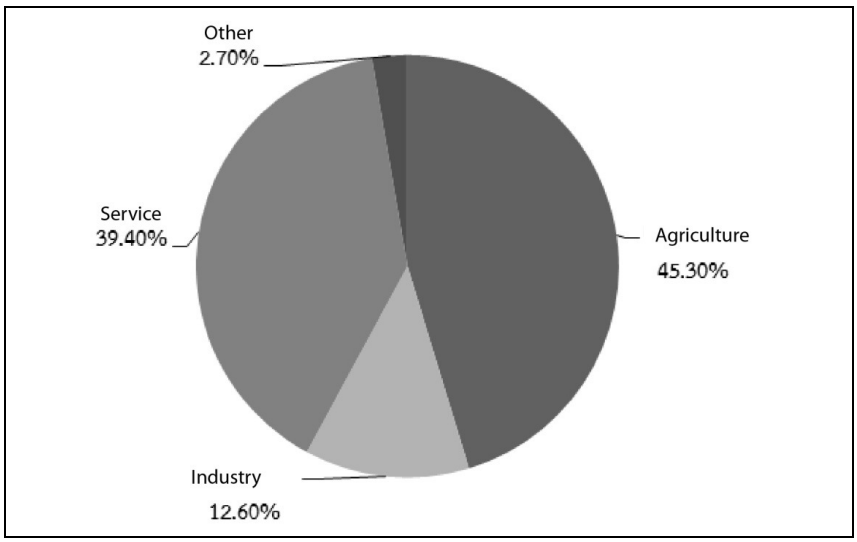
5) Economic

Between the years of 2004-2007 Cambodia economic has rapidly increased 10% annually. Value economic of Cambodia are garment industry, construction, and agriculture sectors. The global economic crisis during 2008-2009 directly affect Cambodia economic growth rate. Not long after the time Cambodia is back to the track, in 2010 and 2011 economic has been improving to 5.96% and 6.09 % in the following year.

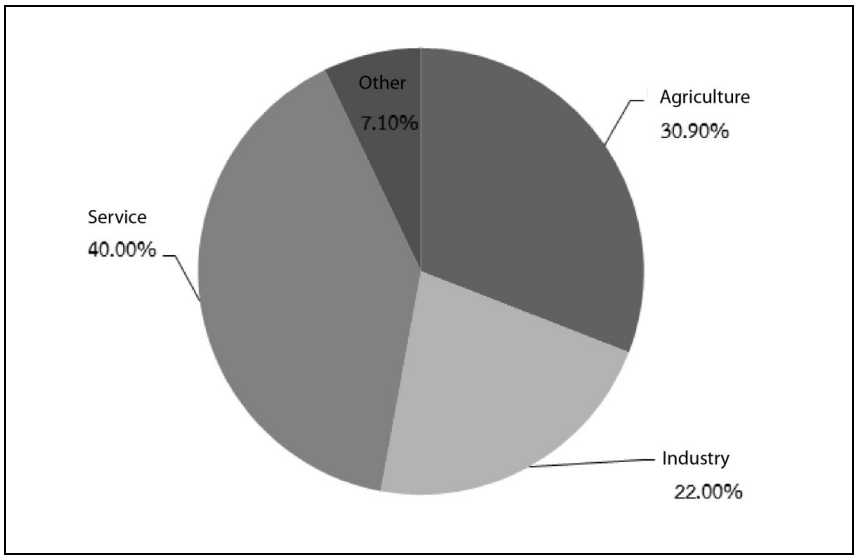
The garment industry represents the largest portion of Cambodia's manufacturing sector, accounting over 70% of the country's export which employs over 320,000 workers or accounts as 5% of labor force within Cambodia.

Cambodia's Gross Domestic Product (GDP) adversely grow, agriculture share the most portion of 45.30% and decrease to 30.9% in 1993 and 2011. In the other hand of industrial sector with dramatically increased from 12.60% to 22% in 1993 and 2011 and service sector from 39.40% to 40% respectively **(Figure 3.4)**.

Manufacturing Sector of Cambodia, 1993



Manufacturing Sector of Cambodia, 2011



Source: Chap (2011); Global Finance (2012)

Figure 3.4 Production Structure in Cambodia, Compare in 1993 and 2011

6) Electricity supply

In the year 2010, Cambodian amount of electricity provided over 2,515,670 million kilowatts to supply across country, with half imported from Vietnam 1,162,028 million kilowatts accounted of 46.19% and 385,278 million kilowatts accounted for 15.32% from Thailand. Noteworthly Cambodia promoted energy strategic plan to reduce dependence on imports electricity sectors, by using water power plant which mainly cooperated and invested from China. With current electricity supply capacity Cambodia has produced as much as 968,364 million kilowatts or accounted for 38.49%. Remain demand more electricity supply in investment sector which is increasing over time. Electricity supply development in the future will result an increase in the local population access to electricity and encouraging investors toward the country.

7) Water supply

Cambodia is one of the least urbanized countries in Southeast Asia with over 80% of people living in rural areas, has lowest sanitation coverage and the second lowest water supply coverage in the region. Recently, authority embraces bilateral and multilateral donors, including foreign funding, international among ASEAN and private sector funding. Phnom Penh Water Supply Authority guarantees development of water supply standards which meet the satisfied by leading invested companies in the country. By the year 2009, Cambodia supplied water to industry sector of over 6,976,346 m^3 or covers 2,755 factories across nation.

3.2 BAN KHLONG LUK-POIPET CROSS-BORDER TRADE ANALYSIS

1) Cross-Border trade information

Overview of cross-border trade of Sa Kaeo Province, Thailand and Banteay Meanchey Province, Cambodia (or Ban Khlong Luk-Poipet cross-border) established the highest economic value compared to the rest of cross-border trade. The shipment value from Thailand to Cambodia had growth in previous 5 years of 24.76% or five years gross value of 181,055 million baht. And the shipment value from Cambodia to Thailand had as well growth in last five years of 45.56% representing a total value of 25,659 million baht. Total shipment value of border trading establihsed 27% growth rate or a total value 206,713 million baht. Important products that Thailand exports to Cambodia are internal combustion engine and machineries, motorcycle and machineries, cosmetics, perfume and soup, animal feed, car and machinery. Otherwise the products, Cambodia exports to Thailand are including steel, aluminum and scrap of paper and garments. (Figure 3.5)

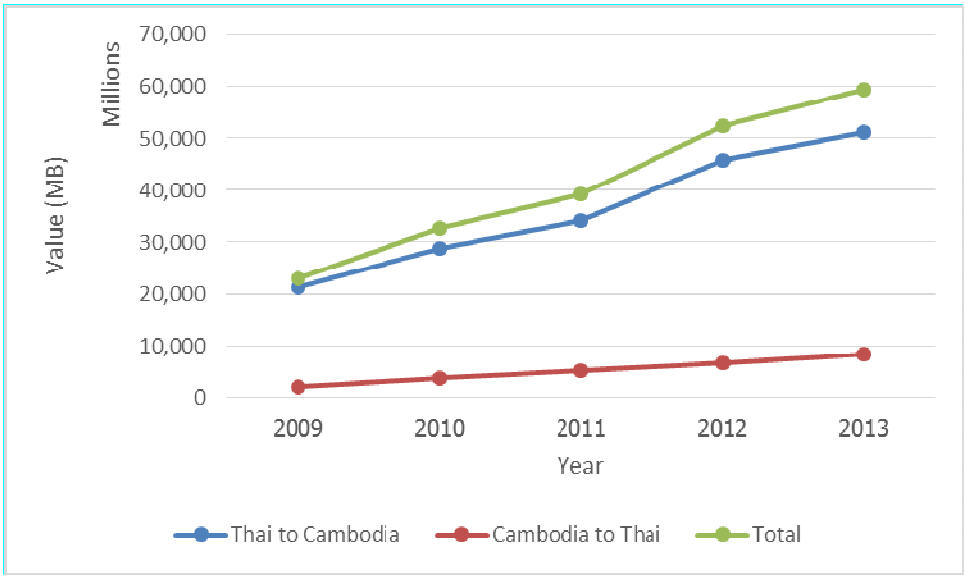
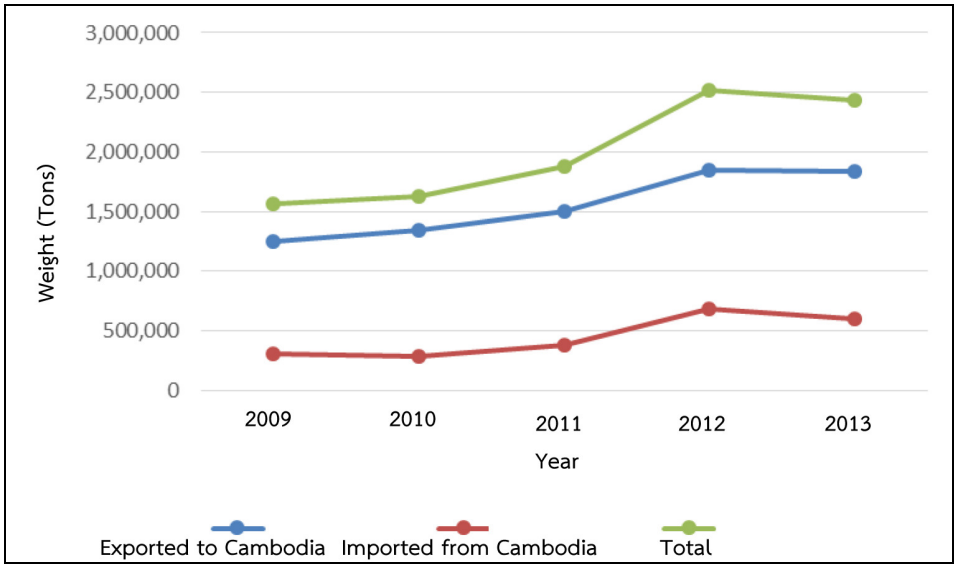


Figure 3.5 Total Shipment Valuve of border Trading Across Ban Khlong Luk – Poipet Cross-Border 2009-2013

Additionally, the amount of goods weiht that Thailand exported to Cambodia had growed in previous 5 years as 10.06% or represented amount of total weight of 7 ,773,05 tons. Otherwise the goods weight that Thailand imported from

Cambodia had been dramatically growed as 17.72% or total of 2,252,093 tons by weight of total volume of border trade which had growth rate of 11.71% or representing the goods weight of 10,025,148 tons in 5 years (**Figure 3.6**).



Source: Aranyaprathet, Customs Facilitation, 2013

Figure 3.6 Goods Amount (Weight: tons) Across Ban Khlong Luk-Poipet Cross-Border, 2009-2013

Estimated the trucks size had conducted by calculate assumption the use of 2 axles, 4 wheels (5 axles with 18 inches-tires) Semi-trailer transport with maximum weight of 45 tons. In 5 previous years had recorded that average daily transport volume of 95 transports per day, the average daily transport volume from Cambodia to Thailand was 27 transports per day or transport volume crossings border per day was an average of 122 transports per day (**Figure 3.7** and **3.8**).

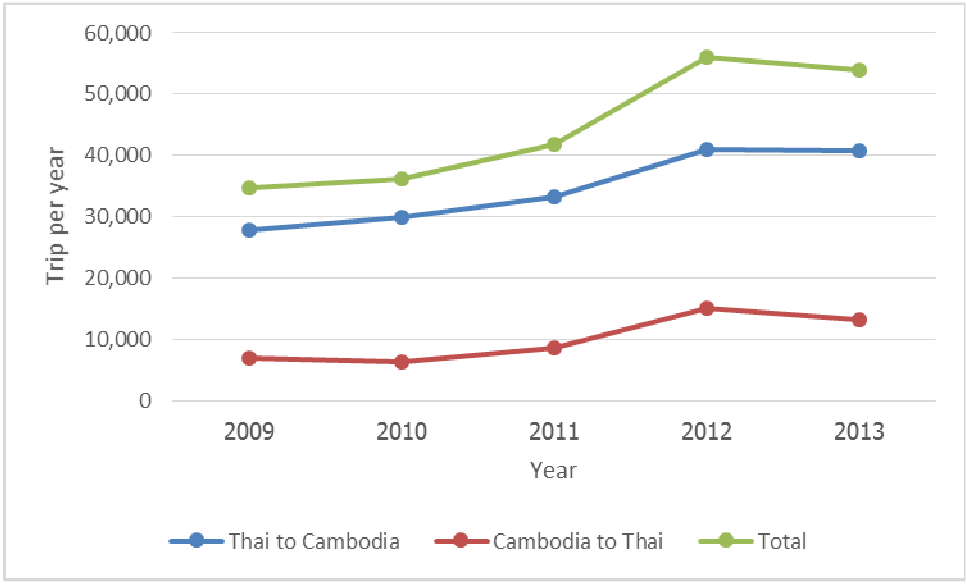


Figure 3.7 Transport Volumes, Semi-Trailer of 2 Axles, 4 Wheels (5Axles with 18-Inches Tires), Maximum loaded 45 Tons Average Volumes (year), 2009-2013

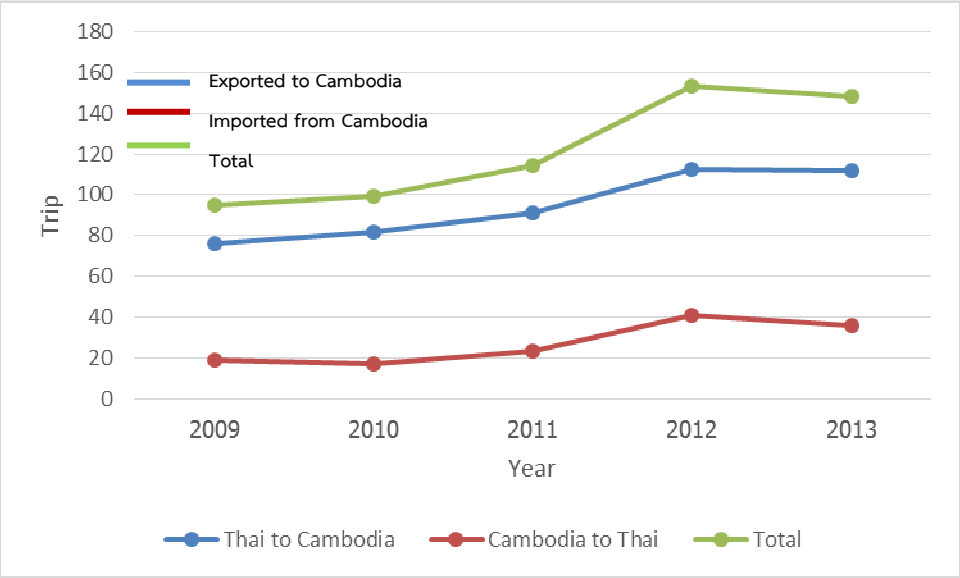


Figure 3.8 Transport Volumes, Semi-Trailer with 2 Axles, 4 Wheels, (5 Axles with 18-Inches Tires), Maximum Loaded 45 Tons Average/day, 2008-2013

2) Conditions for the forcasting cross-border trade

Conditions	Action plan
Information	Quantity and value of imported and exported goods statistics from Aranyaprathet, Customs Facilitation, Thailand
Transportation	• Semi-trailer: 2 axles, 4 wheels (5 wheels, 18 inches-tire) maximum loaded 45 tons according to the border crossing design requires container area
Analysis	Linear Regression Analysis to 2043, on the assumption of growth rate and forecasting results using data from 2009 - 2013.
Forcasting unit	• Value (million Baht) • Amount (Weight: tons)
Limitation	• Growth rate by using the total value and volum (per year) • Regardless of the 3rd cross-border trade • Excluded predicted information during the year or data that is affected by season (Seasonal Index) • Un-devided goods type for each industry • The calculation of transport per transport through cross-border exclude the amount of freight per transport in case of any activity that is not used standard trucks to freight • The amount of freight in each case calculate the full loaded weighing allow for each types
References	• Economic Research Institute for ASEAN and East Asia (ERIA 2009) • Aranyaprathet, Customs Facilitation • The Acts: disallow the over loaded truck, Department of Highway (2009)

3) Result of cross-border trade analysis

Inferent information has retrieved from database in Thailand through simultaneously ongoing activities in cross-border. To complete the equation, the land uses have been estimated as below

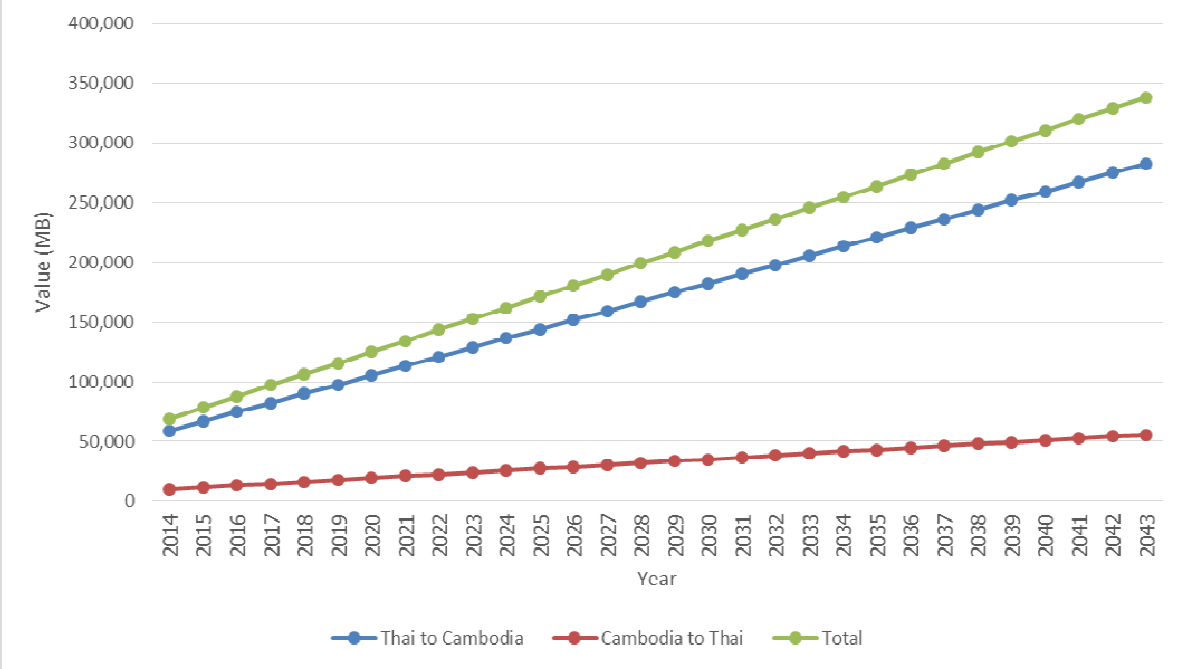


Figure 3.9 Estimated Ban Khlong Luk-Poipet Cross-Border Trade Value, 2014-2043

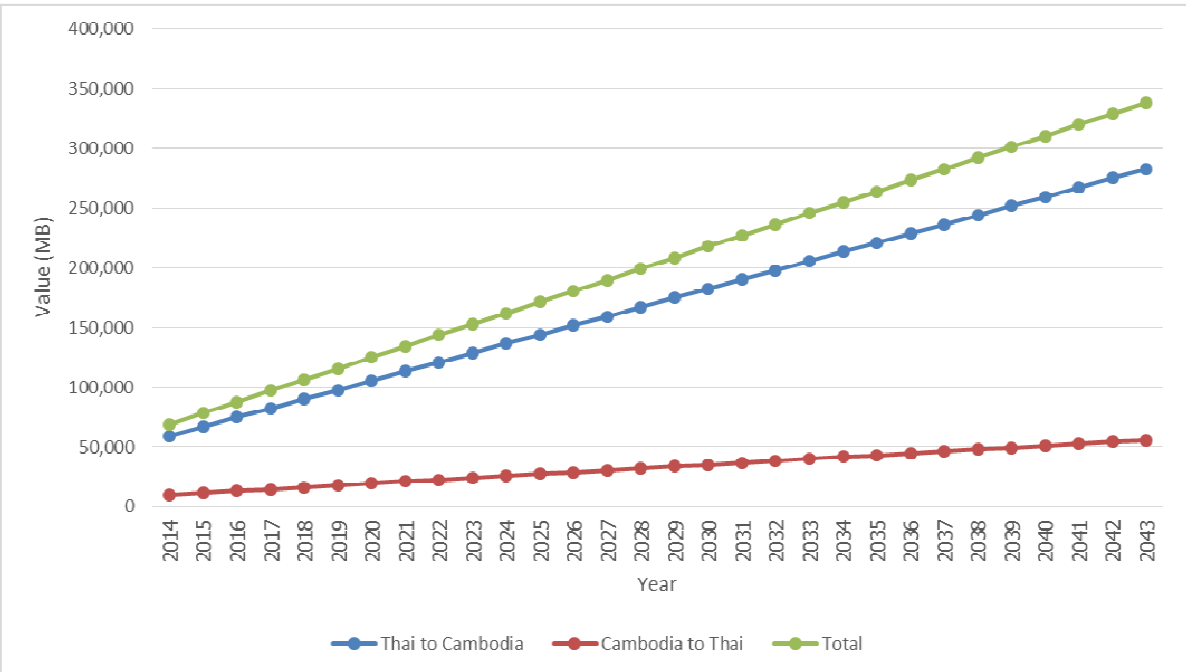


Figure 3.10 Estimated Ban Khlong Luk-Poipet Cross-Border Trade Amount (Weight: Tons), 2014-2043

Estimated growth rate of shipment value that Thailand exports to Cambodia is 47.75% or accounts as 5,129,424 million Baht during 2014-2043 or 30 years total. Whereas growth rate of shipment value from Cambodia to Thailand is worth as hight as 54.14% during 2014-2043 or a total value of 984,508 million Baht in 30 years total, with a total cross-border trade value of 48.71% or accouted of 6,113,932 million Baht in 30 years total (2014-2043).

In addition, it able to estimate the amount of goods weight (tons) from Thailand to Cambodia happening during the years 2014-2043 with a growth rate of 35.34%, representing a 30 years total (2014-2043) amount (weight) of 134,274,672 tons. Whereas weight of goods from Cambodia to Thailand has been estimated growth rate as 47.84% or 64,049,411 tons gross weight in 30 years total (2014-2043). Total amount of goods across border trade has been estimated of 38.98% (during 2014-2043) or as high as 198,316,906 tons in 30 years total (2014-2043).

The shipping estimation has been conducted by calculate assumption that use of truck with 2 axles, 4 wheels, (5 axles with 18 inches-tire) transport with maximum weight of 45 tons resulting average daily transport volume (shipping) export from Thailand to Cambodia of 420 transports per day in 2043. And the average daily transport volume from Cambodia to Thailand as 215 transports daily (2043) or total estimated transport volume crossings border is an average of 635 transports per day in 2043 (**Figure 3.11** and **3.12**).

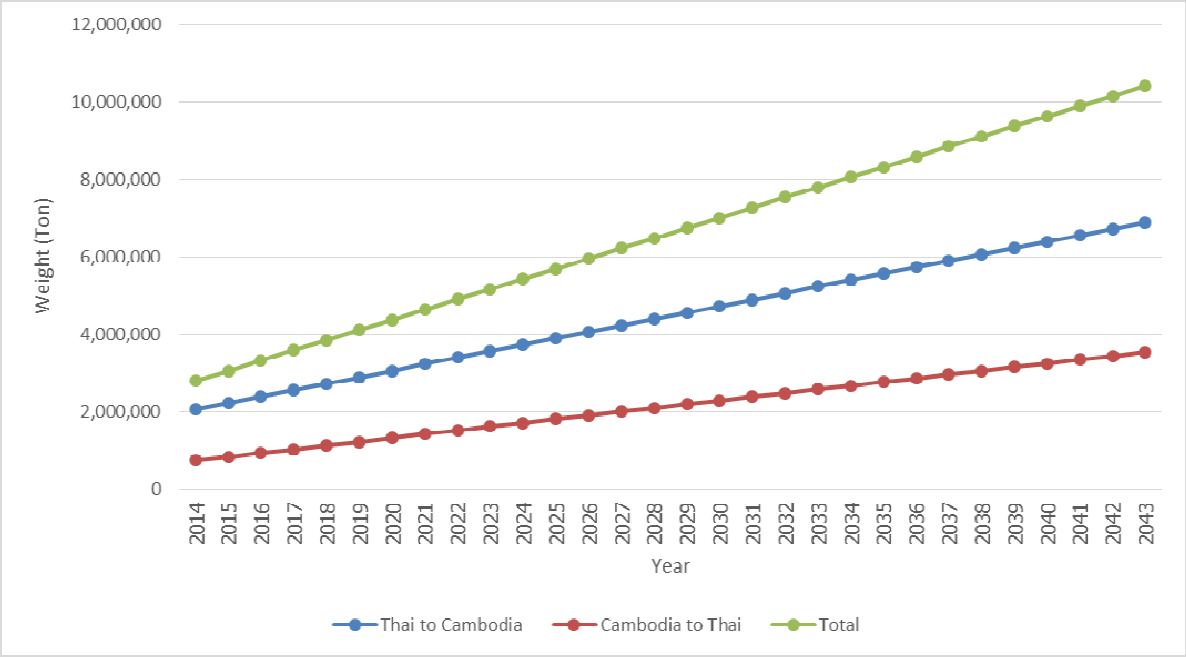


Figure 3.11 Estimated Tranport Volume of Semi-Trailer With 2 Axles, 4 Wheels, (5 Axles, 18 Inches-Tire), Maximum Loaded 45 Tons Average Transports (Year), 2014-2043

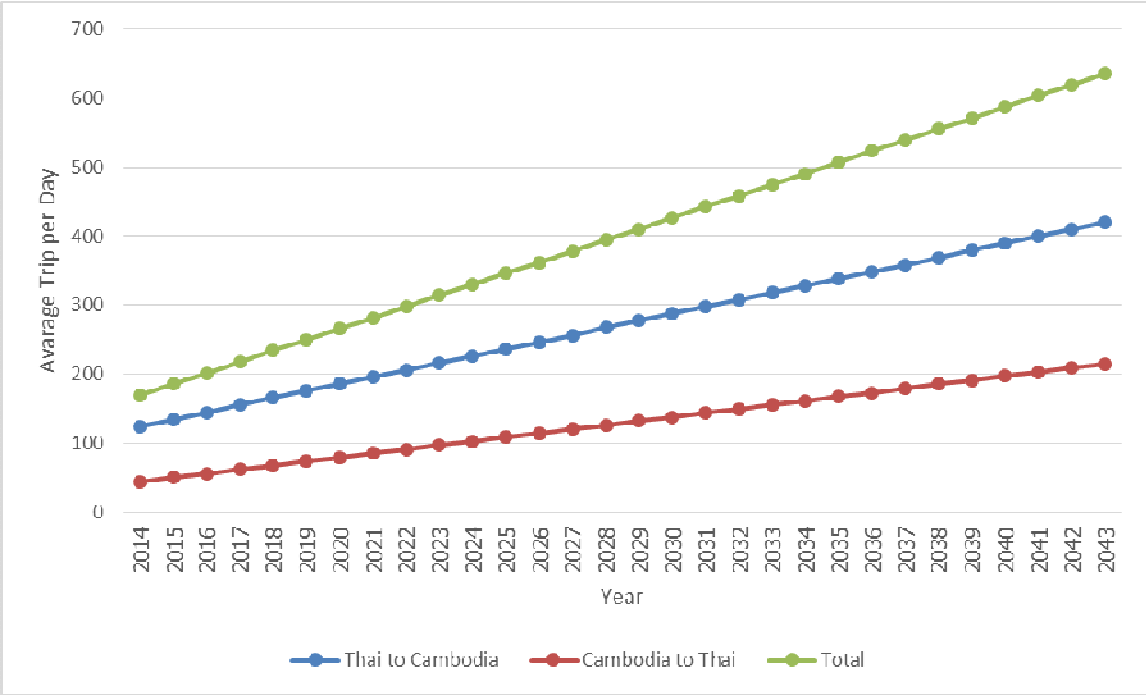


Figure 3.12 Estimated Tranport Volume of Semi-Trailer with 2 Axles, 4 Wheels, (5 axles, 18 inches-tire), Maximum Loaded 45 Tons Average Transport/day, 2014-2043

3.3 SUMMARY AND DESIGN SUGGESTION

According to the estimation able to analyse information and design container yard as below :

Table 3.1 Terms Defined Container Yard in the Analysis of Cross-Border Trade

Information	Year 2043
Truck	Semi-Trailer With 2 Axles, 4 Wheels, (5 Axles, 18 Inches-Tire), Maximum Loaded 45 Tons
Container Equivalent Unit	Forty foot Equivalent Unit (40 foot length, 8 foot width, 9.6 foot height)
Total transport	635 transport per day
Forty foot Equivalent Unit	635 containers per day
Storage time in container yard	Containers are not taken out of the Customs area, not be entitled the load at 3 days
Collect containers in the container yard	45 to 90 minutes
Stacking of Forty foot Equivalent Unit	Over 10 stackings or depend on cranes capacity
Stacking of Contianer yard Equivalent Unit	Not exceed 3 stacking or depend on cranes capacity

According to term defined of container yard able to conclude that by the year 2043 has expected of a 40-foot container equivalent unit total of 635 containers, turnover of not more than 3 days with entitled the load of 3 days. The container turnover is set not exceed 90 minutes depending on facilities. In 2043, one day equivalent able to stack as 3 days maximum as 1,905 containers with 3 stackings or container yard equivalent of 635 containers per day. Considering the container yard area is excluded pavement which requires an area of 203,200 square feet or 18,888 square meters or the area of 12 rais. The designed area is exclude cranes or lifting area and pavement/routes within the container yard.

CHAPTER 4
TRAFFIC AND TRANSPORTATION STUDY

Currently, Khlong Luk - Poipet crossing checkpoint is incapable enlarging transportations and transport infrastructure, including increasing of boarding of Thai and Cambodian. Unapproachable expanding of Khlong Luk-Poipet border crossing which is available for transfer the transport infrastructure and heavy truck to new checkpoint, Nong Ian-Stung Bot. The new crossing checkpoint Nong Ian-Stung Bot is 5 kilometers distance from old Khlong Luk- Poipet. From the approach, need to study in travelling and transportation, crossing checkpoint transferring pattern, traffic and transportation management in crossing checkpoint and surrounding, including expected travelling and transportation in 20 years forward. These studies will be used to design Nong Ian-Stung Bot crossing as sufficient service providing in long run.

4.1 SECONDARY DOCUMENT AND LITERATURES COLLECTION

The secondary data had been collected from the survey and authentic sectors to analyse traffic impact consequent by implementation of Nong Ian-Stung Bot crossing check-point, collected information, review literature and synthesized information comprises of:

- **Import-export value at Aranyaprathet, Customs Facilitation**

  According to the Imports – export statistic through Aranyaprathet, Customs Facilitation in the 12 years earlier (year 2003-2014) found the overbalance value (export value over import value) and simultaneously grows, with average growth of 18% per year. In 2014, the import-export trade had total value of 70,893 million Baht or export value of 57,613 million Baht account of 81.3% of total trade, and import value of 13,280 million Baht represented 18.7% of total trade. Moreover only in the 1st quarter of 2015 had dramatically increase trade value to 22,470 million Baht with export value of 16,938 million Baht and import value of 5,531 million Baht represented 75.4% and 24.6% of total trade respectively. The trade value has 16.7% increased compare to the previous year. Detail import - export including the type of product has been mentioned in analysis and estimation of type and goods volume.

- **Review Studies on Logistics System, Community Plan of Project To Support Crossing Logistics**

  Department of Public Works and Town and Country Planning, Sa Kaeo be considerate in importance of developing area under development policy of Sa Kaeo commercial doors linked Vietnam, Cambodia and Thailand under the Southern Economic Corridor (SEC) in Greater Mekong Subregion Agreement. The authority had initiated the development of Logistics system and community plan to support crossing Logistics from 2012. Main objective was to develop border communities plan and land use, infrastructure including transportation supporting the Aranyaprathet border area development in the future.

  In this study, traffic volume and vehicle crossings at Khlong Luk- Poipet border crossing, including road network in Thailand have been surveyed, they are the main access by National Highway 3 3 (4 -lane road) and other alternative 2-lane roads network to access areas are:

1) National Highway No. 3366 interlinks Highway No.33 to Tha Kham sub-district.
2) Sa Kaeo National Road No. 4001 interlinks National Highway No.3067.
3) National Highway No. 3367 interlinks National Highway No.33 to Tha Kham sub-district and
4) Sa Kaeo Road No. 4078 and No. 4047 service within the area.

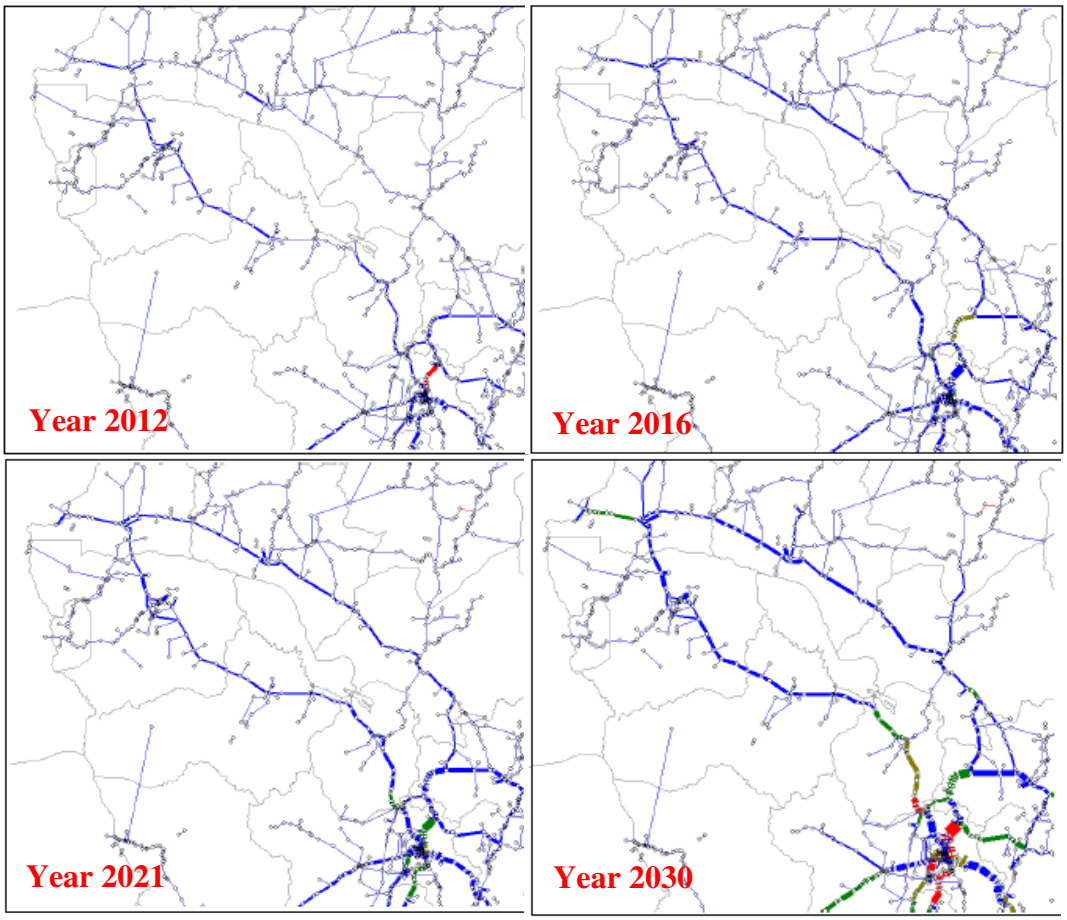
The traffic and transit study and analysis of the Khlong Luk permanent crossing found several problems in areas such as the congested traffic due to the sharing of cars and freight vehicles in the same road, around the checkpoint area has filled with waited freight cars on the inner left lane (operate on 10.00 hour), leave the another lane available for traffic. Apart from these, around the crossing and Rongkleu Market crowed with unorganized pedestrians and slow speed vehicle cross the road aggravate the worse traffic. To minimizing congestion of traffic, public transport should be organized in transport route, schedule and shelter.

Also, Khlong Luk permanent crossing locates nearby Rongkleu Market which is community and trading zone resulting in sharing between large and small vehicles for example motorcycles, bicycles and strollers. The accident rate was relatively high. Moreover pedestrians cutting the traffic flow are common in the area. There is no clearly set line on the road for pedestrians, small and large vehicle. Plus large volume of freight cars through crossing causes congestion and impacting network nearby.

- **Overview on Transport Infrastructure Sectors in the Kingdom of Cambodia**

  In 2 0 1 0 , the Ministry of Public Works and Transport, Royal Government of Cambodia was supported by the Japan International Cooperation Agency (JICA) to study and plan of transport infrastructure development and logistics of the country "Overview on Transport Infrastructure Sectors in the Kingdom of Cambodia" (2010). The report includes a review of the basic infrastructure from the past to the present including the preparation of development plans of transport infrastructure in the future which concludes of development of road transport, rail, marine, air and border transport.

  In spite data from field surveys, JICA had developed a model to predict the traffic volume in the year 2016, 2021 and 2030 **(Figure 4.1)**.



Source: Japan International Cooperation Agency, 2012

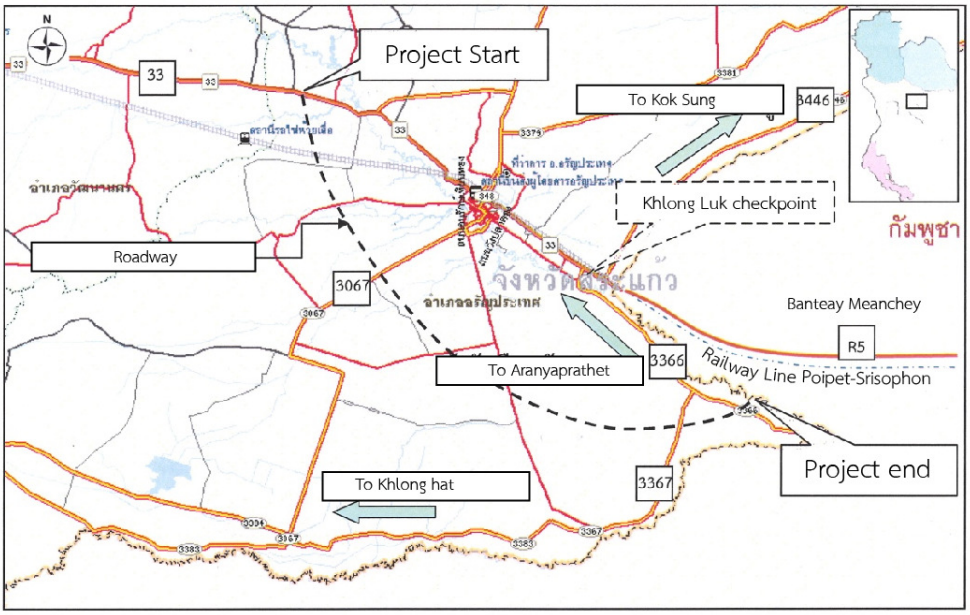
Figure 4.1 Predicted Traffic Volume in the Year 2016, 2021 and 2030

By the year 2016, opening year of the ASEAN Economic Community, regarding the study of JICA overall traffic volumes will astonishing increased by approximately 60% compare to the year 2012, whereas in 2021, or five years after the launch of the ASEAN Economic Community total traffic volumes will double increase compare to the year 2012.

- **Review survey and design of highway network links Nong-Ian Cross Border, Department of Highways.**

  Current (fiscal year 2014), the Department of Highways is in the process of hiring a consulting firm to study the highways network design links the Ban Nong Ian – Stung Bot cross border to improve potentiality of new border crossing and mainly support import- export activity. While Khlong Luk checkpoint is mainly for travelers and the local trade.

  Initially, National Highways links Nong Ian – Stung Bot originate in National Highway 33 southward to Aranyaprathet district through Eastern Railroad, take Highway No. 3067 heading southeast intersect Rural Road SK No.4001, Highway No.3367, Highway No. 3511 and Highway No.3366 to Phrom Hot which is boundary between Thailand and Cambodia in Ban Nong Ian, Thakham sub-district, Aranyaprathet district, Sa Kaeo (**Figure 4.2**).



Source: Survey and design highway network links Nong Ian-Stung Bot cross border, Department of Highway 2014.

Figure 4.2 Highway Network Project Links Nong Ian- Stung Bot Cross Border by Department of Highway.

4.2 SURVEY OF TRAFFIC AND TRANSPORTATION

The traffic and transport through Ban Khlong Luk – Poipet cross-border had been surveyed, including highway networks in Thailand and Cambodia from past to present to predict Nong Ian – Stung Bot characteristics in 20 years forward, by survey traffic volume in project area and affected area in not less than 5 kilometers in radius.

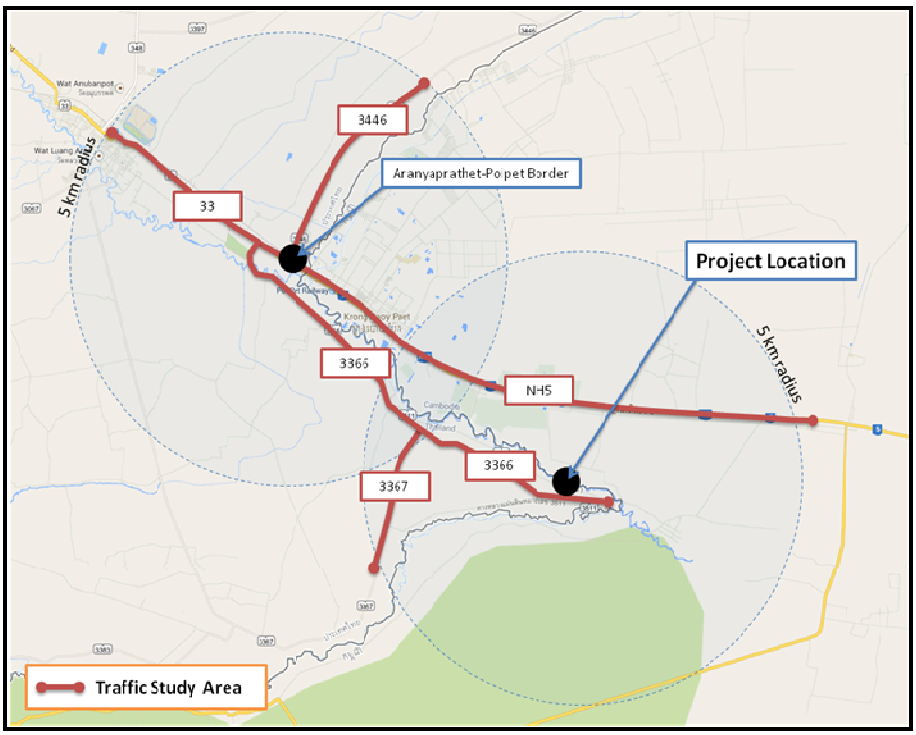


Figure 4.3 Highway Network was Studied Physical Characteristic

Highway No.33 of Thailand is a standard 4-lane highway with a center island, sidewalks and well surface. There are dense communities in the vicinity of the checkpoint and the road between Aranyaprathet and Khlong Luk with heavy traffic throughout the day, especially near the border checkpoint during peak hours and weekends due to tourist attraction around namely Rong Kluea Market/Indochina trade center, hotels and casino in Poipet. Plus the highway is importantly used as transport route between Thailand and Cambodia. However traffic speed survey from Aranyaprathet and Klong Luk in lesser density can be made speed in excess of 90 kilometers per hour which interprets the excellent level of service (LOS A).

Figure 4.4 Physical Characteristic of National Highway No. 33 of Thailand (eastbound)

Figure 4.5 Highway NR5 Poipet–Sisophon 402-401 KM (eastbound)

Highway No.5 (NR5) between Poipet – Sisophon is standard two -lane highways with sidewalk, and well surface (**Figure 4.5**). When travel outbound Poipet will experience no man land and some of agricultural areas. The survey revealed no problems or traffic congestion and can be made speed in excess of 90 kilometers per hour which demonstrates the excellent level of service (LOS A).

For minor roads including Highway No. 3366 and No.3367 is Asphalt concrete with 2- lane traffic flow, no pavements and good surface. And all vehicles use on these roads is local. The survey revealed that a congested hour is during 16.00 to 17.00 hour with average traffic volume of less than 100 vehicles per hour. Able to speed as required by law except in Ban Soke Sabaeng only. If develop Ban Nong Ian – Stung Bot without improve capacity of Highway No. 3366 and No.3367 to accommodate the traffic volume will cause traffic obstruction, accident problem, road physical damage, traffic problems at intersection and separate community along road due to not design to accommodate the traffic volume and large vehicles as main roads.

However as a survey and design of highway network links Ban Nong Ian – Stung Bot cross border by Department of Highways has plans to develop new route inbound – outbound Nong Ian – Stung Bot cross border. When the project completes, would advantage transportation inbound – outbound Ban Nong Ian – Stung Bot cross border without affect Highway No. 3366 and 3367 and community way of life.

1) Survey of Traffic Volume

Traffic Volume had been studied through field survey by consultant team, on Khlong Luk – Poipet border crossing which was potential data for infrastructure designing and traffic management of study area. The survey was conducted in normally day, not the national public holiday or during the end of semester for example Dec 13, 2013 (**Figure 4.6**). Survey conducted into 2 intervened times were AM peak hour (08:00 – 12:00 hour), and PM peak hour (14:00 – 18:00 hour), totally 8 hours per surveyed day and divided to quarter period hourly, the survey hour adjustable depended on the circumstances or traffic nature of study area. Survey study had classified motors to 7 types and were conversed to Passenger Car equivalent Unit (PCU) as showed in **Table 4.1** traffic volume was showed in **Figure 4.7**

Figure 4.6 Traffic Volume Survey in Khlong Luk-Poipet border crossing

Table 4.1 Passenger Car Equivalent Unit (PCU)

Road	Bicycle/ Tricycle	Motor tricycle	Motorcycle	Car/pick-up truck/van	Passenger pick-up truck	Heavy bus	Truck	Other
Outbound	1.00	1.00	0.75	1.00	1.25	3.00	3.00	1.00

Source: Research and development of sustainable infrastructure, Engineering Faculty, Khon Kaen University

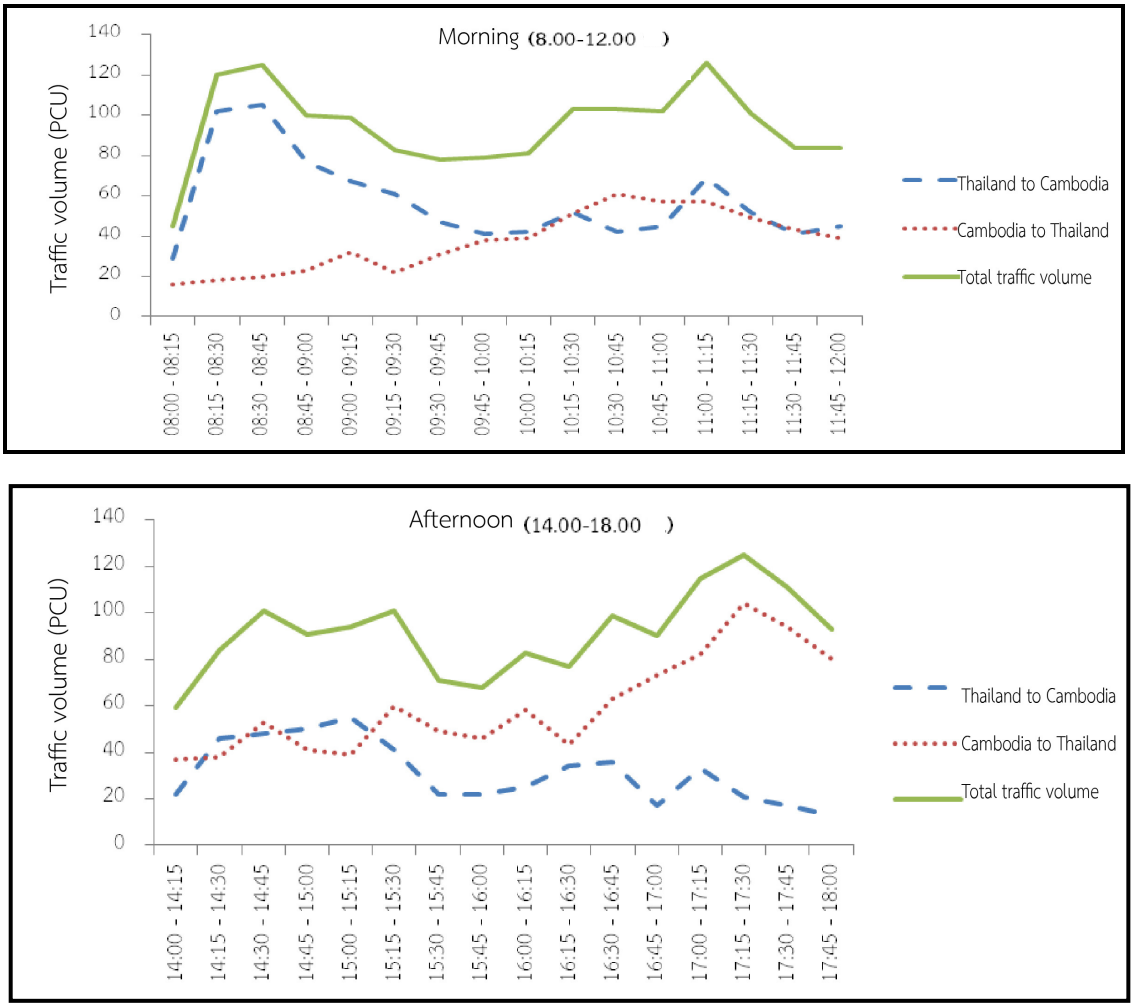


Figure 4.7 Traffic Volume on Khlong Luk - Poipet Crossing, as PCU

According to the data reveals that traffic volume from Cambodia to Thailand was dense in the morning, especially during 08:00-09:00 hour with an estimated volume of 172 PCU and in the direction from Thailand to Cambodia was crowded during 11:00 to 12:00 hour, with the vehicle approximately 213 PCU. Considering traffic volume from the both directions had peak during 11:00 to 12:00 hour with the amount of 361 PCU. Comparing the results of survey with logistics, community plan support the logistics system in crossing (Department of Public Works and Town and Country Planning, Sa Kaeo 2012) found a similarly pattern, both in terms of amount and distribution of travel in each hour. It can be implied that survey result was reliability acceptable (**Figure 4.8**).

Addition, consultants also analyzed traffic volume classified by types of traffic in each period and direction as showed in **Figure 4.12** to **4.15**.

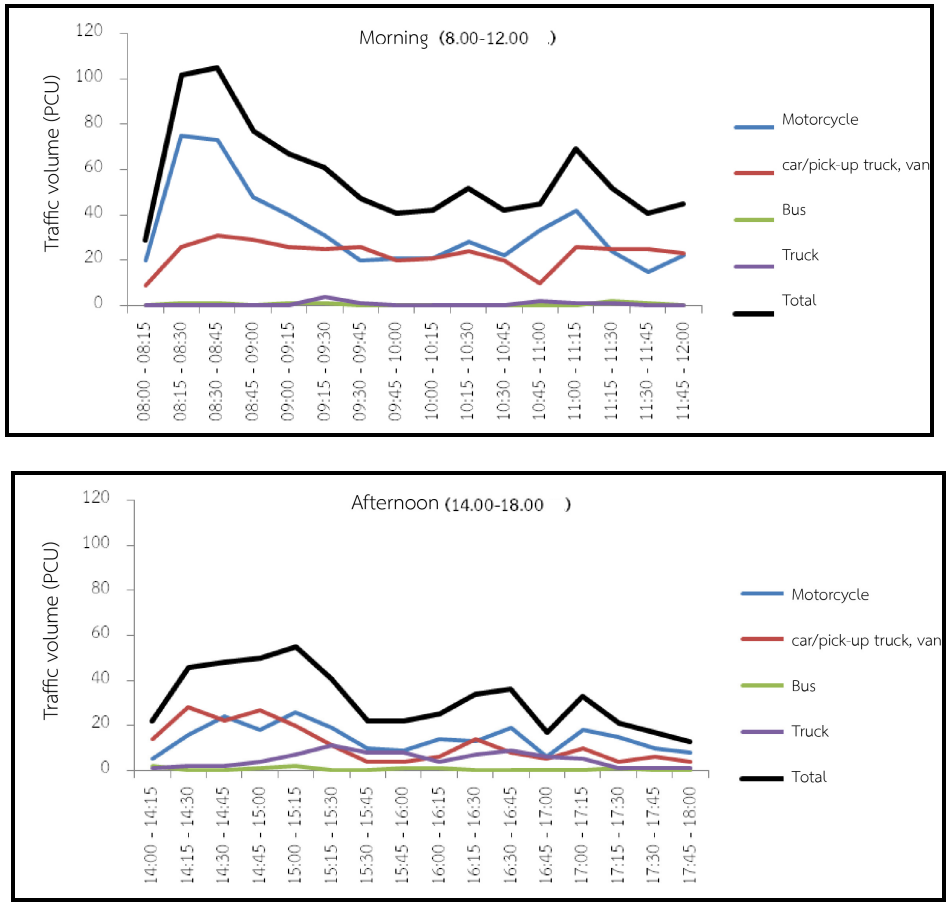


Figure 4.8 Traffic Volume Classify by Time Period (Cambodia ➔ Thailand)

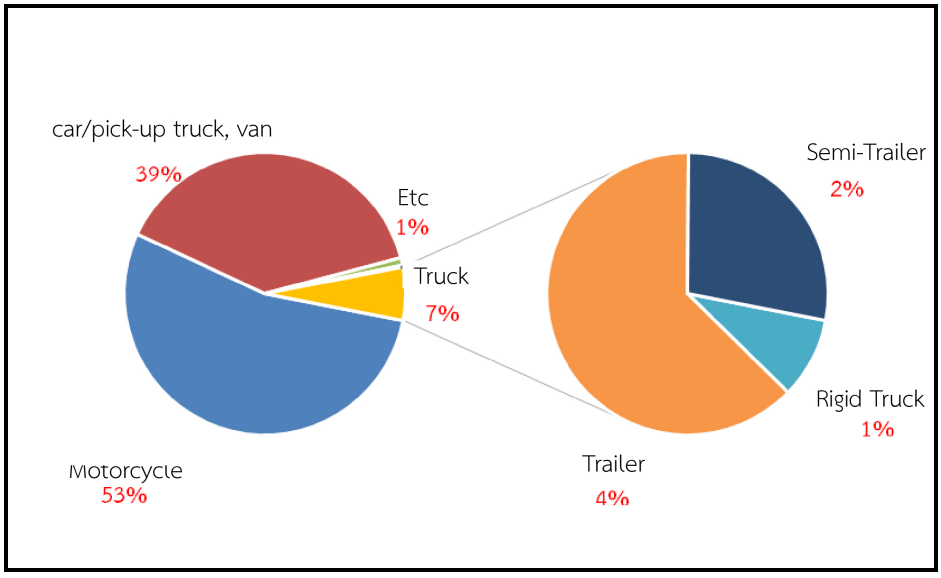


Figure 4.9 Vehicle Ratios Classify by Type, Entire Day (Cambodia ➔ Thailand)

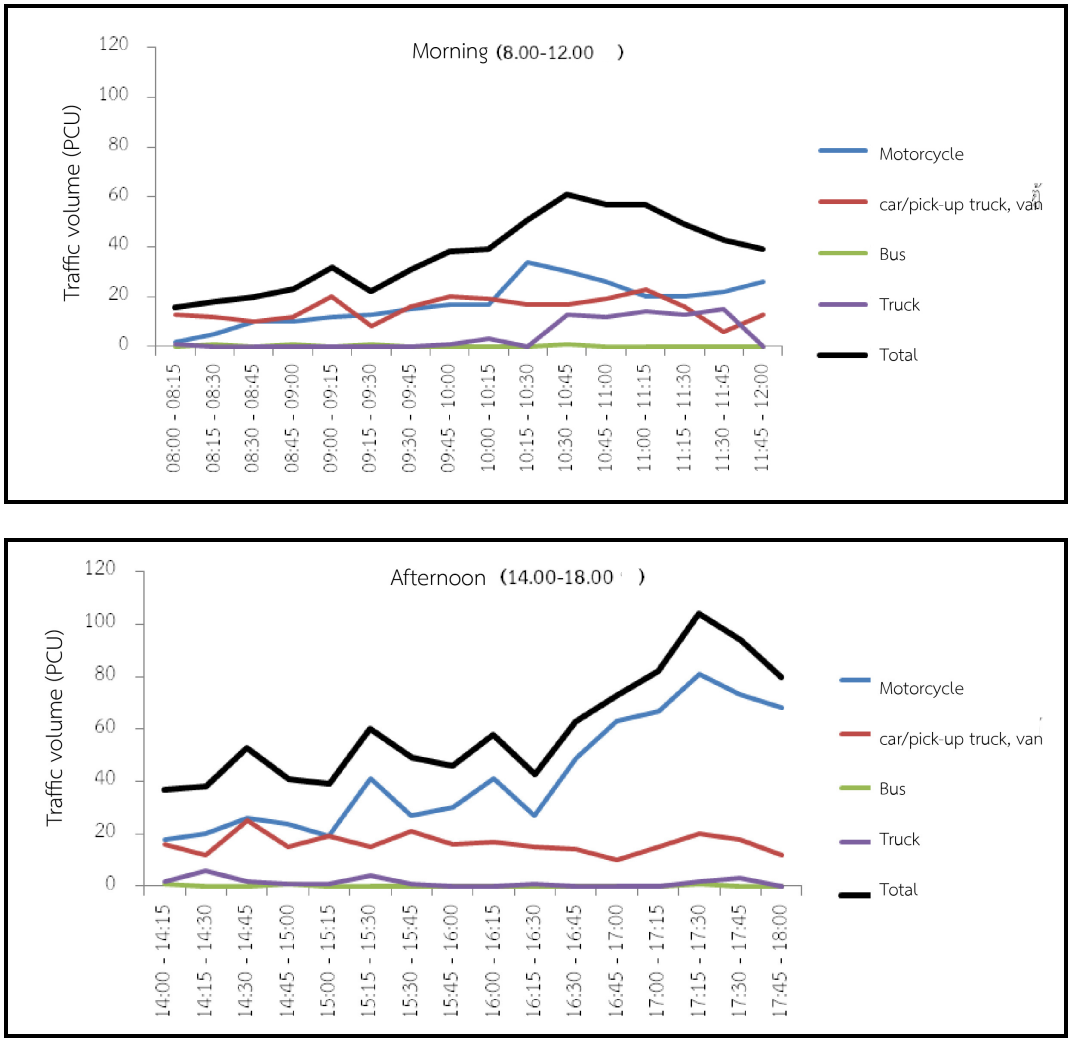


Figure 4.10 Traffic Volume Classify by Vehicle Type in Time Period (Thailand➔Cambodia)

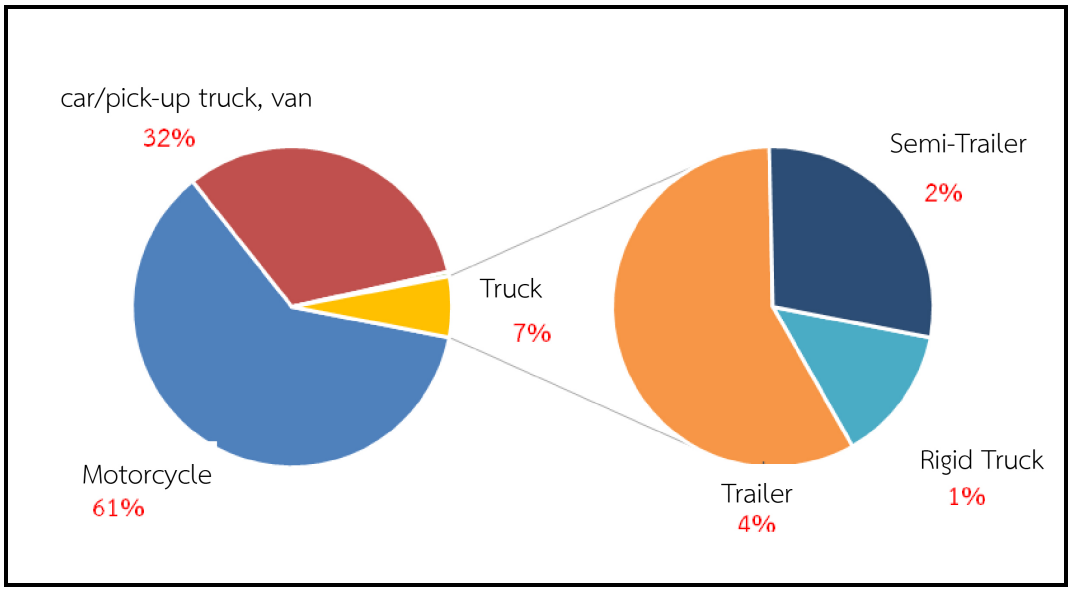


Figure 4.11 Vehicle Ratios Classify by Type, Entire Day (Thailand ➔ Cambodia)

The data had been shown in **Figure 4.8** revealed that traffic volume in direction from Cambodia to Thailand was significantly crowded with motorcycle volume compared to other vehicles during 8:00 to 9:00 hours. Otherwise, during 15:00 to 17:00 hours was crowded with trucks, compared to other periods in normal day. Considering the proportion of vehicles as shown in **Figure 4.9** indicated that motorcycle had highest share as 53%, followed by passenger vehicles (car /pick-up truck/van) of 39%, truck share of 7 % of total vehicles types and other type of vehicle share of 1%.

The data had shown in **Figure 4.10** revealed that traffic volume in direction from Thailand to Cambodia was significantly crowed with motorcycle volume compared to other vehicles between 16:00-18:00 hours. Otherwise, during 10:00-12:00 hours was crowded with trucks, compared to other periods in normal day. Passenger car (car/pick-up truck/van) had similar volume entire day. Considering the proportion of vehicles as shown in **Figure 4.11** indicated that motorcycle had highest share as 61%, followed by passenger vehicles (car/pick-up truck/van) of 32% and truck share of 7 % of total vehicles types like direction from Cambodia to Thailand**.**

To check the validity of the survey, consultants had compared the results of this study with the results of other studies; survey and design of the highway network links Ban Nong Ian – Stung Bot cross border by Department of Highways which is in implementing process and in same survey period with this study. And compare to data in 2012, study on Logistics development, community plan to support border's Logistics. Survey results revealed similar with deviation below 2% reflecting confidence in the representation of the survey as shown in **Table 4.2**.

Table 4.2 Traffic Survey in Ban Khlong Luk–Poipet Compare to Another Studies

Project	Passenger Car Equivalent Unit (PCU/Hour)	Year of survey
1. This survey	279	2013
2. Survey and design of the highway network links Ban Nong Ian – Stung Bot cross border by Department of Highways	274	2013
3. study on Logistics development, community plan to support border's Logistics by Department of Public Works and Town & Country, Sa Keoa	213	2012
	277	2013[1]

Note: [1]Adjust by using trade value expansion ratio in the same period of 2012 and 2013

2) Roadside Interviews

Field study is performed by using Pilot Survey, benefit considering appropriate method. Frequency of interview had been reviewed, and the theory of Yamane (1967) was used to measure interview sampling size, the formula is reliable to 95% CI and less than 5% deviation factor. Considering, adequate sampling size of 400. On field survey, consultants had interviewed 623 samplings (**Figure 4.12,** summary in **Table 4.3).**


Figure 4.12 Roadside Interview of Personal Car

Table 4.3 Summary Key Information From Roadside Interview

Thailand to Cambodia Direction (Outbound)	
General Vehicle	**Truck**
• Majority was personal vehicle (car/pick-up truck/van) accounts as 95% • Majority vehicles carried registration plate of Cambodia account as 90% • Almost trips originate from within Aranyaprathet • Most destinations travel to Poipet district, Cambodia as 89%, to Banteay Meanchey Province, except Poipet district as 9.9% and to other destinations account as 0.1% • The purpose of the trip was mainly intended for business / commercial accounted of 61%, follow by the purpose of travel to work as 19%, the purpose of travel, return home account for 13% and other purposes as 7% • Number of travelers include the driver average of 1.6 travelers per trip	• Majority was trailer and semi-trailer accounts as 91% and 10 wheels truck accounts as 9% • All trucks carried registration plate of Thailand • Originate from within crossing and Aranyaphatet accounts as 13% and originate from within Sa Kaeo Province, except Aranyaphatet accounts as 87% • Most destinations travel to Poipet district, Cambodia accounts as 98%, travel to to Banteay Meanchey Province, except Poipet district as 2% • All travel purpose of transportation • Number of travelers include the driver average of 1.1 travelers per trip • Transportation items, 50% was motors, motorcycle and machinery, and construction materials accounts as 49% and other materials as 1% • Quantity of goods transport compare to the truck capacity found that most were full loaded account as 97% and merely 3% as non-full loaded

Table 4.3 Summary Key Information From Roadside Interview (Cont'd)

Cambodia to Thailand Direction (Inbound)	
General Vehicle	**Truck**
• Majority was personal vehicle (car/pick-up truck/van) accounts as 95% • Majority vehicles carried registration plate of Cambodia account as 92% and plate of Thailand as 8% • Almost trips originate from within cross broder and Poipet accounted as 98% and from other as 2% • Most destinations travel to cross border and Aranyaphatet as 96%, to Sa Kaeo Province except Aranyaphatet district as 3% and to other destinations account as 1% • The purpose of the trip was mainly intended for business / commercial accounted of 76%, follow by the purpose of travel to work as 11%, the purpose of travel, return home account for 12% and other purposes as 1% • Number of travelers include the driver average of 1.24 travelers per trip	• Majority was trailer and semi-trailer accounts as 87%, 10 wheels truck accounts as 7% and 6 wheels truck account of 6% • Majority truck carried registration plate of Thailand account as 98% and 2% carried registration plate of Cambodia • Originate from within crossing and Poipet accounts as 92% and originate from within Banteay Meanchey Province, exclude Poipet accounts as 2% • Most destinations travel to crossing checkpoint and Aranyaphatet district, accounts as 56%, and travel to another districts across Thailand as 44% • Most of travel purpose to return home account as 95% • Number of traveler include driver average of 1 traveler per trip • 97% are unloaded truck, and 3% are non-full loaded, the majority of import item is consuming product

Figure 4.13 Waiting Truck to Cambodia

Figure 4.14 Cart Transportation

4.3 TRAFFIC ANALYSIS OF HIGHWAY NETWORK IN PRESENT AND FUTURE

The traffic condition was analysed, according to the predicted volumes on the road network in the study area and surrounding. Level of Service (LOS) was assessed, which was calculated from performance indicator; Measure of Effectiveness (MOE) in traffic volume per capacity of the road, travelling speed and traffic management delay.

Evaluation criteria for service level of road network used in this study was mentioned in evaluation criteria, service level standards, which was recognized and widely used abroad as shown in **Table 4.4**, while the traffic conditions in the service levels are shown in **Figure 4.15**.

Table 4.4 Evaluation Criteria in Service Level on Studied Highway and Road Network

Service level	Average travel speed on inbound road (Km/hour)	Average travel speed on outbound road (Km/hour)	Traffic management delay (Second)	Volume per capacity ratio (V/C Ratio)
A	≥50	≥96	≤10	0-0.60
B	40-49	91-96	11-20	0.61-0.70
C	30-39	86-90	20-35	0.71-0.80
D	20-29	74-86	35-55	0.81-0.90
E	15-19	48-74	55-80	0.91-1.00
F	<15	<48	>80	>1.00

Source: Austroads (1998), TRB (2000) and Homberger et.al. (1992)

(**Retrieve from www.in.gov**)

Figure 4.15 Level of Traffic Service

Traffic analysis and Measure of Effectiveness (MOE) road network in this study was divided into 3 important related parts as following

1) National Highway 5 (NR5) Effectiveness in Present and Future (Poipet-Srisopon)

National Highway between Poipet and Sisophon within National Highway 5 was analyzed, the highway where in future will be connected trail permanent crossing Ban Nong Ian – Stung Bot. Currently, the road is outbound, an asphalt concrete, 2-lane with wide shoulder (1 meter wide), no median with normal road surface quality and effectively converted to 4 - lane in the future. Idealistic capacity of roads is approximately 2,816 PCU / hour / total 2-direction traffic (HCM 2000).

Due to safety and international security reason, unable to directly implemented traffic volumes survey. However, comparing observed data with the study of Department of Public Works and Town and Country Planning, Sa Kaeo and JICA in 2012 found similar traffic volume on along NR5 including highway between Poipet and Sisophon , Aranyaprathet – Poipet and number 8 survey location. Moreover the road was closed path, not much distribution of traffic flow, may be noted that traffic volume on highway from Poipet to Sisophon be relatively stable and can predict the traffic volume by using number 8 survey location volume. Volume per capacity on NR5 was showed in **Table 4.5**.

Table 4.5 Expected PCU/hour in Future

Year	PCU/hour[1,2]	Volume per capacity (V/C)	LOS
2016 (AEC launch)	1,003	0.36	A
2020 (Opening Stung Bot border crossing)	1,262	0.45	A
2024	1,567	0.55	A
2029	1,967	0.69	B
2034	2,366	0.84	D
2039	2,781	0.99	E

Note: [1] Expected PCU/hour in future according to growth rate by JICA (2013)
[2]Study of JICA (2013) in PCU/day, converted to PCU/hour by using Peak Period

Result of NR5 traffic analysis: According to data in **Table 4.5** found that NR5 near Khlong Luk - Poipet which in the future will become junction point connected to the crossing had current level of service at level A (the traffic volume per capacity less than 0.60) and continuously provided service till 6 following years. The service will dropping in every 5 years to E level in the 17th years after opening of Stung Bot border crossing. However, regarding to NR5 physical character reveals that the highway able to provide C level service till the year 2032. In the following year the service will dropped and severe congested during peak time.

2) Traffic Volume Analysis on Entry – Exit Border Crossing

In analysing of the size and number of road traffic (lane) entry – exit the checkpoint had been analysed addition of growth rate of traffic volume in the future by JICA (2012). In equivalent hypotheses is set with no Aranyaprathet – Poipet checkpoint, all activity happening in future will operate in Nong Ian – Stung Bot instead, with the 2-lane road characteristics as current NR5. Response with this assumption Nong Ian – Stung Bot is non-profit, with highly congested traffic as shown in **Table 4.6**.

Table 4.6 Expected Highest Traffic Volume/Hour in the Future

Year	PCU/hour		highest traffic volume/capacity	LOS (Survey location)
	Thailand to Cambodia	Cambodia to Thailand		
2016 (AEC launch)	474	412	0.32	A
2020 (Opening Stung Bot border crossing)	596	518	0.39	A
2024	256	644	0.49	A
2029	606	808	0.62	B
2034	1,118	972	0.74	C
2039	1,315	1,143	0.87	D

Note: Expected traffic volume in the future base on growth rate (JICA, 2013)
* Calculated values at the entry – exit Aranyaprathet - Poipet permanent crossing.

Result of entry-exit border crossing traffic analysis: all described assumptions found that amount of traffic through entry – exit border crossing tends to continuously increase to exceed 2,000 PCU/hour during rush period in 2034. The service level remains acceptable (Level C), till the year 2039 (17 years after opening of Stung Bot border crossing). However, for reasons of safety and to support growth in the long run, consultants proposed the design of the entry – exit Nong Ian – Stung Bot border crossing road is not less than four traffic lanes with median.

3) Analysis of Intersection Nong Ian – Stung Bot with NR 5

Currently, the Nong Ian – Stung Bot on the NR5 network has no intersection point yet. Analysis of traffic intersections cannot be done by using current base-behavior. Therefore, the analysis must be based on several assumptions related distribution of traffic flows. One of the most important assumptions was the type of vehicle that will be move from the Aranyaprathet - Poipet to the Nong Ian – Stung Bot border crossing.

The analysis was divided into two cases were

- **Case 1** All personal car and large vehicles move to Nong Ian – Stung Bot border crossing
- **Case 2** Only truck and large bus will be move to Nong Ian – Stung Bot border crossing

Traffic volumes on NR5 network and traffic volume through crossing classified by vehicle categories were analysed on an intersection that will occur in the future. Intersection had shown in **Figure 4.16**, vehicle type and origin/destination point had shown in **Table 4.7**.

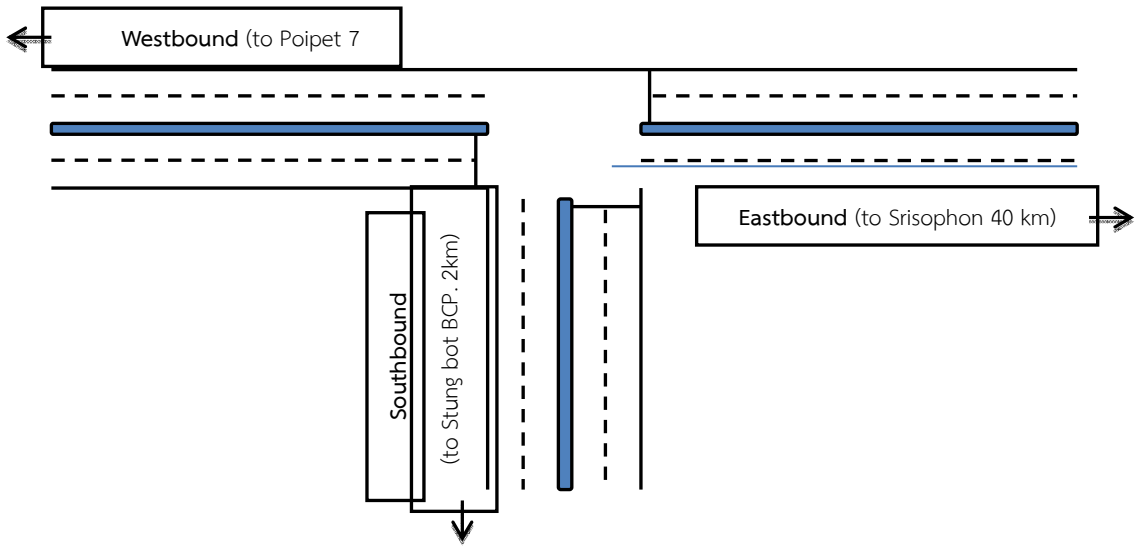


Figure 4.16 Intersection Connect Nong Ian – Stung Bot Border Crossing with NR5

Table 4.7 Expected Traffic Volume on Intersection During Rush Period in the Future

Year	PCU/hour[1,2]			
	Eastbound	**Southbound**	**Westbound**	**Total int. flow**
Case 1 All personal car and large vehicles move to Nong Ian – Stung Bot border crossing				
2016 (AEC launch)	331	185	345	861
2020 (Opening Stung Bot border crossing)	395	239	445	1,078
2024	459	292	544	1,295
2029	544	362	677	1,583
2034	633	436	814	1,883
2039				
Case 2 Only truck and large bus will be move to Nong Ian – Stung Bot border crossing				
2016 (AEC launch)	331	33	348	712
2020 (Opening Stung Bot border crossing)	395	43	417	854
2024	459	52	486	997
2029	544	65	578	1,187
2034	633	79	673	1,384
2039	724	91	771	1,587

Note: [1] Expected PCU/hour in future according to growth rate by JICA (2013)
[2] Distribution of traffic volume in each direction of the intersection was considered as the vehicle categories but with the limitation of vehicle, not included in this table.

The result showed in **Table 4.7** revealed that the traffic volume in Case 1 and 2 was significantly different especially case 2; large truck and bus will be transfer to the Ban Nong Ian – Stung Bot checkpoint. Software was used to analyze Intersection which famously used worldwide to calculate and indicate Measure of Effectiveness (MOE) in intersection traffic, level of service, traffic management delay, capacity and length of waiting car.

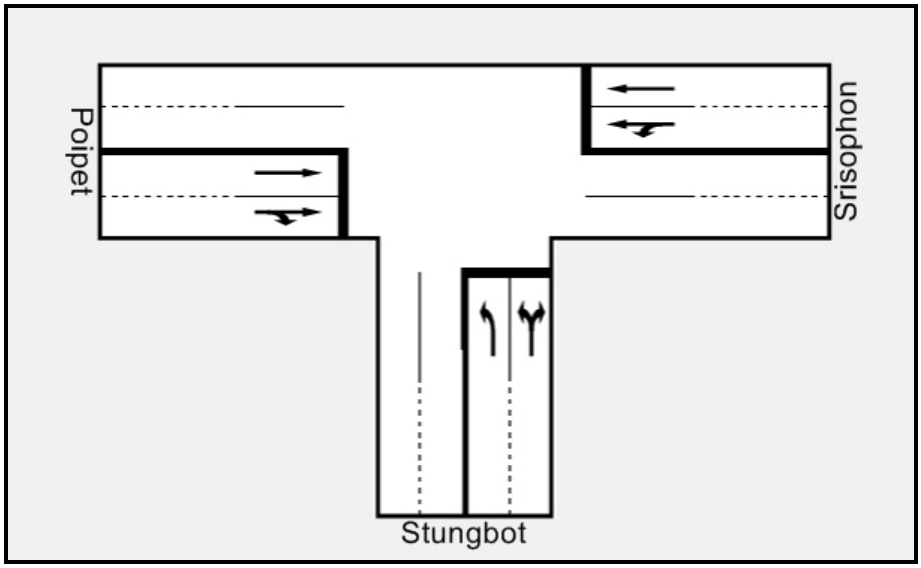


Figure 4.17 Physical Characteristics of Baseline Junction

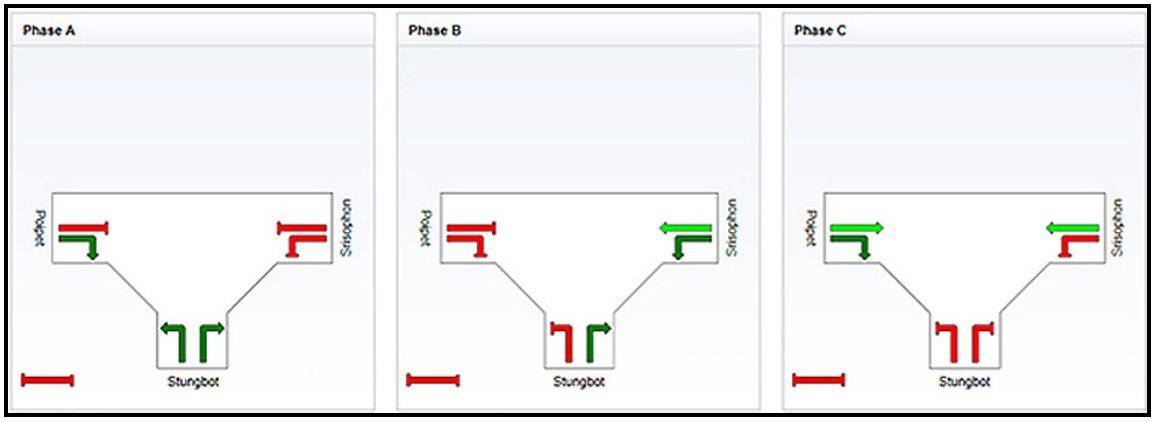


Figure 4.18 Plan Around Traffic Light in Baseline Junction

The analysis and design of intersections and traffic lights had completed by Software. The result showed that intersections of four traffic lanes with median, no return lane could adequately accommodate traffic in both case; Case 1 (All personal car and large vehicles move to Nong Ian – Stung Bot border crossing) and Case 2 (Only truck and large bus will be move to Nong Ian – Stung Bot border crossing) with the service level of the junction of level B (very good service). Except case 1 in 2039, service of the intersection will failed to level C, remain in threshold. However, it deduced that in the worst case of each junction fall in level of service D in the year 2039 which might approach traffic jams problem.

To design intersections which are adequate accommodate traffic volume of not less than 2 0 years period after launch of the project. Problem management should project since design time. Consultants approached more option by adding return lane to increase junction capacity and reduce the return-waiting car in order to provide better performance as shown in **Figure 4.19** and **Table 4.8**.

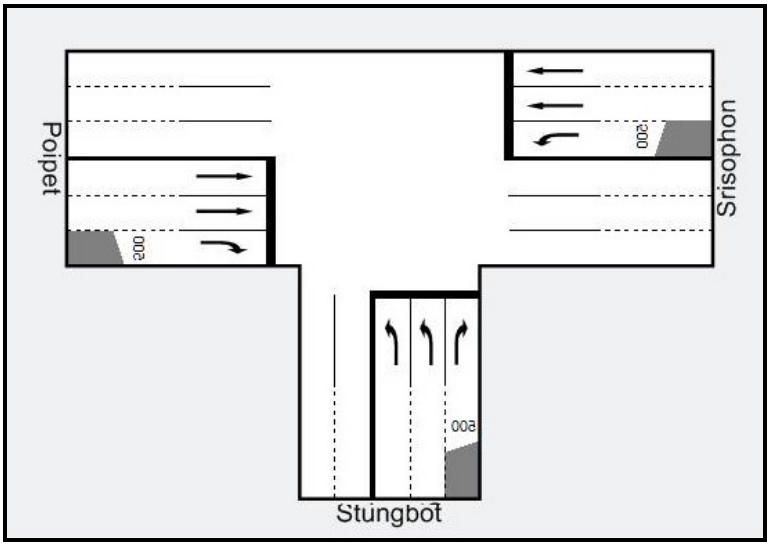


Figure 4.19 Physical Characteristics In Case of Adding Return Lane

Table 4.8 Result of Junction Analysis in Adding Return Lane

Year	Measure of Effectiveness in junction (MOE)			
	Degree of Saturation	**Average Delay (Second/Veh)**	**95% Back of Queue (Veh)**	**Level of Service (Average/Worst)[1]**
Case 1 All personal car and large vehicles move to Nong Ian – Stung Bot border crossing				
2020 (Opening Stung Bot border crossing)	0.45	15.14	4.2	B/C
2024	0.54	15.72	4.9	B/C
2029	0.66	16.72	6.2	B/C
2034	0.79	17.92	7.6	B/C
2039	0.92	20.16	9.1	B/C
Case 2 Only truck and large bus will be move to Nong Ian – Stung Bot border crossing				
2020 (Opening Stung Bot border crossing)	0.53	11.88	5.3	B/C
2024	0.62	12.36	6.2	B/C
2029	0.69	12.90	7.4	B/C
2034	0.74	13.34	8.8	B/C
2039	0.79	14.03	10.3	B/C

Note: [1]Average means averaged level of service in around junction; otherwise Worst means the worst level of service

The result showed that adding return lane will increasing efficiency of the service in terms of capacity to accommodate maximum traffic, Degree of Saturation of the junction, back of queue 25% reducing and level of service remain in very good level of B in the year 2040. While the worst level of service was fall to C which continued in good service with only moderately accommodated an increasing of traffic volume either case.

Results of intersection analysis: physical characteristics as shown in **Figure 4.18** would cost lesser in the construction, and can provide adequate accommodated future traffic volumes until the year 2036. However, the model in **Figure 4.19** is strongly recommend; traffic lane with return lane added to increase level of service, provide adequate accommodated future traffic volumes and increase safety for travelling.

4) Railway Level Crossing in Nong Ian – Stung Bot Border Crossing Analysis

Railway Level Crossing or intersection was one of the most dangerous and frequent accidents on the rail network. According to the railway intersection was integrated mode of travelling (Mode) which was different in terms of physical characteristics, behavior and management. Currently, Railway Level Crossing was classified to 2 main categories;

1) At Grade Level Crossing, with vehicle or a pedestrian thoroughfare crossing and

2) Grade Separation Level Crossing was to establish a bridge or tunnel.

Result of Level Crossing analysis: For the analysis and selection of Level Crossing mode on the road linking Nong Ian – Stung Bot border crossing and NR5 of Cambodia found that At Grade Level Crossing would be appropriate, provide adequately accommodate traffic (**Figure 4.20**).

Figure 4.20 At Grade Level Crossing Model

5) Traffic Analysis in Poipet After Opening of Stung Bot Cross Border

The conclusion and suggestion in the impact of opening of the Nong Ian – Stung Bot cross border on Poipet community and Khlong Luk – Poipet cross border as following

- Operating of Ban Nong Ian – Stung Bot cross border will significantly reduce congestion levels in Ban Khlong Luk – Poipet (not less than 30% reducing).
- Removing the large truck off the commercial and residential areas will positively impact on the communities surrounding Ban Khlong Luk - Poipet. Positive impact on noise, vibration, dust, smoke, air pollution, and reduce traffic congestion. It also benefit in reducing severe accidental risk.
- The physical characteristics of the road and either roadside area is capable to accommodate the traffic volume (According to predictions in section 4.3.3).

- The future Ban Khlong Luk – Poipet cross border will mainly serves travelers. The development should focus on traveler facilities; develop sidewalks, bikeway, lots, shelter, market, shops and restaurants. It requires study and land use planning with traffic map and urban development as Livable City. The detail will describe afterward.

6) Traffic intersection analysis in case of developing National Highway No. 58 and interchange

The Merge Point has been proposed into Stung Bot cross border. The 3 -way intersection will be formed with the National Road No.5 , the main road. The construction has directly affected Stong Bot traffic management. Nevertheless, Ministry of Public Works and Transport of Cambodia plans to reconstruct the National Road No.5 8 and collaborates with Chinese government studying "Feasibility Study Report on Reconstruction Project of National Road No.5 8 in Cambodia, finish by June, 2014.

According to the study reveals that At Grade intersection managing by traffic light can accommodate the traffic flow in the future. However, Interchange reduces delay travel time, significantly. In other words, Interchange would increase the intersection capacity in long run (Construct of Interchange will reduce delay travel time by 42%).

Interchange expects to reduce traffic congestion, increase traffic capacity, and reduce accident rate. Otherwise, the Conflict Point and Merging Point should be analyzed (**Figure 4.21**). In case of Interchange will reduce Conflict Point from 16 points to 8 points and Merging Point from 8 points down to 6 points or accounts as 50% and 25% reducing, respectively. This implies the reducing of accidental rate in Conflict Point and Merging Point. In the other Conflict Point and Merging Point should manage with traffic light in large intersection. Importantly, reducing traffic volume on NR5 leads to better management.

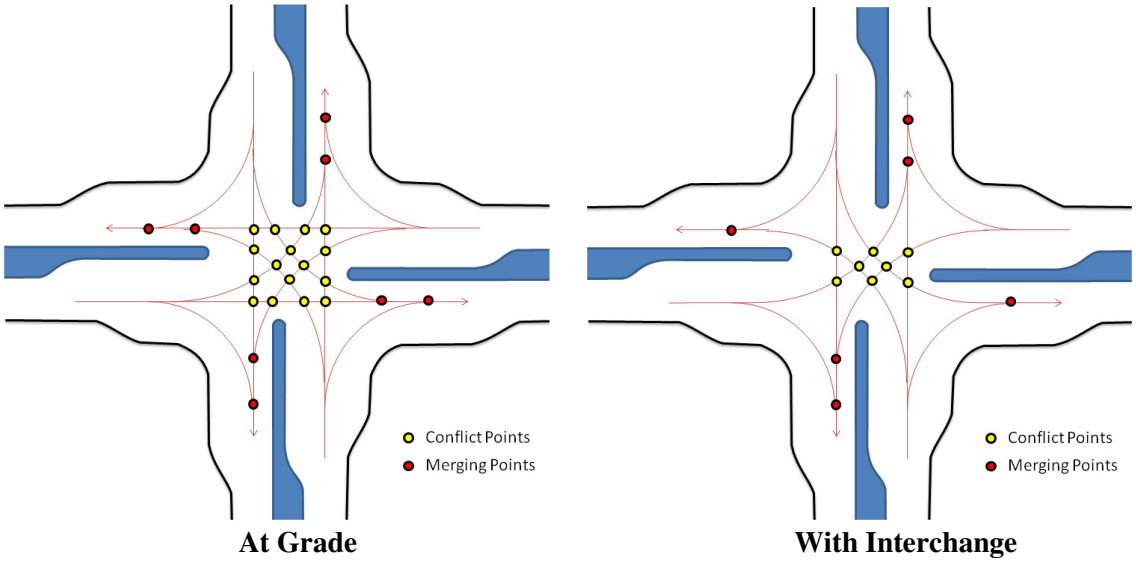


Figure 4.21 Conflict Point and Merging Point analysis of at Grade and With Interchange Along National Road No. 5

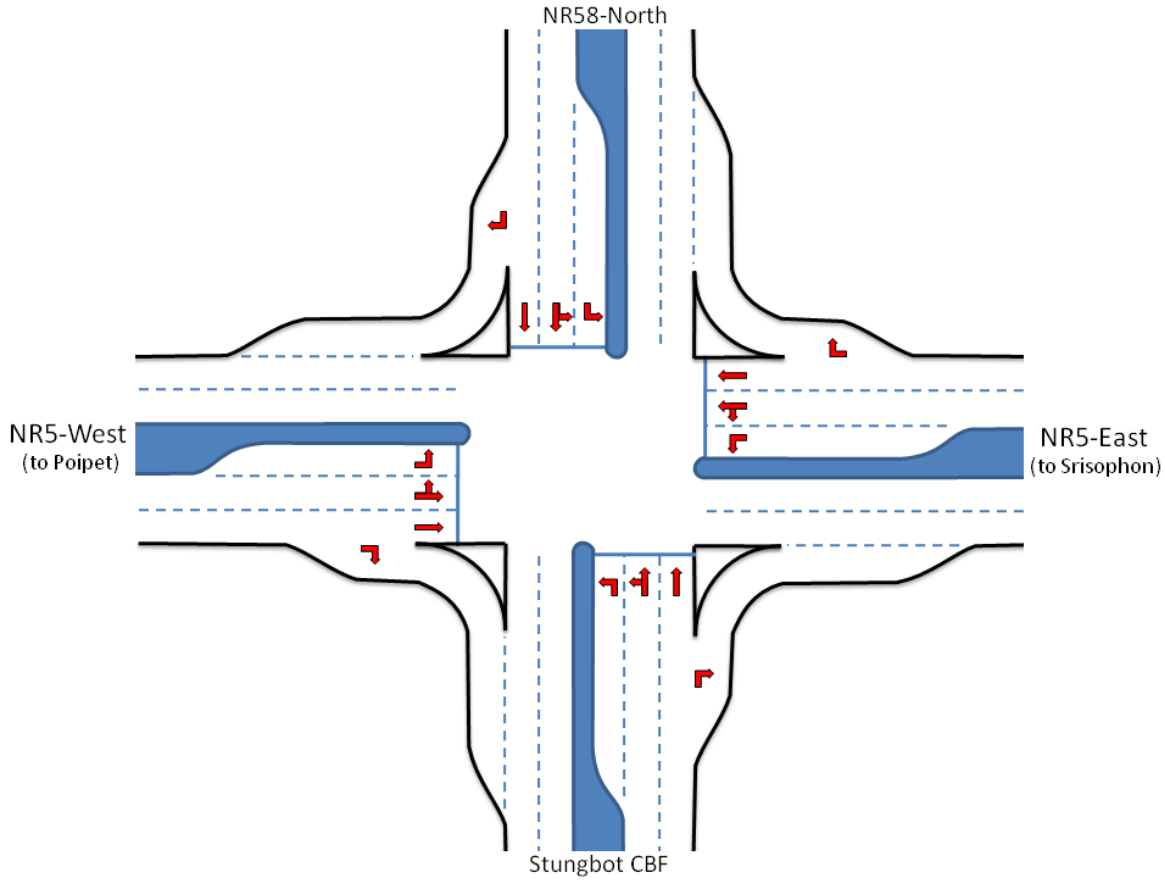


Figure 4.22 Traffic Direction in With Interchange

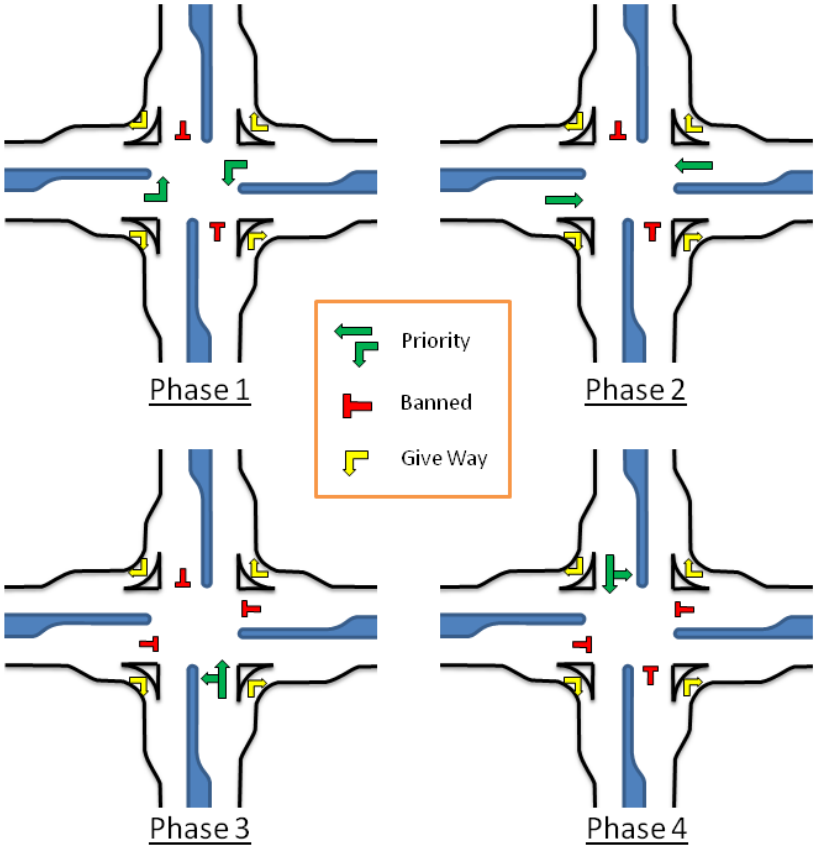


Figure 4.23 Traffic Light Intervals With Interchange

CHAPTER 5
STUDY OF GUIDELINES FOR CREATING VALUE ADDED AND MUTUAL BILATERAL BENEFIT HAPPENING IN THE FUTURE

Study approach to adding value in facilitation of cross-border trade, transit trade or cross-border transit. Effectiveness service; rapidly and simply will result in the amplify value of trade and investment among the two nations. The construction of Stung Bot, Kingdom of Cambodia will base on trading and investment information of Sa Kaeo, where has a certainly policy and strategy for the development cooperation agreement with Stung Bot, Cambodia. Stung Bot and Sa Kaeo will be efficient gateway to Indochina,

According to information on trade, investment, border trade, and employment was found that related activity in production, transportation or distribution had great opportunity in future. When considering consumption rate, in both nations require third distribution party for instance Vietnam stretch to project area, Stung Bot to create new market cooperation agreement, stimulate consumption rate, and border trading. Consequently, goods distribution from Stung Bot through Ho Chi Minh city, Vietnam will create great economic growth. Moreover creating economic and logistics link Oh Neang – Poipet – Stung Bot providing more opportunity in economic growth for both nations. Benefits have been shown in **Table 5.1**.

Table 5.1 Value Added and Mutual Benefits

Order	Value Added	Benefit
1	Regional strategic	➢ Promote infrastructure linkage in the Southern Economic Corridor and link Thailand - Cambodia – Viet Nam ➢ Fully facilitate Border transport ➢ Investment linkage between Thailand's eastern seaboard industrial special economic zone Poi Pet–O Niang and industry estate in Ho Chi Minh City ➢ Information linkage intra-organization by operate the Single window model, under the Transport Agreement of the Greater Mekong Sub-region (GMS Cross) cooperation and including other services for instance certification of license, validation control of transport vehicle and traded goods at One Stop Service in order to facilitate the import - export and foreign investment
2	Economic	➢ Cross-Border trade will be higher grow than 20 percent in the five years forward ➢ Promote expected industry within Eastern Provinces
3	Industry	➢ Increase Exported product, automobile machineries, textile products, oil and electronic devices ➢ Increase Imported products, second hand garments, blankets, fruit iron remnant or fishery products ➢ Grow of industry especially raw materials like limestone, steel, aluminum, gold and jewelry ➢ Energy industry, especially form oil ➢ Agro-processing industry
4	Spatial	➢ Increase Sa Kaeo GDP at current prices to 15 percent over the five years forward (worth 37,989 million, in 2010 value) or average growth of 4% annually ➢ Wholesale and retail trade value will increase over 20% in the five years forward ➢ The growth in the textile cross-border trade
5	Labor	➢ Decline the impact of labor shortages due to labor migration or plant settlement in the border between Thailand and Cambodia ➢ Develop skilled labor
6	Tourism	➢ Enhance the tourism at cross-border by reducing congestion in Aranyaprathet – Poi Pet crossing ➢ Increase tourism to the city of Siem Reap and the vicinity. ➢ Increase potential tourism to Phnom Penh and Ho Chi Minh ➢ Increase potential in services hotel, restaurant, and tour

CHAPTER 6
ENGINEERING STUDY

6.1 PROJECT ROUTE SELECTION, PRELIMINARY DESIGN, PROJECT ROAD WITH NECESSARY CONSTRUCTION PROCEDURES AND RAILROAD CROSSING RESOLUTION STUDY AND PRELIMINARY DESIGN

This part of work involves a determination of project route alternatives and having them compared in order that the most suitable one can be achieved, and that the project detailed design can be carried out respectively. Project route selection criteria and details are listed below:

6.1.1 Project Route Selection

The information obtained from the studies on project site and its surrounding road network as well as the initial site survey conducted will be used to determine project route alternatives so that the most suitable route for the project can be achieved. Regarding this, the Consultant has determined 3 alternatives for project route, as showed in Figure 6.1, all of which contain the same starting point, i.e. at the CL 241,394: 1,506,503 co-ordinates, in Ban Stung Bot, Banteay Meanchey Province of Cambodia. This location is about 40 metres northward from the canal that borders between the 2 countries and is the location where the 2 countries agreed to have it developed as a new border crossing point. Details of each route alternative are as follows:

Alternative 1 contains a starting point at CL 241,394 : 1,506,503 co-ordinates, heading northward for approximately 100 metres, diverting north-west for about 800 metres before meeting with the existing non-asphalt road. Going along this non-asphalt road, the route heads northward, crossing railway and meets with highway no. 5, which is the end of the route, respectively. This route covers the length of 1,999 metres in total. The areas where the route will be cut through are plains, most of which are mixed between paddy fields and waste lands.

Alternative 2 contains a starting point at CL 241,394 : 1,506,503 co-ordinates, with straight-line directions throughout the route. It heads east-northward and crosses railway before meeting with highway no. 5, which is the end of the route, covering the length of 1,866 metres in total. The areas where the route will be cut through are plains, most of which are mixed between paddy fields and waste lands.

Alternative 3 contains a starting point at CL 241,394 : 1,506,503 co-ordinates, heading north for approximately 200 metres, diverting north-east for about 1,250 metres before meeting with the existing non-asphalt road. Going along this non-asphalt road, the route heads northward, crossing railway and meets with highway no. 5, which is the end of the route, respectively. This route covers the length of 2,284 metres in total. The areas where the route will be cut through are plains, most of which are mixed between paddy fields and waste lands.

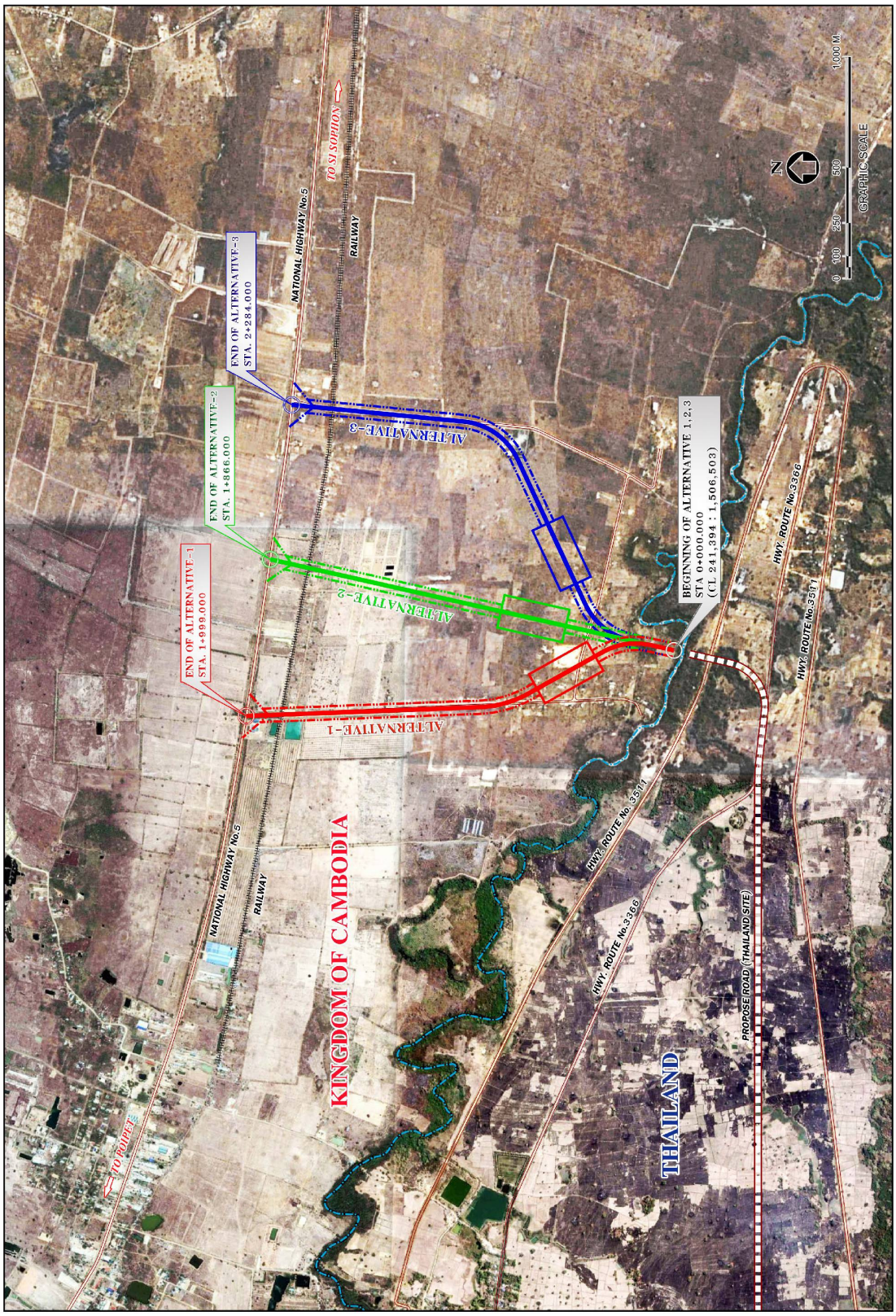


Figure 6.1 Rout Alignment Alternatives of Project

6.1.2 Project Route Selection Criteria

The Consultant will propose the minimum of 3 route alternatives, with the most suitable route selected so that the related detailed design can be conducted respectively. Marks will be assigned for each criteria used for route alternatives comparison, i.e. 35 marks in engineering, 35 marks in economic and financial and 30 marks in environmental, making the total of 100. The route with the highest mark will be considered most suitable and be selected accordingly.

For routes comparison purpose, the related marks have been weighted for each sub-item as showed in **Table 6.1.**

Table 6.1 Project Route Selection Marks Allocation Criteria

Variables	Marks
1. Engineering	
1.1 Length of the Route	10.0
1.2 Horizontal Characteristics of the Route	7.5
1.3 Vertical Characteristics of the Route	7.5
1.4 Suitability of the Intersection Location	10.0
Sub-Total (1) Engineering	35
2. Economic and Financial	
2.1 Construction Cost	15
2.2 Land Acquisition and Compensation Costs	10
2.3 Land Use	10
Sub-Total (2) Economic and Financial	35
3. Environmental	
3.1 Impacts on Air Quality, Noise and Vibration Standards (amount of the areas sensitive to the impacts within 500 metres' distance)	10
3.2 Impacts on Relocation and Acquisition	
- amount of the buildings being acquired (houses)	10
- amount of land plots being acquired (rais)	10
Sub-Total (3) Environmental	30
Grand Total	**100**

In marks allocation, the Consultant will consider advantages, disadvantages as well as pros and cons of each topic, have them classified into different levels by assigning relevant multiplying factors. When having the multiplying factor multiplied with the weighted mark of that topic, the result will be the full mark of such item for that route. After the total mark of each topic for each route has been compared with one another, the route with the highest mark will be considered most suitable.

The engineering and economic and financial multiplying factors in each level contain the following interpretations:

Multiplying Factor	1.00	means	Very Good Characteristic
Multiplying Factor	0.75	means	Good Characteristic
Multiplying Factor	0.50	means	Fair Characteristic
Multiplying Factor	0.25	means	Bad Characteristic

The environmental multiplying factors in each level contain the following interpretations:

Multiplying Factor	1.00	means	No Impact
Multiplying Factor	0.75	means	Minor Impact
Multiplying Factor	0.50	means	Medium Impact
Multiplying Factor	0.25	means	Severe Impact
Multiplying Factor	0.00	means	Actions Prohibited

6.1.3 Evaluation on Suitable Project Route

6.1.3.1 Engineering Marks Allocation

1. Length of the Route

The route with shorter length will be more economical in terms of time and travelling expenses, not to mention the lower construction and maintenance costs. Therefore, in calculation, the multiplying factor of the route with the shortest length will be assigned as 1.00. For other alternatives, their multiplying factors will be calculated by Straight-Line method, with the following equation:

$$\text{Multiplying Factor} = 1 - \frac{(\text{Length of Route Alternative} - \text{Length of the Shortest Route Alternative})}{\text{Length of the Shortest Route Alternative}}$$

In case the multiplying factor obtained from calculation has a minus value, 0.00 is to be used as a multiplying factor.

The multiplying factors based on lengths of the route are showed in **Table 6.2**

Table 6.2 Multiplying Factors Based on Lengths of the Route

Route Alternative	Length of the Route (Metre)	Multiplying Factor
1	1,999	0.93
2	1,866	1.00
3	2,284	0.78

2. Horizontal Characteristics of the Route

Normally, straight alignments are better than zigzags, and the alignments with greater curve radiuses are usually superior to the ones with less since they provide safer, faster and more convenient driving. Apart from that, straight alignments will also allow flexibility in determining size and location of the border crossing point since the border crossing point would best be located on straight line. The above variables can be used to define multiplying factors for horizontal characteristics of the route as follows:

Alternative 1 Because this alternative diverts to use the existing non-asphalt road on the west, it will be in zigzag shape throughout the route with a straight line between the curves that is rather short with approximate 380 metres' length. This causes limitations in defining location and size of the border crossing point. As from what described, it could be considered that this alternative 1 possesses fair horizontal characteristic of route, and its multiplying factor will be equal to 0.50.

Alternative 2 Since this alternative is in straight-line shape throughout the route, its horizontal characteristic of route is considered very good. Hence, its multiplying factor will be equal to 1.00.

Alternative 3 Because this alternative diverts to use the existing non-asphalt road on the east, the route will be in zigzag shape throughout the route with a straight line between the curves that is rather long with approximate 720 metres' length. This entitles flexibility in defining location and size of the border crossing point. As from what described, it could be considered that this alternative 3 possesses good horizontal characteristic of route. Hence, its multiplying factor will be equal to 0.75.

3. Vertical Characteristics of Route

Gradient of the route and changes of vertical roadway elevation do affect the convenience and safety in driving. The route with fewer changes of vertical roadway elevation or less gradient will be better than that with more.

The above variables can be used to define multiplying factors for vertical characteristics of route as follows:

Alternative 1 Since this alternative is cut across the plain, most of which are paddy fields and waste lands, the route will be involved with very little gradient and changes of roadway elevation. This is considered a very good vertical characteristic of route. Therefore, its multiplying factor will be equal to 1.00.

Alternative 2 Since this alternative is cut across the plain, most of which are paddy fields and waste lands, the route will be involved with very little gradient and changes of roadway elevation. This is considered a very good vertical characteristic of route. Therefore, its multiplying factor will be equal to 1.00.

Alternative 3 Since this alternative is cut across the plain, most of which are paddy fields and waste lands, the route will be involved with very little gradient and changes of roadway elevation. This is considered a very good vertical characteristic of route. Therefore, its multiplying factor will be equal to 1.00.

4. Suitability of the Intersection Location

A suitable location for an intersection should be on the part of road or route that is in a straight line form as this will allow more safety for road users than the intersection that is located on the curve. Moreover, the proper location for an intersection should also be in an open area without buildings or obstructions that might affect its design or construction.

The above variables can be used to define multiplying factors for the suitability of the intersection locations as follows:

Alternative 1 An intersection is located on highway no. 5, on the straight line section, which is considered suitable. But since there is a gas station located in the same area, which can cause obstructions to the design and construction; the location of this intersection is then considered good, but not that much. Therefore, its multiplying factor will be equal to 0.75.

Alternative 2 Since an intersection in this alternative is located on highway no. 5, which is at the straight line section; its location is considered suitable. In addition, this location is also an open area with no buildings obstructed. Therefore, the location of this intersection is considered very good, and its multiplying factor will be equal to 1.00.

Alternative 3 Since an intersection in this alternative is located on highway no. 5, which is at the straight line section; its location is considered suitable. However, because there are houses located in the same area which might cause obstructions

to the design and construction; the location of this intersection is considered good, but not that much. Therefore, its multiplying factor will be equal to 0.75.

A summary on engineering marks allocation is displayed in **Table 6.3**

Table 6.3 Marks Allocation Summary on Routes Engineering Comparison

Comparing Items	Full Mark	Alternative 1		Alternative 2		Alternative 3	
		MF	Mark	MF	Mark	MF	Mark
1. Length of the Route	10.00	0.93	9.30	1.00	10.00	0.78	7.80
2. Horizontal Characteristics of the Route	7.50	0.50	3.75	1.00	7.50	0.75	5.63
3. Vertical Characteristics of the Route	7.50	1.00	7.50	1.00	7.50	1.00	7.50
4. Suitability of the Intersection Location	10.00	0.75	7.50	1.00	10.00	0.75	7.50
Total Mark	**35.00**		**28.05**		**35.00**		**28.43**
Sequence		**3**		**1**		**2**	

6.1.3.2 Economic and Financial Marks Allocation

1. Construction Cost

In comparison of the route alternatives construction costs, only the construction cost of the alternative road will be considered. The alternative with less construction cost will be superior to those higher in term of investment budget saving. In assigning multiplying factor values, the route with the least construction cost takes the multiplying factor of 1.00 while the others' will be equal to 1.00 less the difference between the construction costs of such alternative and the one with least, divided by the least construction-cost alternative as showed in equation and
Table 6.4 below.

$$MF_i = 1 - \left(\frac{C_i - C_{min}}{C_{min}} \right)$$

when MF_i = Multiplying Factor of the Route i

C_i = Construction Cost of the Route i (Million Baht)

C_{min} = The Minimum Construction Cost of the Route (Million Baht)

Table 6.4 Multiplying Factors Based on Construction Costs

Route Alternative	Construction Cost (Million Baht)	Multiplying Factor
1	114.7	0.93
2	107.1	1.00
3	131.1	0.78

2. Land Acquisition and Building Compensation Costs

Land acquisition and building compensation costs are a part of project investment. The route with lower cost of land acquisition and building compensation will be more advantageous as it can lower an investment budget. In calculation, the multiplying factor of the route with the lowest costs of land acquisition and building compensation will be equal to 1.00. For other route alternatives, their multiplying factors will be equivalent to 1.00 less the difference between the cost of land acquisition and building compensation of that route and that of the route with the lowest costs, divided by the route with the lowest costs of land acquisition and building compensation, as showed in the following equation and **Table 6.5.**

$$MF_i = 1 - \left(\frac{C_i - C_{min}}{C_{min}} \right)$$

when MF_i = Multiplying Factor of the Route i

C_i = Land Acquisition and Building Compensation Costs i (Million Baht)

C_{min} = The Minimum Costs of Land Acquisition and Building Compensation (Million Baht)

In case the multiplying factor obtained is a minus figure, 0.00 is to be used instead.

Table 6.5 Multiplying Factors Based on Land Acquisition and Building Compensation Costs

Route Alternative	Land Acquisition and Building Compensation Costs (Million Baht)	Multiplying Factor
1	23.3	0.00
2	8.1	1.00
3	10.6	0.70

3. Land Use

The development of Stung Bot border control facility route needs to be complied with the uses of land or activities zones. Regarding this, considerations need to be made on land access potential, activities and major roads connection as well as the convenience and speed of transporation and immigration procedures. These are all important for transportation costs reduction and urban planning for future land use. Accordingly, the route with high potential in accessing activities zones is considered to possess opportunities for transportation and immigration time reduction as well as suit for urban planning for future land use. Its multiplying factor is then set as 1.00.

An access within 1.5 – 2 km.'s distance with bad urban planning for the future means low potential (multiplying factor equivalent to 0.25)

An access within 1 - 1.5 km.'s distance with rather bad urban planning for the future means medium potential (multiplying factor equivalent to 0.50)

An access within 0.5 - 1 km.'s distance with good urban planning for the future means high potential (multiplying factor equivalent to 0.75).

An access within 0.5 km.'s distance with very good urban planning for the future means high potential (multiplying factor equivalent to 1.00).

The above-mentioned factors can be used to determine multiplying factors of the route alternatives with impacts to land uses in the following manners:

Alternative 1 The longest distance of 1 – 1.5 km. for accessing the activities zone with rather bad urban planning for the future. This is owing to the fact that the left-hand side of the route alternative 1 contains some limitations of future land development as it is closed to the canal that borders Thailand and Cambodia. It is, therefore, considered to contain a medium potential, with multiplying factor equivalent to 0.50.

Alternative 2 The longest distance of 0.5 – 1 km. for accessing the activities zone. It is, therefore, considered containing high potential as both the left and right –hand sides of this route alternative 2 are balanced which can be well managed for future land use. Its multiplying factor is equivalanet to 0.75.

Alternative 3 The longest distance of 1.5 - 2 km. for accessing the activities zone with bad urban planning for the future. This is owing to the fact that on the right-hand side of the route alternative 3 (southward) lies Stung Bot Temple which will be an obstacle for future land development. This is, therefore, considered containing low potential, with multiplying factor equivalent to 0.25.

Summary of the routes economic and financial comparisons are displayed in **Table 6.6**

Table 6.6 Marks Allocation Summary on Economic and Financial Comparisons

Economic and Financial Factors	Full Mark	Alternative 1		Alternative 2		Alternative 3	
		Multiplying Factor	Mark	Multiplying Factor	Mark	Multiplying Factor	Mark
1. Construction Cost	15	0.93	13.95	1	15	0.78	11.7
2. Land Acquisition and Building Compensation Costs	10	0.00	0.00	1	10	0.70	7.00
3. Land Use	10	0.50	5.00	0.75	7.5	0.25	2.50
Total Mark	**35**		**18.95**		**32.50**		**21.20**
Sequence			**3**		**1**		**2**

6.1.3.3 Environmental Marking

The environmental criteria used will be those containing different concurrent environmental conditions while the impacts of each alternative can be compared to one another, i.e. air quality, noise, vibration and impacts on relocation and acquisition, with the following marking details:

1. Impacts on Air Quality, Noise and Vibration

   Some parts of the project route are close to impact-sensitive areas, for example, houses, residences, religious places and academies, etc. All of these may be impacted on air quality, noise and vibration caused by project development activities. Therefore, a comparison will be made on the amount of sensitive areas within 500 metres' distance. With reference to this, the fewer amount of sensitive areas the route is close to, the lower impact it will cause, in comparison with those close to more.

No Sensitive Area		means	No Impact
Sensitive Area of	1-60 places	means	Little Impact
Sensitive Area of	61-120 places	means	Average Impact
Sensitive Area of	121-180 places	means	High Impact
Sensitive Area	>180 places	means	Severe Impact

   The above variables can be applied for the multiplying factors determination regarding the impacts on air quality, noise and vibration as follows:

   Alternative 1 : Containing 135 places of sensitive area within 500 metres' distance. It is, therefore, considered to cause high impact to environment, and the multiplying factor will then be equal to 0.25.

Alternative 2 : Containing 158 places of sensitive area within 500 metres' distance. It is, therefore, considered to cause high impact to environment, and the multiplying factor will then be equal to 0.25.

Alternative 3 Containing 119 places of sensitive area within 500 metres' distance. It is, therefore, considered to cause average impact to environment, and the multiplying factor will then be equal to 0.50.

2. Impacts on Relocation and Acquisition

A construction will inevitably cause the buildings, constructions and the agricultural lands to be relocated and acquired. Therefore, a comparison will be made on the amount of buildings to be relocated and the lands and buildings to be acquired. In relation to this, the less the route cuts across the buildings and lands, the lower the impact will be caused, in comparison with the route that cuts more across the buildings and lands.

Impacts to Buildings:

No Buildings Relocated			means	No Impact
Buildings Removed	1-10	Units	means	Little Impact
Buildings Removed	11-20	Units	means	Average Impact
Buildings Removed	21-30	Units	means	High Impact
Buildings Removed	>30	Units	means	Severe Impact

Impacts to Lands:

No Land Acquired			means	No Impact
Land Acquired	1-40	Rai	means	Little Impact
Land Acquired	41-80	Rai	means	Average Impact
Land Acquired	81-120	Rai	means	High Impact
Land Acquired	>120	Rai	means	Severe Impact

The above variables can be applied for multiplying factors determination regarding the impacts on relocation and acquisition as follows:

Alternative 1 : There are 22 units of building to be relocated. It is, therefore, considered to cause high impact to environment. The related multiplying factor will then be equal to 0 . 2 5 . At the same time, there are 73 Rai of land to be acquired which are considered to cause average impact. Hence, its multiplying factor will be equal to 0.50.

Alternative 2 : There are 7 units of building to be relocated. It is, therefore, considered to cause little impact to environment. The related multiplying factor will then be equal to 0 . 75 . At the same time, there are 78 Rai of land to be acquired which is considered to cause average impact. Hence, its multiplying factor will be equal to 0.50.

Alternative 3 : There are 9 units of building to be relocated. It is, therefore, considered to cause little impact to environment. The related multiplying factor will then be equal to 0 .75 . At the same time, there are 89 Rai of land to be acquired which is considered to cause high impact. Hence, its multiplying factor will be equal to 0.25.

Marks summary on route alternatives environmental comparison has been displayed in **Table 6.7**

Table 6.7 Route Alternatives Environmental Comparison

Factors for Comparison	Full Mark	Alternative 1		Alternative 2		Alternative 3	
1. Environmental							
1.1 Impacts on Air Quality, Noise and Vibration	10	0.25	2.5	0.25	2.5	0.5	5.0
1.2 Impacts on Relocation and Acquisition							
- Relocation	10	0.25	2.5	0.75	7.5	0.75	7.5
- Acquisition	10	0.50	5.0	0.50	5.0	0.25	2.5
Total	**30**		**10.0**		**15.0**		**15.0**

6.1.4 Project Routes Selection Summary

A comparison of the 3 route alternatives according to various factors stated can be summarized as showed in **Table 6.8** below.

As from the above, it can be concluded that Alternative 2 has got the highest mark in total, i.e. 8 2.5 0 . The second goes to Alternative 3 , with the total mark of 64.63 . Alternative 1, on the other hand, has got the lowest mark of only 57 .00 . Regarding this, Alternative 2 receives the highest marks for all factors, including Engineering, Economic and Financial as well as Environmental.

Table 6.8 Comparison Results of The 3 Route Alternatives

Comparison Details	Full Mark	Alternative 1		Alternative 2		Alternative 3	
		M.F.	Mark	M.F.	Mark	M.F.	Mark
Engineering Factors:							
1. Length of the Route	10.00	0.93	9.30	1.00	10.00	0.78	7.80
2. Horizontal Characteristic of the Route	7.50	0.50	3.75	1.00	7.50	0.75	5.63
3. Vertical Characteristic of the Route	7.50	1.00	7.50	1.00	7.50	1.00	7.50
4. Suitability of the Intersection Location	10.00	0.75	7.50	1.00	10.00	0.75	7.50
Total in Engineering Factors	**35**		**28.05**		**35.00**		**28.43**
Economic and Financial Factors:							
1. Construction Cost	15	0.93	13.95	1.00	15.00	0.78	11.70
2. Land Acquisition and Buildings Compensation Costs	10	0.00	0.00	1.00	10.00	0.70	7.00
3. Land Use	10	0.50	5.00	0.75	7.50	0.25	2.50
Total in Economic and Financial Factors	**35**		**18.95**		**32.50**		**21.20**
Environmental Factors:							
1. Impacts on Air Quality, Noise and Vibration	10	0.25	2.50	0.25	2.50	0.50	0.50
2. Impacts on Relocation and Acquisition							
- Relocation	10	0.25	2.50	0.75	7.50	0.75	7.50
- Acquisition	10	0.50	5.00	0.50	5.00	0.25	2.50
Total in Environmental Factors	**30**		**10.00**		**15.00**		**15.00**
Grand Total	**100**		**57.00**		**82.50**		**64.63**
Ranking			**3**		**1**		**2**

In addition, after a study on land use has been conducted by the consultant, it was found that the route alternative 2 is most suitable for the project as it contains good urban planning for future land use and supports future land development, with Stung Bot border control facilities as a center. This is an increase of a potential to access each activities zone, being connected with highway no. 5, rapidly and conveniently, within the accessing distance of less than 1 km. And due to its short distance, not only it is an increase of utility and services efficiency but also convenient for maintenance and security services.

In conclusion, Alternative 2 is the route that is most suitable for the project and can be further processed for the feasibility study and project detailed design respectively.

6.1.5 Design of Bridge Structures, Drainage System And Other Structures

(1) Design of Bridge Structures

The design of bridges structure is primarily based on ASSHTO LRFD. According to the structure type selection, prestressed I-girder was found to be the most suitable structure for this project.

For this project the bridge is to design the overpass structure which has two bridge structures. Each bridge is 11.0 m wide and 540 m long, shown in **Figure 6.2** and **Figure 6.3**

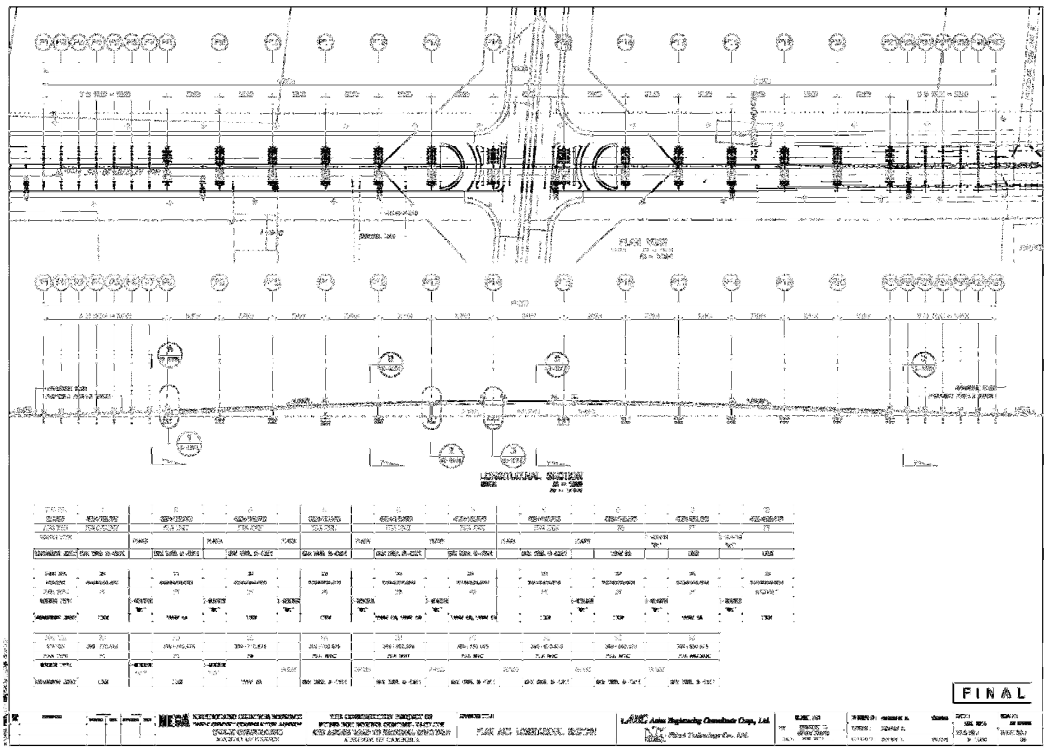


Figure 6.2 Overpass Plan

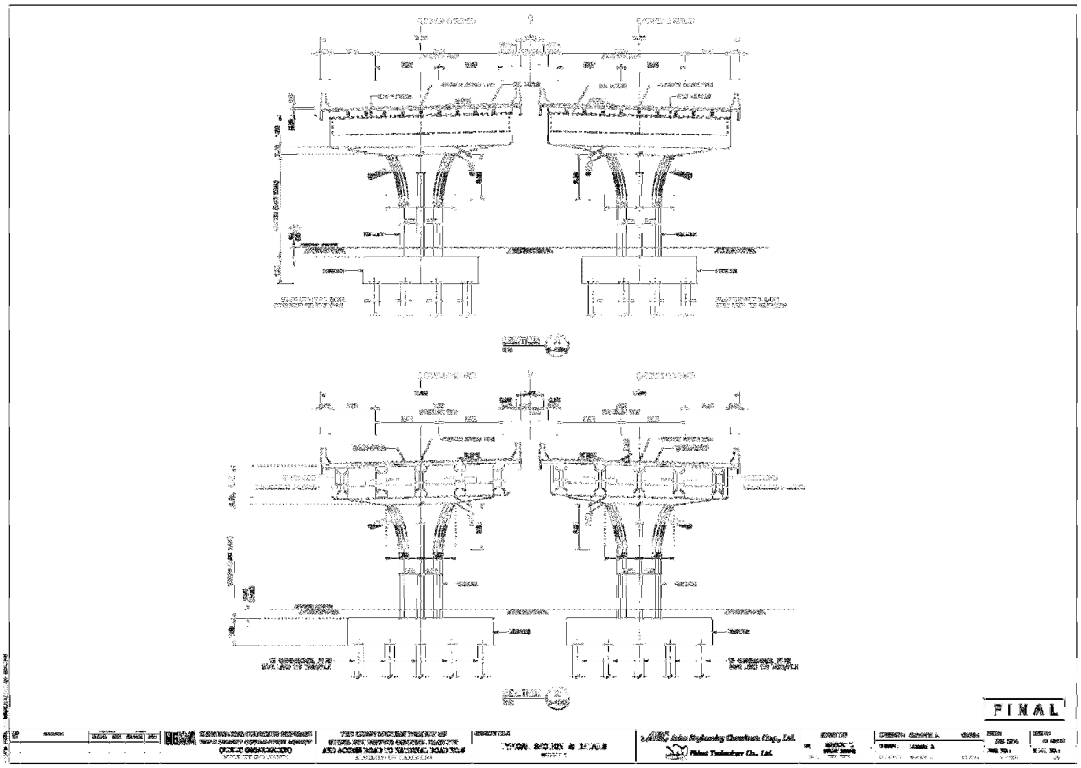


Figure 6.3 Section

(2) Design of Border Control Facility Structure and Other Structures

In general, the border control facilities are designed to be reinforced concrete structure. The typical structure will have floors, beams, and columns supported by pile foundations. ACI and AISC standards are the main codes for the design. The list of relevant buildings is as follows.

1. Terminal Building
2. Departure Booth Check
3. Arrival Booth Check
4. Common Control Area Building
5. Control Area Building
6. Canteen and Toilet Building
7. X-ray Building
8. Physical Check Building
9. Cross Dock Warehouse
10. Power House
11. Dormitory Building
12. Truck Gate
13. Guard House

14. Garbage House
15. Pump House

6.2 GEOTECHNICAL INVESTIGATION AND SOURCES OF CONSTRUCTION MATERIALS

6.2.1 Geotechnical Investigation

The results of soil boring, test pit, sampling and laboratory testing in the project area were performed. The soil profile are shown in **Figure 6.4**

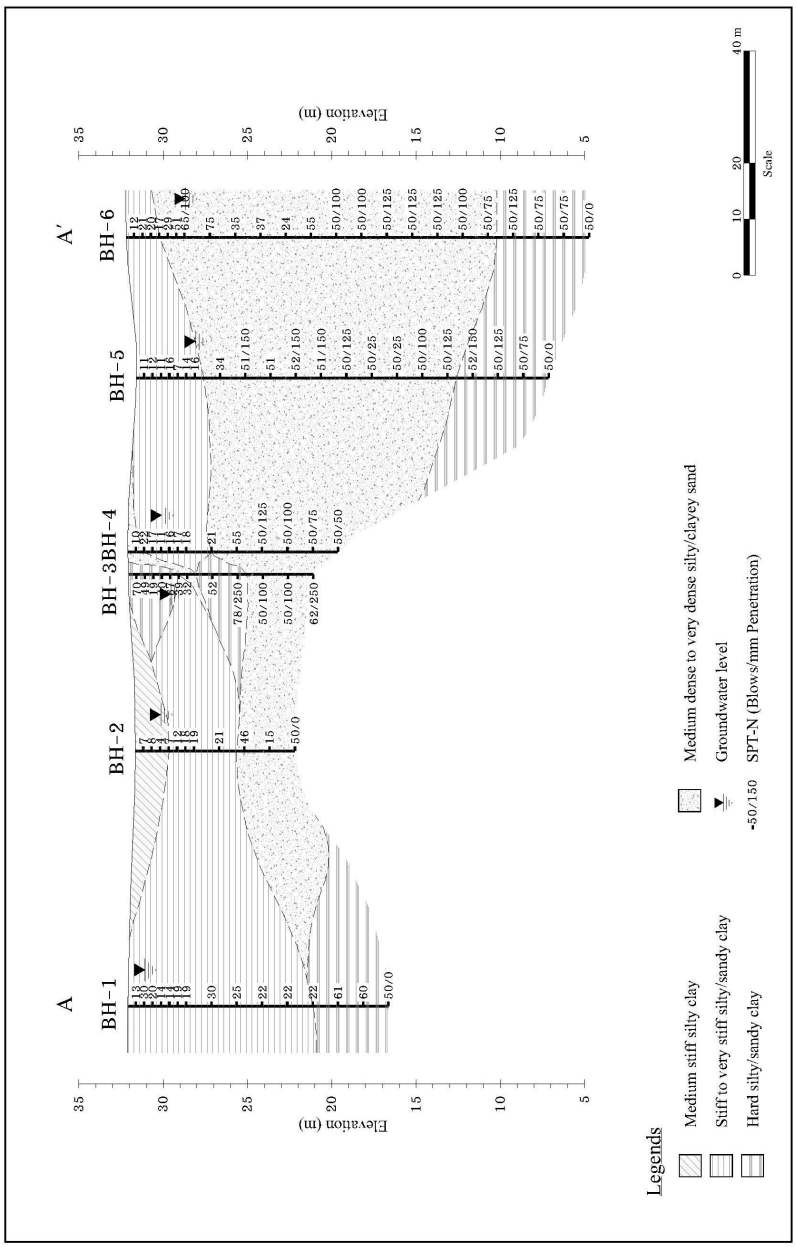


Figure 6.4 Soil Profile

6.2.2 Material Sources and Material Testing

The material survey is identified the potential sources of construction material within the project vicinity, inspected the production capacity of various sources and examined the engineering properties of the material relevant to the project.

For material sources i.e. sand, laterite and crushed rock are estimated quantity, price, production rate, location and distance from project site and also the quantity of each materials will be provide more 100% of real using. The samples of materials consist of Sand Concrete Sand Embankment laterite Crushed Rock (Embankment) and Crushed Rock (Concrete) will be tested by ASTM and AASHTO standard. The names of the material sources are presented in **Table 6.9** and the location maps are shown in **Figure 6.5**.

Table 6.9 Names of Material Sources

Sand	Laterite	Crushed Rock	Embankment
TEK PURSAT (SC-1)	KO NAY (L-1)	PHNOM THOM 3 (RA-1/RC-1)	JUNG TEK PEW 1 (E-1)
-	PHNOM TA NGEN (L-2)	KO NAY (RA-2/RC-2)	JUNG TEK PEW 2 (E-2)

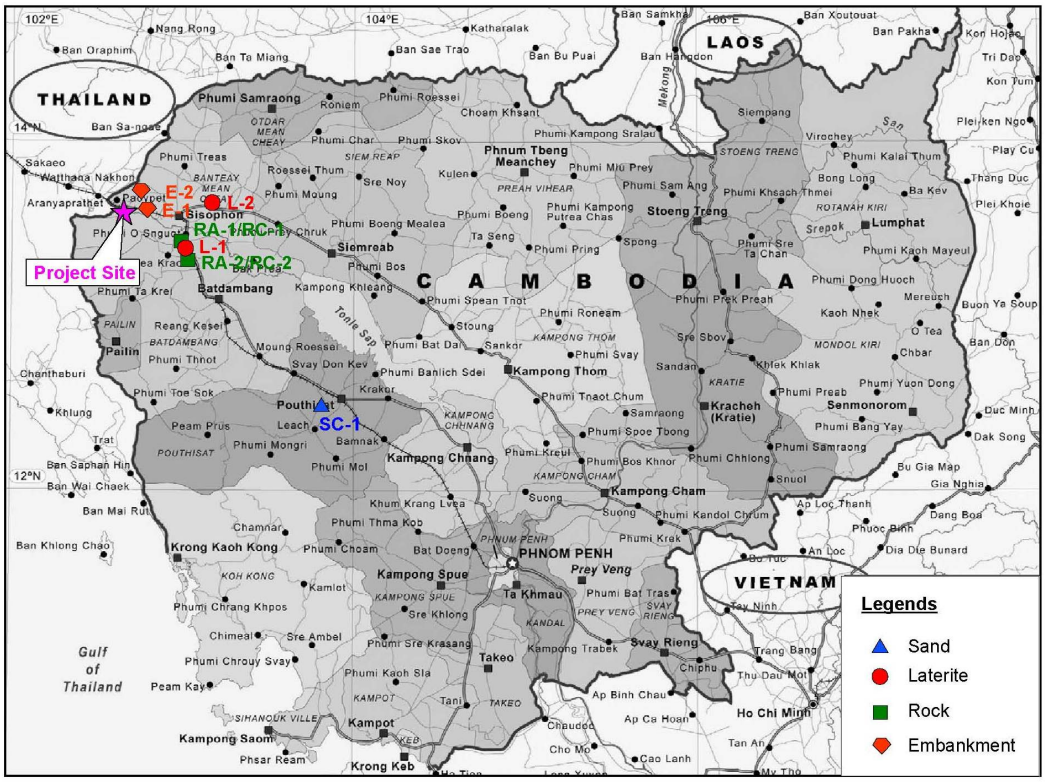


Figure 6.5 Map of Material Sources

6.3 PAVEMENT DESIGN, STABILITY AND SETTLEMENT ANALYSIS

6.3.1 Pavement Design

The pavement type in the project area is designed as rigid pavement. The structure of the pavement is 25 cm thick of jointed reinforced concrete supported by 15 cm of aggregate subbase (crushed rock) on embankment of CBR more than 6%.

The pavement type for the extension to the National Road No.5 is designed as flexible pavement, i.e. asphalt concrete pavement. The thickness of the asphalt concrete pavement is 10 cm which is supported by 20 cm of crushed rock base CBR not less than 80% on 15 cm of laterite subbase CBR not less than 25% and 15 cm of type A selected material CBR not less than 10%.

6.3.2 Load Carrying Capacity Calculation

The bearing capacity factors are obtained from the internal friction angle or cohesion which is based on the standard penetration value. The allowable loads of spread footing based on Terzaghi's bearing capacity with the factor of safety of 3.0 for the representative soil profile are calculated. Also the allowable capacities with the factor of safety of 2.5 of 4 driven pile sizes are calculated.

6.3.3 Slope Stability Analysis

The slope stability of the fill with surcharge for the maximum height of 3.5 m on stiff to very stiff clayey soil ground is analyzed. The factor of safety (FS) is 5.291 therefore the embankment is stable.

6.3.4 Settlement Calculation

The soil parameters for consolidation in the fill area are estimated from the index properties averaged from the tested soils of BH-1 to BH-4. The heights of the fill area in the area of near the Border is about 3.5 m and decreasing height until to the area near the National Road No. 5 is about 1.5 m. The consolidation settlements of the stiff to hard subsoil condition are estimated. As the consolidation settlements of the varied heights are small so the represented consolidation settlement of the area may be approximated
0.10 m.

6.4 THE STUDY AND ANALYSIS OF HYDROLOGY AND DRAINAGE WORKS

The procedure of study and analysis of hydrology and drainage works of this project are as following :

- Collecting Hydrologic Data and Site Reconnaissance
- Preparing Design Criteria
- Design of Drainage Structure
- Flood Protection of Project Area

1) Collecting Hydrologic Data and Site Reconnaissance

1.1 The collected data and information are as follow:

- Topographic map scale 1:50,000 and satellite image of project area
- The quantity of rainfall and the analysis result of the relation of rainfall intensity – duration time and frequency of occurrence or IDF curve of rainfall data of observation station at Sra Kaew province.

1.2 Site Reconnaissance for Investigation of Drainage Condition

- The project area is low land area with rice farming and land levels are a little incline from west to east.
- The border line between Thailand and Cambodia is Khlong Phrom Hoti which is 15-20 meter width natural canal and close to project area. Water of Khlong Nam Sai flow from west to east direction.
- The recent rainy season (B.E 2556), both side along Khlong Nam Sai of Thailand and Cambodia were inundated about 0.80-1.00 m. depth and more than 2.00 m. at low land area.
- Most of soil characteristic in project area is clay.

2) Design Criteria

2.1 Design criteria of hydrology: In order to estimate peak runoff discharge affects project site, there are main issue as follow:

- The method of estimating peak runoff depends on size and characteristic of catchment area. For this project, catchment area is smaller than 25 sq.km. then the runoff shall be analyzed by rational method.
- Return period of rainfall

Rainfall return period of occurrence shall be defined as type of drainage structure.

R.C.P. or side ditch

- 5 Years for internal area and road in light community area.
- 10 Years for road in dense community area.

Pipe culvert

- 10 Years for catchment area no more than 25 km2 or for design R.C.P.
- 20 Years for catchment area more than 25 to 1,000 km2 or for design R.C. box culvert

Bridge design

- 50 Years for catchment area 25 to 1,000 km2

2.2 Hydraulic Design Criteria

1. Determination type of drainage structure
   - Box culvert shall be utilized for no more than 10.00 m. stream width and/or 1.50-3.50 water depth including none log or any floating material causing flow obstruction.

- R.C.P. shall be utilized for no more than 5.00 m. stream width and no more than 1.50 water depth including none log or any floating material causing flow obstruction.

2. Flow Characteristic of Drainage Structure

Flow characteristic shall be open channel flow and calculate by manning equation

3) Hydrology Analysis

1. The analysis of catchment area in this project by using topographic map 1:50,000 scale found that size of area is about 24 sq.km and flow direction is shown as **Figure 6.6**

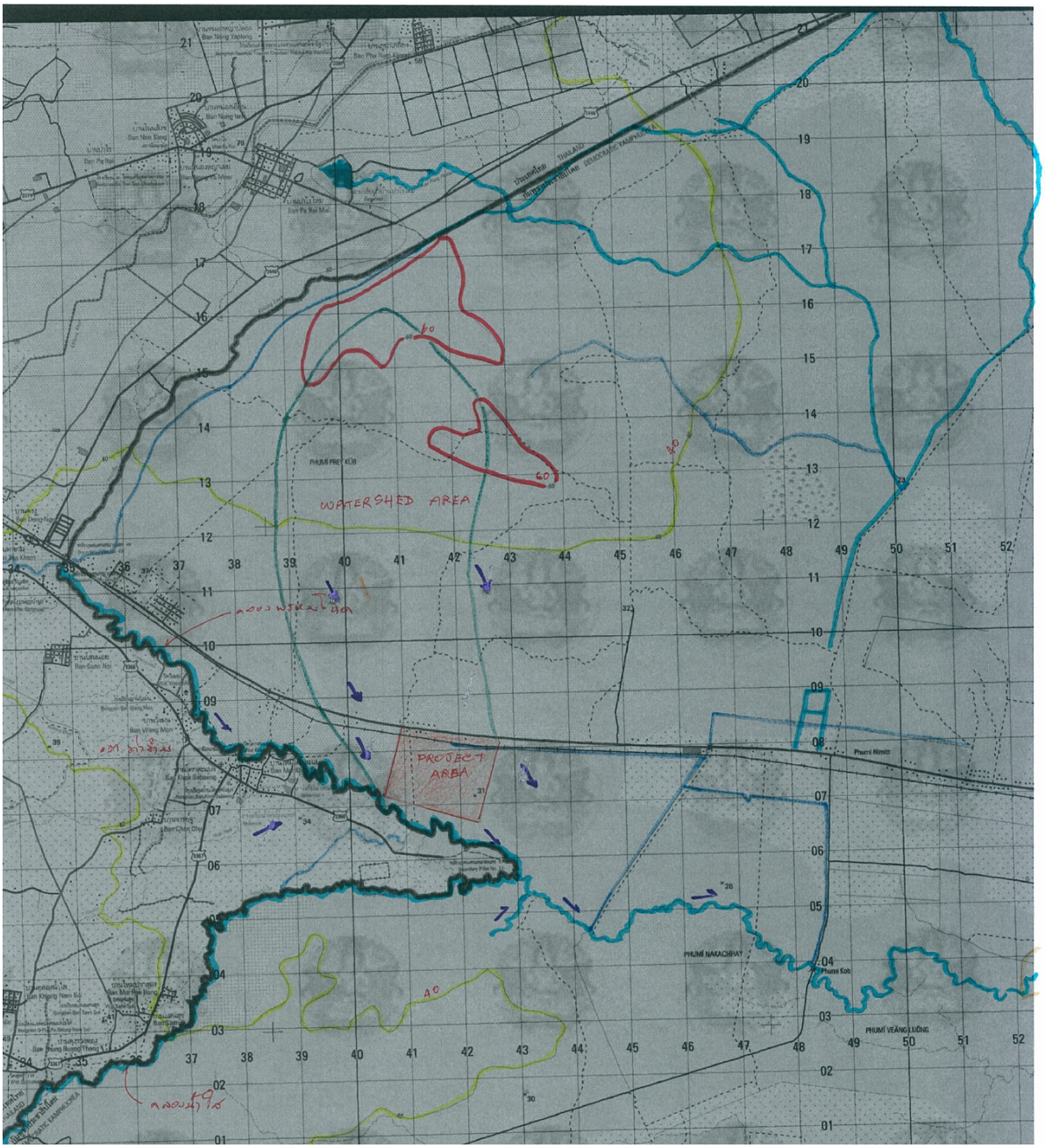


Figure 6.6 Catchment Area and Flow Direction

The design of drain ditch along the boundary of project area shall be application of these catchment features for calculating drain ditch.

4) Design of Drainage System

Drainage design comprises of two parts, Master plan for conceptual design and drainage detailed design for 1st alternative.

Conceptual design of master plan will prepare main drainage ditch surround the boundary project area. The main drainage ditches are as the following:

- The north bound; there is side ditch along the north side of highway no. 5 to receive runoff water from the northern part of catchment area and convey it to the eastern low land and there is side ditch at the south of highway no. 5 to receive water of area between highway and track then drain it to the eastern low land as well.
- The east bound; there is side ditch to receive runoff water from the inside area and convey it to the southern low land which connect to the Prom Hoti canal.
- The west bound; there is side ditch along the western boundary of project area to receive runoff water from the southern part of catchment area of highway no.5 and convey it to the southern low land which connect to the Prom Ho ti canal.
- The south bound; there is ditch which extend from east and west ditch.

The drainage detailed design of both alternatives comprise of three zone area.

1) Detail of drainage layout at BCF zone; surface area shall be designed to incline to the curb of road which there are inlets and manholes for receive surface flow and drain to R.C.P. under foot path and then convey to facultative ponds and next to main ditch along the boundary area.
2) Detail of drainage layout at container stock yard; the surface slope shall be design to incline from track to both side of its area. The surface runoff shall flow on incline surface to the side ditch along the internal road. At the cross dock building path, the flow will be drained to steel grating cover of manhole in front of buildings and drain to R.C.P. and then convey to facultative ponds and next to main side ditch.
3) Detail of drainage layout at accommodation and development area; the design provide main ditch surround area as well while the internal area shall be comprised of R.C.P. or gutter along the internal road to receive water from divided catchment area. These water shall be conveyed to drain to facultative ponds and main ditch at boundary line of project area as same as other area.

The design procedure of pipe or gutter are as the followings:

1) Analyze and divide optimum catchment area for optimum pipe size and pipe depth.
2) Design the optimum pipe size conform to connectivity flow for benefit of construction cost.
3) Design the flow characteristic comply with design criteria.

Details of calculation shall be proposed in the design report and detailed drawings.

5) Recommendations for Improving Drainage System in the Vicinity Area for Acceleration of Flow Discharge

In order to prevent the water detention at west boundary of project area resulting to the flow obstruction of BCF area the existing drainage system in vicinity area of Cambodia should be improved as follow:

1. Improve existing canal by extend its capacity or lining
2. Construct the regulator gates for draining runoff water to the other canal during flood time.

Details of recommendation are shown on **figure 6.7 and 6.8**

Figure. 6.7 The Recommended Canal and Regulator Gate

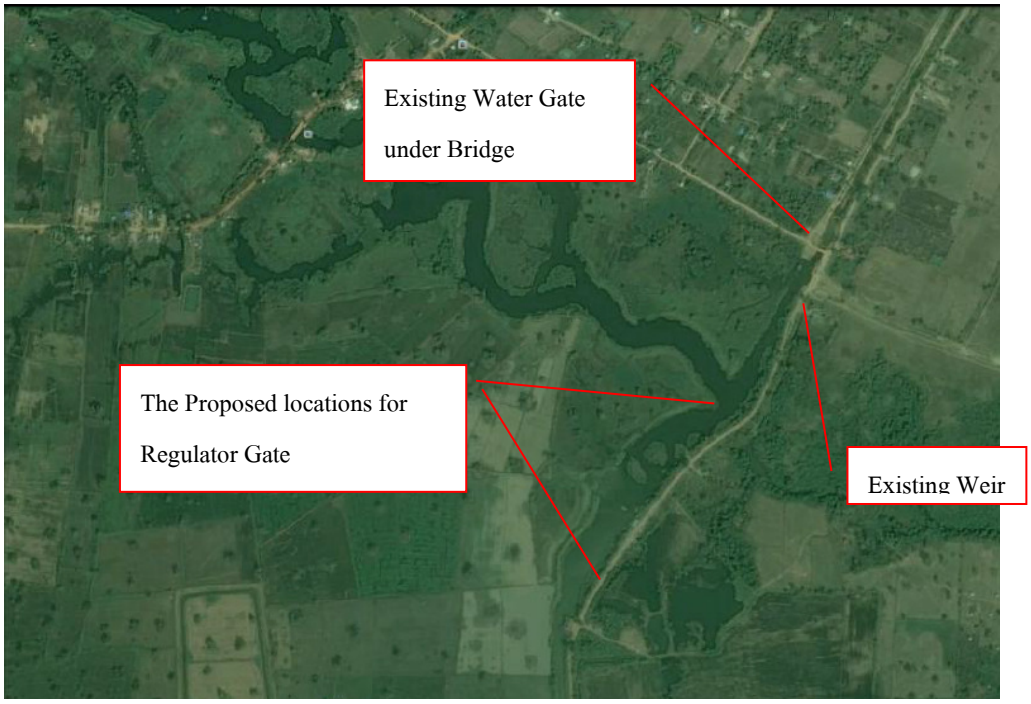


Figure 6.8 Existing Canal and Existing Weir and Water Gate

6.5 THE SURVEY AND DATA COLLECTION OF LAND OCCUPATION IN PROJECT.

The consultants have led the practice from Bureau of Location and Design, The Department of Highways (Thailand) for estimation. For Detailed Design Stage and Conceptual Design Stage, the details of land acquisition and building compensation are shown as follow.

No.	Alternative	Area (Ha.)	Land Acquisition (Baht)	Number of Building (Building)	Building Compensation (Baht)	Amount (Baht)	Amount (Million US Dollar)
1	Detail-Design	111.63	286,734,000	48	23,449,500	310,183,500	9.56
2	Conceptual -Design	205.58	587,356,000	71	59,242,450	646,598,450	19.92

6.6 STUNG BOT'S ZONING PLAN

The following zones have been proposed to support the collection and distribution of goods (**Figure 6.9**):

- **A1 : Stung Bot Border Zone**

  Buildings located within Stung Bot's border crossing are significant components for customs facilitation and thus shall be positioned to be easily accessible, clearly noticeable, designed with unique features and to be the first landmark to be noticed upon entering the area. Meanwhile, goods inspection areas are to be designed to accommodate large access and circulation of trucks that park in line for customs facilitation both entering and leaving the the area. Other than, assign parking spaces for large, middle-sized trucks, and trailers during the transfer of goods to facilitate the process and minimize traffic congestion that may occur within the project area. Approximate area of 130 rai or 208,400 sq.m. Accounts for 21.99 % of the overall space usage.

- **A2: Office and Custom Zone**

  Inclusive of government buildings that provide services for offices such Immigration Bureau, Customs Office, Ministry of Tourism, Department of Forestry are designed to be arranged in conjunction with the Cross-borders office and Customs Office to facilitate coordination of work between operational staff across the different divisions as well as visitors. The office buildings will perform through utilization of the Electronic Data Interchange (EDI) system. This reduces the consumption of paper as well as demand for staff in the area since information will be computed and transferred via electronic documents.

  Buildings and goods inspection areas must be positioned towards outskirts of the site for convenient access for delivery truck inspection and facilitate services regarding the transporation and transition of goods. Since Stung Bot's border crossing involves logistic services across the Thailand – Cambodia border, thus, a Customs Office within the area must be provided in the area to provide services for the users. Information regarding the type, quantity, origin, destination etc. from the Unloading Station Office must be sent over to the Customs Office for preliminary inspection through use of the Electronic Data Interchange (EDI) to expedite the process. Approximate area of 17 rai or 27,000 sq.m. Accounts for 2.86% of the overall space usage.

- **A3 : Residentail Zone**

  Zone provided for Residential buildings that support the staff of Customs, Migration and Quarantine. Including, assign Recreation Center for all staff. This includes support for various logistics activities to expedite the distribution of goods. Approximate area of 39 rai or 62,500 sq.m. Accounts for 6.60% of the overall space usage

- **B1 : Cross Dock Warehouse**

  In general, ware houses or cross dock warehouses are designed to be located adjacent to unloading stations and container yards since operational activities are interconnected. For example, in the case that an item is to be stored in the warehouse, the vehicle is able to park to unload, record, and assign the good to be

stored according to category or customer group. Approximate area of 47 rai or 74,500 sq.m. Accounts for 7.87% of overall space usage

- B2 : **Container Yard**

  Goods that is large in size, or that has weight that exceeds the handling capabilities; for example, cars, machines etc. These items require an open-area for storage. Hence, a concrete yard is to be provided for this purpose. Approximate area of 79 rai or 125,000 sq.m. Accounts for 13.27% of overall space usage

- **B3 : Maintenance Zone and Parking**

  Aside from logistic activities which is the main activity in the area, within unloading stations has to be machine maintenance activities to store damaged machines during building operation as well as machinery parts for future maintenance services. Approximate area of 26 rai or 40,900 sq.m. Accounts for 4.33% of the overall space usage.

- **C1 : Logistics Zone**

  Zone provided for office buildings that support the delivery and unloading of goods to targeted areas. This includes support for various logistics activities to expedite the distribution of goods. Approximate area of 52 rai or 83,950 sq.m. Accounts for 8.86% of the overall space usage.

- **C2: Commercial Zone**

  The zone addresses commercial buildings as well as other buildings that support sales and retail; to accommodate for activities related to sales and investment in the cross-border area. Approximate area of 51 rai or 82,000 sq.m. Accounts for 8.68% of the overall space usage

- **D : Green Area**

  To create good environmental conditions, landscape design should contain open green spaces with D1 approximate area of 51 rai or 82,234 sq.m. Accounts for 8.68% ,D2 approximate area of 161 rai or 257,800 sq.m. Accounts for 27.21 of overall space usage

- **Infrastructure (Project Plan 20 year)**

  Areas to support infrastructure, public utility, public assistance and roads network in the project. Approximate area of 16 rai or 25,260 sq.m. Accounts for 27.21% of overall space usage

- **Expansion Area**

  An area prepared to accommodate future expansion and development around the Truck Terminal to support related logistic activities within the area. Approximate total area of 650 rai or 1,040,035 sq.m.

- **Buffer Area**

  Due to the border area being a sensitive zone, a buffer area of 300m in length is required all along between the border and the project road.

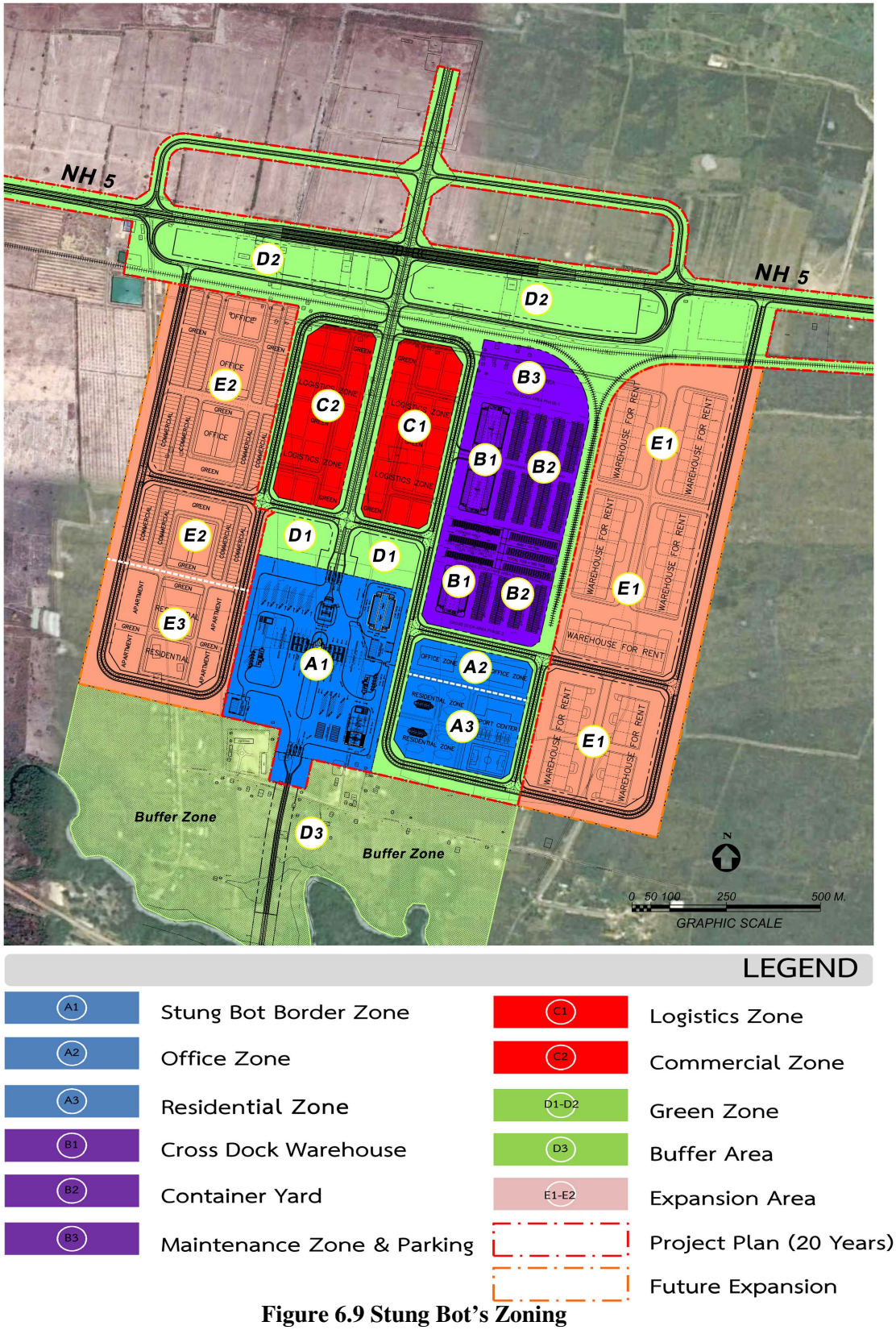


Figure 6.9 Stung Bot's Zoning

Table 6.10 Area of Stung Bot 's Zoning Plan

Item	Zone	Area		
		Rai	s.qm.	%
A1	Stung Bot Border Zone	130	208,400	21.99
A2	Office Zone	17	27,064	2.86
A3	Residential and Recreational Zone	39	62,553	6.60
B1	Cross Dock Warehouse	47	74,552	7.87
B2	Container Yard	79	125,746	13.27
B3	Maintenance Zone & Parking	26	40,900	4.32
C1	Logistics Zone	52	83,954	8.86
C2	Commercial Zone	51	82,234	8.68
D1	Green Area	51	82,234	8.68
D2	Green Area & Parking	161	257,807	27.21
	Infrastructure	16	25,262	2.67
	Project Area	592	947,572	100
E	Future Expansion	650	1,040,035	
E1	Warehouse & Related Industry	224	358,894	
E2	Commercial Zone	131	210,113	
E3	Residential Zone	50	79,553	
	Infrastructure	245	391,476	
	Future Expansion Area	650	1,040,035	
	Grand Total (Project Area+Expansion Area)	1,300	2,080,070	

6.7 AN ANALYSIS ON BORDER CHECKPOINT LANES REQUIREMENT

The study analyzed traffic consultant to design the Cambodian border so that border has the ability to accommodate the traveling public and freight applications. Procedures for this checkpoint. outbound trucks can pass through with the transaction documents only and no surveillance. This process will take about 3 minutes or 20 cars per hour.

For inbound country is similarly procedure. The border pass is 3 minutes and then conduct an item with the X-ray machine which takes about 6 minutes or 10 cars per hour.

The study of traffic will have a truck passing in and out shown in **Table 6.11**

Table 6.11 Number of Trucks Crossing During Rush Hour. (Vehicles / hour)

Year	Outbound	Inbound
2016	27	31
2021	36	41
2026	47	54
2036	69	79

Assuming that Consultants the analysis of the documents shown in **Table 6. 12,** the number of output countries should be at least 3 input channels as well as the number should be at least 4 channels.

Consultant analysis number of x-ray machine for suitable of trucks crossing the border. The analysis of cross-border per hour found that in the first year should be the year of the X-ray 2 should have all 4 channels in **Table 6.13**. The consultants have calculated that opens the queuing process found to be queuing up to 19 cars in one hour so there should be a set number of parking spaces for at least 19 x-ray units.

Table 6.12 An Analysis on Border Checkpoint Lanes Requirement

Traffic Volume	Year	Traffic Volume	Capacity	Suggested Amount of Lane
Direction		Car/Hour	Car/Hour/Lane	Lane
Cambodia Outbound Trucks	2016	27	30	1
	2021	36	30	2
	2026	47	30	2
	2036	69	30	3
Cambodia Inbound Trucks	2016	31	20	2
	2021	41	20	3
	2026	54	20	3
	2536	79	20	4
Total Lane	Inbound			4
	Outbound			3

Table 6.13 Number of X-ray Lane

Traffic Volume	Year	Traffic Volume (Average)	Capacity	Waiting Line
Direction		Car/Hour	Car/Hour/Lane	Lane
Number of Truck Inbound to Cambodian	2016	6	10	2
	2021	21	10	2
	2026	27	10	3
	2036	40	10	4

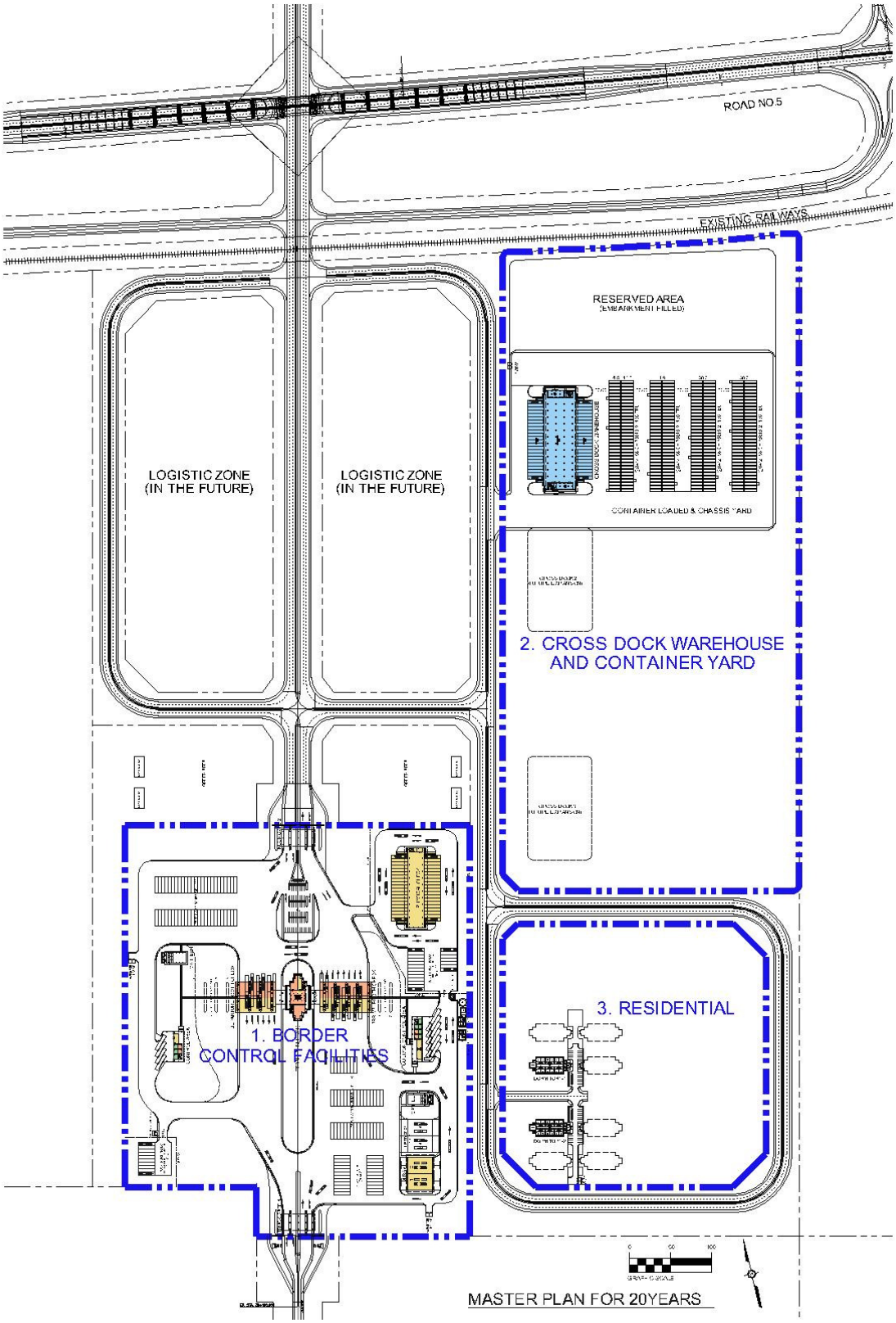
Table 6.14 Maximum Queue Length

Traffic Volume	Year	Traffic Volume	Capacity	Waiting Line
Direction		Car/Hour	Car/Hour	Car/Hour
Cambodia Inbound Trucks (with Goods)	2016	31	30	1
	2021	41	30	11
	2026	54	40	14
	2036	79	60	19

6.8 MASTER PLANNING

The master plan can accommodate up to 20 years. It consists of land uses and buildings over three plots of land. They are:

1. Border Control Facility (BCF) approximately 49.5 acres.
2. Cross Dock Warehouse and container Yard approximately 70 acres
3. Residential Area approximately 25 acres


ROAD NO.5
EXISTING RAILWAYS
RESERVED AREA
(EMBANKMENT FILLED)
LOGISTIC ZONE
(IN THE FUTURE)
LOGISTIC ZONE
(IN THE FUTURE)
CONTAINER LOADED & CHASSIS YARD
2. CROSS DOCK WAREHOUSE
AND CONTAINER YARD
3. RESIDENTIAL
1. BORDER
CONTROL FACILITIES
MASTER PLAN FOR 20YEARS

Master Plan

1. Border Control Facility (BCF)

The BCF consists of two clusters of buildings; inbound and outbound:

1. Terminal: Terminal is a two-storey building with the area of approximately 1,500 square meters. It is used as a central office.
2. Inbound Document Examination Building: The building has four medians.
3. Outbound Document Examination Building: The building has three medians.
4. Inbound Common Detention Building: The building is one-storey high with approximately 1,300 square meters total area.
5. Outbound Detention Building: The building is one-storey high with 900 square meters total area.
6. Canteen and restrooms: The canteen and restrooms are one-storey buildings with the area of 800 square meters on each side, inbound and outbound.
7. Inbound X-ray Building: The X-ray building is one-storey high with the area of 1,200 square meters.
8. Physical Check Building: Physical check building is one-storey high with the area of 2,200 square meters.
9. Other support buildings, such as, power substation and water house.

2. Cross Dock Warehouse and Container Yard

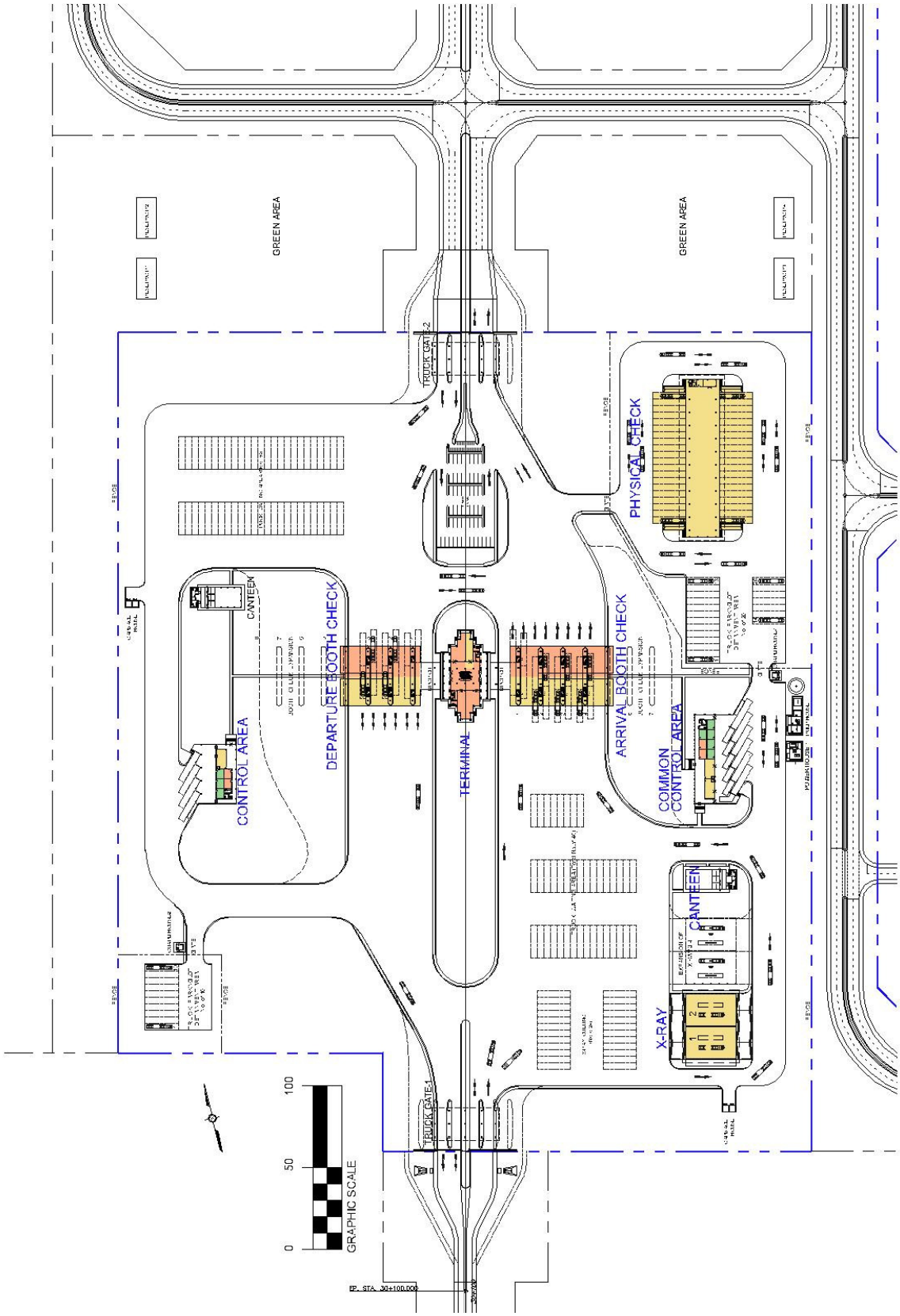
A cargo terminal has approximately 5,300 square meters. There is one building. It is 38-meter wide and 120-meter long. There are 24 loading bays for trucks. On the back of the warehouse, there is a container yard that can accommodate 272 containers per level.

3. Residential Zone

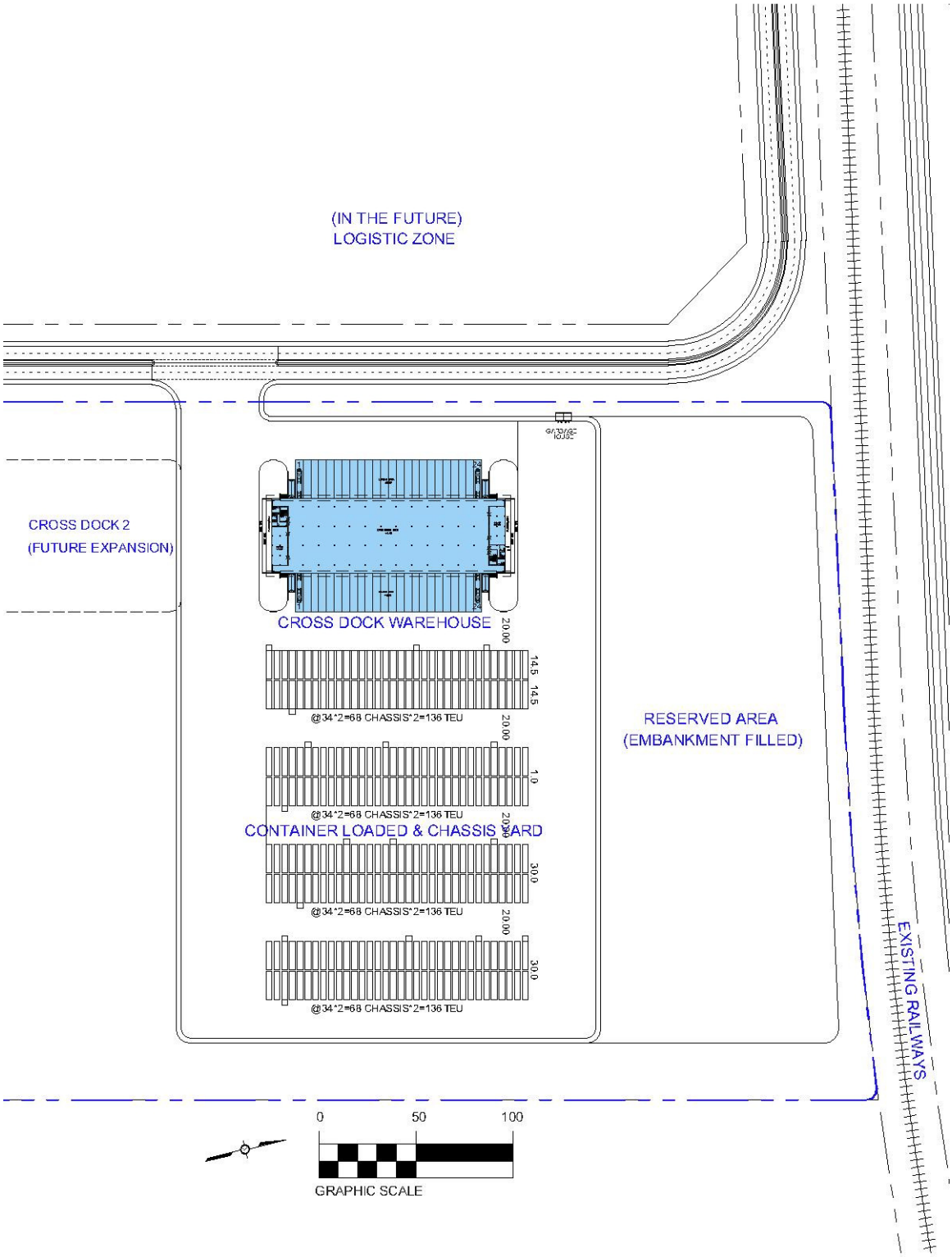
The residential zone consists of two midrise buildings. They are of the same design. They are two-storey high with the area of approximately 1,600 square meters per building. There are parking lots located in front of the buildings. Each building has 12 dwelling units per floor. Combined two floors, there are 24 dwelling units total. Each unit is supposed to house four persons with a restroom located within the unit.

At the entrance to the building, there is an office for the house keeper. There are two staircases located at both ends of the building. Each floor has common dining room and common living room.

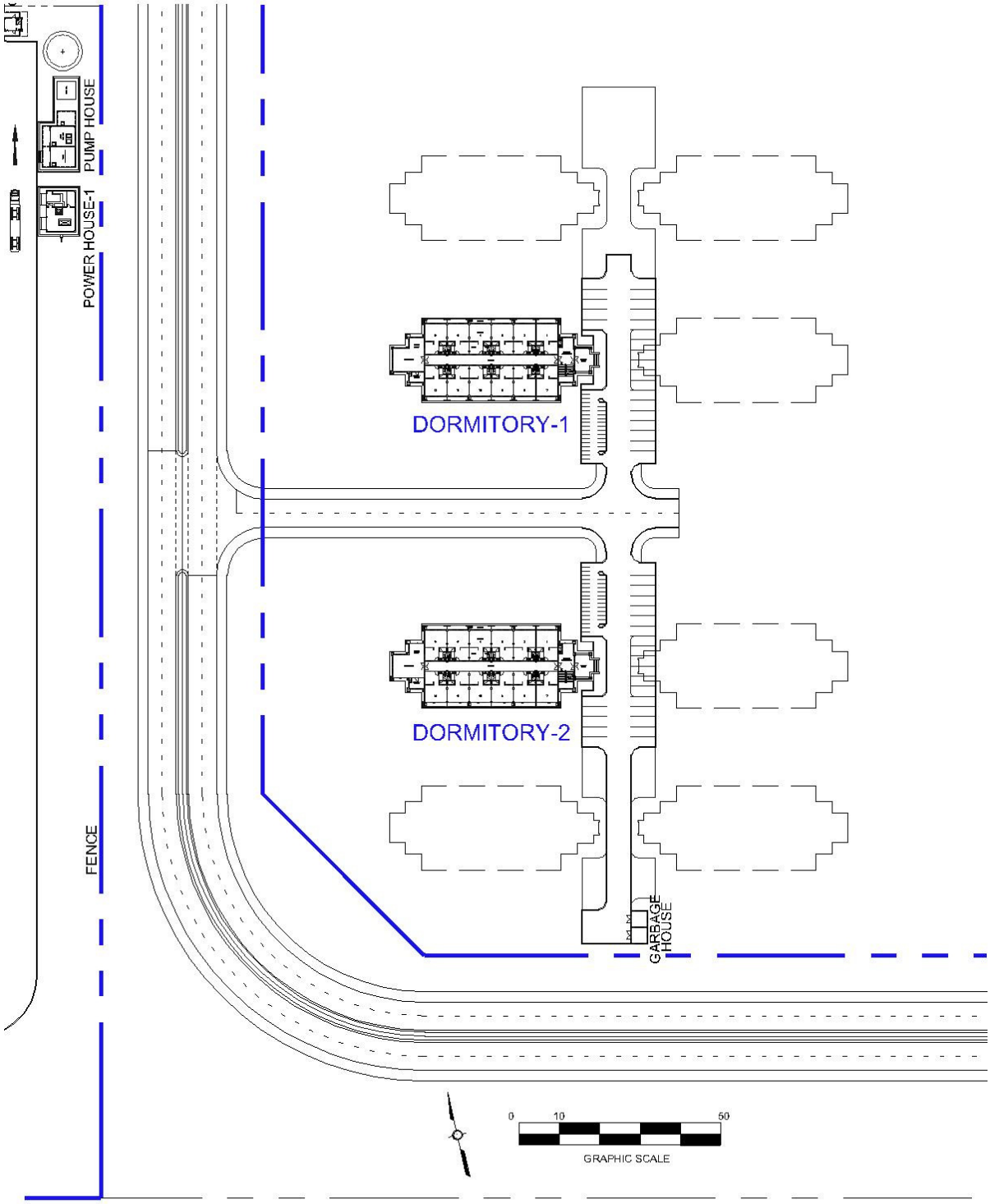
The details of the BCF, the cross dock warehouse, the container yard and the residential building are shown on the following pages.



Border Control Facility



Cross Dock Warehouses and Container Yard

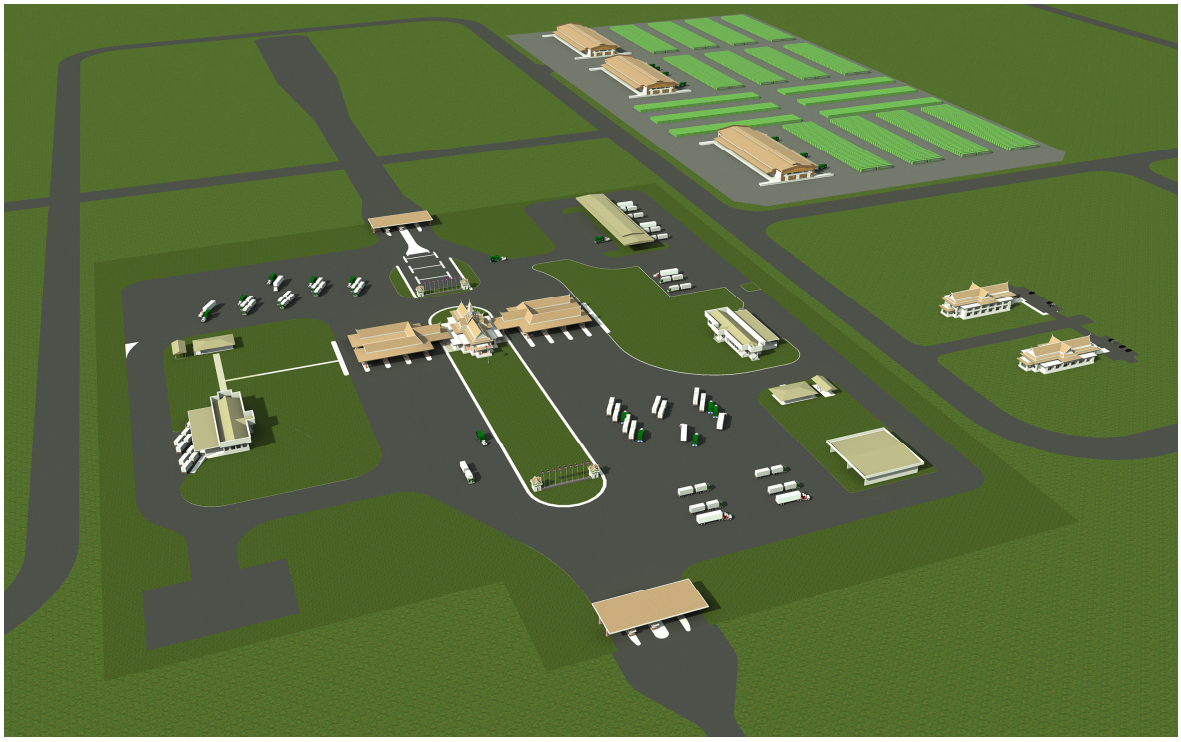


Residential Zone

6.9 ARCHITECTURAL DESIGN CONCEPT

The representative has informed the consultant that MPWT desires the architectural style of Bavet BCF so that they can be of the same design and standards. The details of the Bavet BCF are as follows:

View of Bavet BCF



Overall Perspective View of the Project for the Next 20 Years

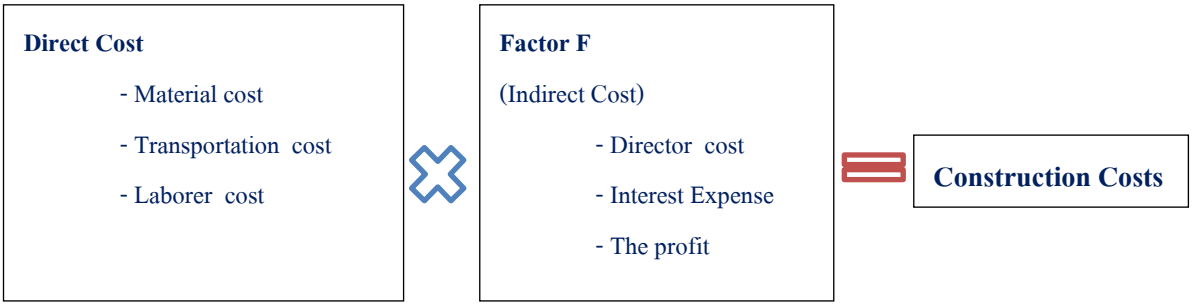
6.10 GUIDELINE TO CALCULATE THE PRICE. ESTIMATED COST OF THE PROJECT AND INVESTMENT.

6.10.1 Guideline to Calculate the Price

Consultants use guidelines established by the Comptroller General's Department (CGD), which is standard for most theoretical analysis. Consists of five main sections.

1. Direct Cost The rules and procedures for calculating the cost or the cost of construction.
2. Indirect Cost A fraction of the cost of construction operations. Interest income consists of the Director and to the ease of its use in practice. Calculated and prepared in the form of tables called Factor F
3. To calculate the cost of compliance and other expenses necessary.
4. The criteria for the construction of a fair price.
5. Guidelines and procedures related to the rules.

Layout guidelines to calculate price



6.10.2 Investment Cost Estimate

Investment Cost Estimate consist of these items .

1. Construction cost of Border Control Facility and Road.
2. Construction cost of Dormitory.
3. Construction cost of Cross Dock Warehouse and Container Loaded & Chassis Yard.
4. Construction cost of Interchange at National Road No.5.
5. Cost Estimate of Equipment.

6.10.2.1 Construction Cost of Border Control Facility and Road.

Construction cost estimate consist of these items .

1. General and Site Facilities
2. BCF Zone consist of these item.

Terminal Building

Arrival Truck Booth Check

Departure Truck Booth Check

Control Area Building

Common Control Area Building

Truck Gate

Guard House

Arrival Toilet Building

Departure Toilet Building

Arrival Canteen

Departure Canteen

X-Ray Building

Physical Check Building

BCF Road and Landscape

Landscape

3. Road Work consist of these item.

   Main Road RC.pave.thk. 25 c.m.

   Minor Road RC.pave.thk. 25 c.m.

4. Utility building

   Garbage house

   Pump house

5. Drainage

   Drainage and Manhole

6. M&E WORKS consist of these item.

   Electrical work

   Mechanical work

   Information System

   IP Megapixel closed circuit TV System (CCTV)

7. Power House

Table 6.15 Construction Cost of Border Control Facility and Road

Year 2014

DIVISION	DESCRIPTION	Amount (Baht)	Amount in US$
1	GENERAL	56,492,885	1,740,760.02
2	EARTHWORKS	147,473,375	4,544,213.95
3	SUBBASE AND BASE COURSES	12,890,474	397,204.38
4	SURFACE COURSES	159,800,444	4,924,057.69
5	STRUCTURES	26,664,012	821,619.32
6	INCIDENTALS	64,257,753	1,980,025.05
7	BUILDING WORKS	221,618,278	6,828,899.58
8	E&M WORK	18,046,437	556,079.15
	TOTAL AMOUNT	**707,243,657**	**21,792,859.14**

Building for Border Control Facility

Table 6.16 Construction Cost of Building for Border Control Facility

Year 2014

NO.	DESCRIPTION	QUANTITY (sq.m.)	UNIT RATE (Baht / sq.m.)	AMOUNT (Baht)	AMOUNT in US$
	BUILDING WORKS				
1	TERMINAL	1,555	40,728	63,332,669	1,951,519.71
2	DEPARTURE TRUCK BOOTH CHECK	1,551	14,119	21,898,065	674,762.43
3	COMMON CONTROL AREA BUILDING	1,367	15,721	21,490,489	662,203.47
4	ARRIVAL TRUCK BOOTH CHECK	1,950	14,406	28,092,293	865,630.07
5	CONTROL AREA	920	19,594	18,026,521	555,465.48
6	ARRIVAL AND DEPART CANTEEN	331	33,306	11,024,234	339,698.45
7	X-RAY BUILDING	2,016	5,813	11,719,491	361,121.97
8	PHYSICAL CHECK	1,773	12,982	23,016,240	709,217.63
9	TRUCK GATE	815	9,623	7,842,488	241,656.80
10	GUARD HOUSE	13	175,120	2,276,565	70,149.60
11	POWER HOUSE	75	23,297	1,747,257	53,839.62
12	PUMP HOUSE	100	35,438	3,543,843	109,199.26
13	GARBAGE HOUSE	136	29,182	3,968,761	122,292.58
14	BCF + ROAD			3,639,360	112,142.48
	TOTAL AMOUNT			**221,618,278**	**6,828,899.55**

Construction cost of Border Control Facility and Road = 21.79 Millions of USD.

6.10.2.2 Construction Cost of Dormitory

Construction cost of Dormitory 2 Buildings

Table 6.17 Construction Cost of Dormitory

Year 2014

No.	DESCRIPTION	QUANTITY (sq.m.)	UNIT RATE (Baht / sq.m.)	AMOUNT (Baht)	AMOUNT in US$
1	DORMITORY 2 BUILDINGS	2,850	20,575	58,638,840	1,806,885.04
2	ROAD AND PARKING	3,843	1,800	6,917,353	213,149.88
	TOTAL AMOUNT			**65,556,193**	**2,020,034.92**

6.10.3 Construction Cost of Cross Dock Warehouse and Container Loaded & Chassis Yard

Construction cost of Cross Dock Warehouse and Container Loaded & Chassis Yard consist of these items .

1) Cross Dock Warehouse
2) Container Loaded & Chassis Yard

Table 6.18 Construction Cost of Cross Dock Warehouse and Container Loaded & Chassis Yard Consist

Year 2014

NO.	DESCRIPTION	QUANTITY (sq.m.)	UNIT RATE (Baht / sq.m.)	AMOUNT (Baht)	AMOUNT in US$
1	CROSS DOCK WAREHOUSE	5,133	10,082	49,925,423	1,538,391.60
2	CONTAINER LOADED & CHASSIS YARD	70,146	1,200	84,200,982	2,594,551.58
	TOTAL AMOUNT			**134,126,405**	**4,132,943.18**

6.10.4 Construction cost of Interchange at National Road No.5

Construction cost of Interchange at National Road No.5 consist of these items .

1) Road work
2) Overpass
3) E & M work
4) Contingency
5) Supervision

Table 6.19 Construction Cost of Interchange at National Road No.5

Year 2014

NO.	DESCRIPTION	Amount (Baht)	Amount in US$
1	ROAD WORK	130,124,110	4,009,617.28
2	OVERPASS	186,561,478	5,748,666.62
3	E&M WORK,LANDSCAPE AND ROAD ACCESSORY	33,159,537	1,021,771.07
	TOTAL AMOUNT	**349,845,124**	**10,780,054.97**

6.10.5 Cost Estimate of Equipment.

Equipment of BCF consist of these items

1) X-RAY Machine
2) Forklift Truck
3) Reach Stacker

Table 6.20 Cost Estimate of Equipment

Year 2014

NO.	Description	Unit	Quantity	Unit Price (Baht)	Amount (Baht)	Amount in US$
1	X-RAY MACHINE	each	2	139,000,000	278,000,000	8,566,234.25
2	FOLKLIFT TRUCK	each	10	1,500,000	15,000,000	462,206.88
3	REACH STACKER	each	1	28,000,000	28,000,000	862,786.18
	TOTAL AMOUNT				321,000,000	9,891,227.31

6.10.6 Project Investment Cost Summary

Investment Cost Estimate consist of these items .

1) Construction cost of Border Control Facility and Road.
2) Construction cost of Dormitory.
3) Construction cost of Cross Dock Warehouse and Container Loaded & Chassis Yard.
4) Construction cost of Interchange at National Road No.5.
5) Equipment.
6) Improvement of Exiting Road
7) Construction Supervision
8) Contingency
9) Flooding Mitigation

Table 6.21 Investment Cost Summary

Year 2014

NO.	DESCRIPTION	Million Baht	Million US$
1	BORDER CONTROL FACILITY AND ROAD	707.2437	21.7929
2	DORMITORY	65.5562	2.0200
3	CROSS DOCK WAREHOUSE AND CONTAINER YARD	134.1264	4.1329
4	INTERCHANGE	349.8451	10.7801
5	IMPROVEMENT EXISTING ROAD	7.0364	0.2168
	TOTAL 1	**1,263.8078**	**38.9427**
6	CONSTRUCTION SUPERVISION	37.9142	1.1683
7	EQUIPMENT	321.0000	9.8912
	TOTAL 2	**1,622.7220**	**50.0022**
8	CONTINGENCY	162.2722	5.0002
	TOTAL 3	**1,784.9942**	**55.0024**
9	FLOODING MITIGATION	36.3474	1.1200
	GRAND TOTAL	**1,821.3416**	**56.1224**

CHAPTER 7
INITIAL ENVIRONMENTAL EXAMINATION

7.1 REVIEW OF ENVIRONMENTAL LAW

The Kingdom of Cambodia has used Sub-Decree on Environmental Impact Assessment Process, 1999 to determine an Environmental Impact Assessment. The main provision of this Sub-Decree is to determine an Environmental Impact Assessment (EIA) upon every private and public project or activity, and it must be reviewed by the Ministry of Environment (MoE), prior to the submission for a decision from the Royal Government. The project will be approved by the Royal Government.

The Sub-Decree classified the type and size of the proposed project(s) and activities, including existing and ongoing activities in both private and public prior to undertaking the process of EIA. Considering the Stung Bot Border Control Facility and Access Road to National Road No. 5 project: building facilities, residence, infrastructure and Highway (access NR5), must conduct and submit the EIA to MoE before operating project as following **(Table 7.1)**

Table 7.1 Infrastructure Project Must Proposed EIA

D.	INFRASTRUCTURE	
1.	Urbanization development	All sizes
2.	Industrial zones	All sizes
3.	Construction of bridge-roads	≥ 30 Tones weight
4.	Buildings	Height ≥ 12 m or floor ≥ 8,000 m^2
5.	Restaurants	≥ 500 Seats
6.	Hotels	≥ 60 Rooms
7.	Hotel adjacent to coastal area	≥ 40 Rooms
8.	National road construction	≥ 100 Kilometers
9.	Railway construction	All sizes
10.	Port construction	All sizes
11.	Air port construction	All sizes
12.	Dredging	≥ 50,000 m^3
13.	Damping site	≥ 200,000 people

Source: GoC, 1999

Therefore, regarding to the construction of the Interchange (bridge road) of Stung Bot Border Control Facility and Access Road to National Road No. 5 project is weight over 30 tons must submit EIA to MOE before operating the project.

7.2 INITIAL ENVIRONMENTAL EXAMINATION

Development projects of Stung Bot crossing and road links to NR5 in Kingdom of Cambodia has both positive and negative impact on environment. Thus, the initial environmental examination will be done by environmental checklist, anticipating the current environment compare with the implementation of the project in construction phase. As well as the level of impact which can identify impact as follows

1) Identify as positive and negative impact

(1) Positive Impact**;** benefits of environmental resources, value for human use and quality of life value in project and surrounding areas due to construction activities and implementation of projects or as a result of project development.

(2) Negative Impact; bad impact in natural resources, value for human use and quality of life value in project and surrounding areas due to construction activities and implementation of projects or as a result of project development.

2) Impact magnitude consider of

Activities of project may result in a change or affect natural resources and environment in different levels of severity. To determine the impact, magnitude will be considered in various factors including the quality standards of environmental resources, boundaries of space/distance, effect duration and community health. Effects or impact magnitude can be classified into 4 levels

(1) No impact or no significant impact means activity or result of project cause no changes or impact both direct and indirect to resources, nature and environment

(2) Low impact means activity or result of project cause some changes in natural resources, environment but still in acceptable level, affected distance is low, shore duration of impact, might affect in mental health of residences such as cause aggravate

(3) Moderate impact means activities or results of project cause impacts on the environment and natural resources on higher marks or still in standard level. The area affected by the extent of the impact is quite wide but limited in the project area only. Activity occurred in many areas affected long period but not permanently. Activities affect public health but not as severe as to be life-threatening.

(4) Severe impact means activities or results of project cause impacts on natural resources and environmental changes over the standard set. Or cause severe environmental changes with severe/permanent damages. Extent of the impact is spread out wide. Impacts occur throughout the project area. Long- term impact permanently. Activities affect the life-threatening public health.

The summary of expected environmental impact using Environmental Checklist in both construction and operation phase had been summarized in **Table 7.2**.

Table 7.2 Summary of IEE

Environmental factor/impact	Negative impact	
	Construction	**Operation**
1. Physical Environment		
1.1 Topography		
- Change of topography	No impact	No impact
1.2 Hydrology and surface water quality		
- Water flow and quality	Low	No impact
1.3 Climate and air quality		
- Suspended particle and pollution	Low	Low
1.4 Noise level		
- Affect community	Low	Low
2. Biological Environment		
2.1 Ecology		
- Change of ecology	No impact	No impact
2.2 Aquatic ecology		
- affect aquatic animal	Low	No impact
3. Value of Human Use		
3.1 Land use	Low	No impact
- Change of land use pattern		
3.2 Transportation		
- Blockage of traffic	Low	Moderate
3.3 Infrastructure		
- Use community's infrastructure	Low	No impact
3.4 Drainage and flood control		
- blockage of natural water flow	Low	Low
3.5 Waste and wastewater management		
- Waste and wastewater generate from project area	Low	No impact
4. Quality of Life Value		
4.1 Socio-economic		
- Socio-economic impact	Low	Low
4.2 Migration and expropriation		
- Migration and expropriation	Moderate	No impact
4.3 Aesthetic and tourism		
- Aesthetic and tourism impact	Low	No impact

CHAPTER 8
PUBLIC RELATION AND PUBLIC PARTICIPATION

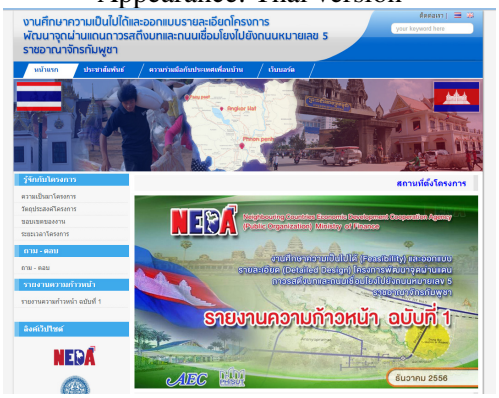
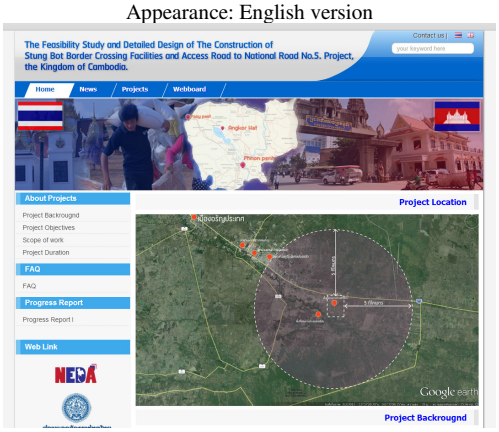
The public relations and public participation on Feasibility Study and Detailed Design of Stung Bot Border Control Facility and Access Road to National Road No.5, Kingdom of Cambodia had arranged to gather comments and suggestions from the public. The obtained advices and suggestions will be analyzed and concluded to improve the Detailed Design.

The media relations preparation purpose of informing the public, and involved sectors of the project, which summarized as

Table 8.1 Media Relations

	Media Relations	Publishing
Document	PowerPoint 	Power point for the Public participation seminar on Wednesday, Oct 29, 2014 from 09.00-12.00 hours at conference room, Leehengchai Hotel, Poipet
Publication	Brochure 	Project summary, for instance, concept of the design and zoning of the Stung Bot Border Crossing Facilities

Table 8.1 Media relations using at the Seminar (Cont'd)

	Media Relations	Publishing
Exhibition	Exhibition board 	Exhibition had been arranged in front of the conference room. The board had provided concept of design and zoning of the Stung Bot Border Crossing Facilities
Project poster		The poster had been install to promote the project
Site	Appearance: Thai version  Appearance: English version 	Project website, consultants create website to publish information and promote the project to the target audience and interested www.Neda-Stungbot.com evident of 6,550 persons had visited (Retrieve in September 30, 2014 at 17.30 hours)

The seminar was accomplished

Mr. Nong Teaun, Deputy Governor of Poipet opened the seminar, and Mr. Somkiat Triamjangarun, project consultant reported

The consultant presented the project

During the Seminar

Figure 8.1 Seminar Activities

CHAPTER 9
SOCIO-ECONOMIC FEASIBILITY STUDY

Feasibility study aims to evaluate the feasibility of the project by considering the benefits arising With Project compares to Without Project whether is worth cost-efficient resources which are used to develop the project or not. Benefits government in consideration to promote or support a particular project when resources and budget are limited.

Feasibility of project comprises of 2 studies namely Economic Feasibility Study and Financial Feasibility Study. Economic feasibility study focuses on society reward-receive or return on investment, and economy impact. Financial feasibility study focuses on the returns to investors or entrepreneurs.

The Assumption for analysis as Follows :

1) The construction period from Development of project plan is 3 years, Project's Benefit period is 20 years and Total is 23 years.
2) The capital cost and project's benefit are constant price (year 2014).
3) The discount rate is 12 %per year and conformed to Guideline of Asean Development Bank and World Bank for developing country.
4) The conversion from market price to economic price will use Conversion Factor by deducting indirect resource allocation costs such as TAX, transfer payment, subsidy from market price to receive actual economic price.

9.1 CAPITAL COST EVALUATION

The future development includes construction of border crossing building, office buildings, interchange, container yard, utilities, facilities, and access roads link Thailand – Cambodia through Stung Bot border crossing toward NR5 of Cambodia. The cost components of investment and implementation comprise of investment cost and other cost as follows

1) Investment Cost

Investment cost arising from the Stung Bot Border Control Facility and Access Road to NR5 consists of investment cost which summarized in Table 9.1 as financial value of 1,821.34 million Baht or economic value of 1,702.12 Baht.

2) Operation and Maintenance Cost (O&M)

Operation and Maintenance cost is categorized into 3 costs as

- Border Control Facility and Road Dormitory Cross Dock Warehouse and Container Yard and Interchange are calculated as 3% of construction cost (Operation and Maintenance Cost report in Establishment study and detail design of The Nakhon Phanom Border Transport Center)
- Equipment consists of Cargo Scanning (Songkhla Customs officer, information providing), Mobile X-Ray machine, which is calculated the O&M cost as 1% of construction costs with 20 usable years. Therefore the Replacement Cost in 20th

year or in 2039 of Forklift Truck and Reach Stacker will cost of 3% and every 10 years of Replacement Cost (Operation and Maintenance Cost report in Establishment study and detail design of The Nakhon Phanom Border Transport Center)

9.2 PROJECT'S BENEFIT

9.2.1 Direct Benefit

Direct Benefit is directly arising benefit from With Project: remove border crossing from Poipet to Stung Bot to support expansion of trade and transport service. Provide rapidly and convenient transport to entrepreneurs in both the Thailand and Cambodia. The direct benefit arising as following

1) Value of Travel Time (VOT)

In case of Without Project, transport still takes at least 3 hours a trip. Whereas, the With Project will reduce the travel time to 2.5 hours a trip. As a result, overhead driver's salary will be reduced and also benefit the project development.

2) Vehicle Operation Cost (VOC)

In spite of reducing driver's salary, reducing transport cost with affect Vehicle Operation Cost directly benefit Developmental Benefit (from the study of Economic Analysis of Transportation Improvements, Project for improvement in Vietnam and Cambodia: ADB 2007). Stung Bot border crossing will also links Poipet – O'Neang. and Srisophon estates, these estates will benefit from the project. The estimation of VOT and VOC benefit have been shown in **Table 9.3**

9.2.2 Indirect Benefit

Indirect Benefit is expected benefits from trade value of Cambodia to Thai. The project development in future expects incremental Benefit regards to the study "Economic Analysis of Transportation Improvements, Project for improvement in Vietnam and Cambodia (ADB 2007)", has defined economic growth rate as 1.0-1.5 due to remove border crossing from Poipet to Stung Bot. Therefore, the economic flexibility rate is used in the study is 1.5. In the case of develop Stung Bot border control facility will efficiently improve transport, and directly benefit Cambodia.

9.3 ECONOMIC FEASIBILITY STUDY

Feasibility Analysis is an analysis of costs and benefits. The current value of the investment cost and benefit will be adjusted to the financial value, into economic value. Indicator has mentioned above.

The analysis has summarized in **Table 9.1**

Table 9.1 Economic Feasibility Analysis

Indicator	Result
NPV at 12% (Million Baht)	353.21

B/C ratio at 12%	1.73
EIRR	15.06%

9.4 SENSITIVITY ANALYSIS

The analysis is determined to make assumptions affect the project in crisis situations that may result failure or loss which can be divided into 3 cases are

Case 1 10% increased investment cost, fixed benefit

Case 2 Fixed investment cost, 10% reduced benefit

Case 3 10% increased investment cost, 10% reduced benefit

The result has shown in **Table 9.2**

Table 9.2 Sensitivity Analysis

Indicator	Case		
	Case 1	Case 2	Case 3
NPV at 12% (Million Baht)	201.77	166.45	15.01
B/C Ratio at 12%	1.58	1.56	1.42
EIRR	13.63%	13.49%	12.13%

Sensitivity analysis of all cases by switching value of investment cost and benefit are pass defined criteria refer that should further develop.

9.5 SOCIAL RETURNS ANALYSIS

Economic Analysis is purpose to analyze the economic feasibility of the project. This reflects the possibility of further developing project that will benefit the economic growth. Additionally, the Social Return has been analyzed in 5 kilometer radius to determine effect on Social welfare as income distribution and reduce poverty rate. The compensation will be paid to the land expropriation as

1) Income distribution; promote the employment for people in the surrounding area advantage income distribution. And the surrounding communities benefit from the cross-border for example service
2) Promote investment to the local entrepreneurs in service business for instance accommodation, hotel and restaurants.
3) For the people who was expropriated (sacrifice to the society), the government should pay special consideration

In order to achieve the objectives of national development should create the project to support a return to a low income population for instance, social welfare as income distribution and reducing poverty as well as reducing the impact of the migration/ expropriation.

9.6 RESULT OF FEASIBILITY STUDY

Establishing Stung Bot Border Control Facility and Access Road to National Road No. creates direct benefit to international relations and prepares for the trade expansion in the future. The benefit with Project comprises of saving traveling time with the VOT of 180.40 million Baht, saving truck transport due to reducing transport cost with the net VOT of 441.29 million Baht and increased trade value of 2,002.16 million baht with the total expected benefit of 2,623.86 million baht. The economic feasibility analysis of project revealed all the criteria passed defined indicators. With the Sensitivity analysis of all cases by switching value of investment cost and benefit are pass defined criteria refer that should further develop.