

THE KINGDOM OF THAILAND
MINISTRY OF COMMUNICATIONS
DEPARTMENT OF HIGHWAYS

FINAL REPORT

FOR

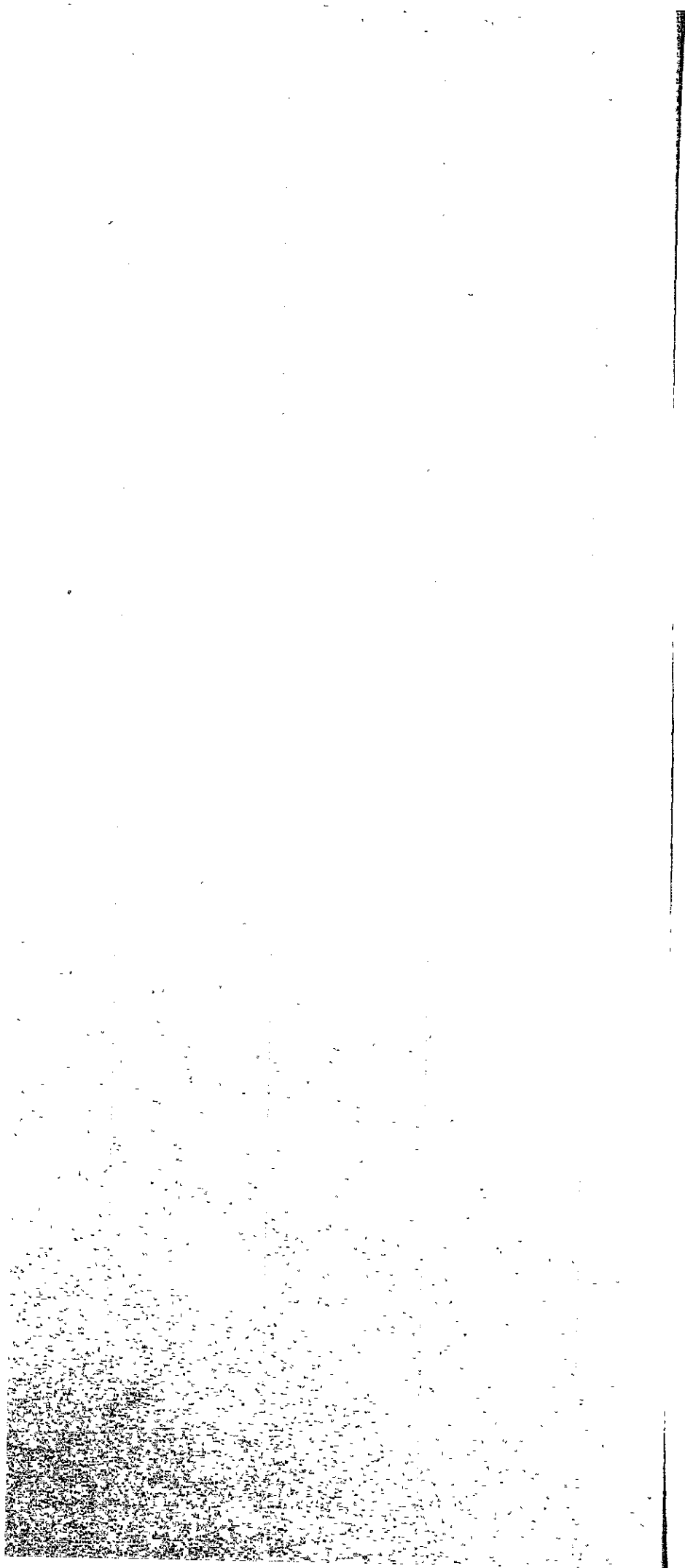
**ROAD DEVELOPMENT STUDY
IN THE NORTHEASTERN REGION**

VOLUME 1 : MAIN REPORT

MARCH 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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MARCH 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

No.13874

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61.4
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国際協力事業団	
受入 月日 '84.9.26	122
登録No. 09068	61.4
	SDF

PREFACE

In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a study on the Project to improve the road network in the Northeastern Region of Thailand and entrusted it to the Japan International Cooperation Agency (JICA).

The JICA sent to Thailand a survey team headed by Mr. Masahiko Tohi from March 29, 1982 through December 23, 1982.

The team exchanged views with the officials concerned of the Government of Thailand on the project and conducted a field survey in the region involved. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

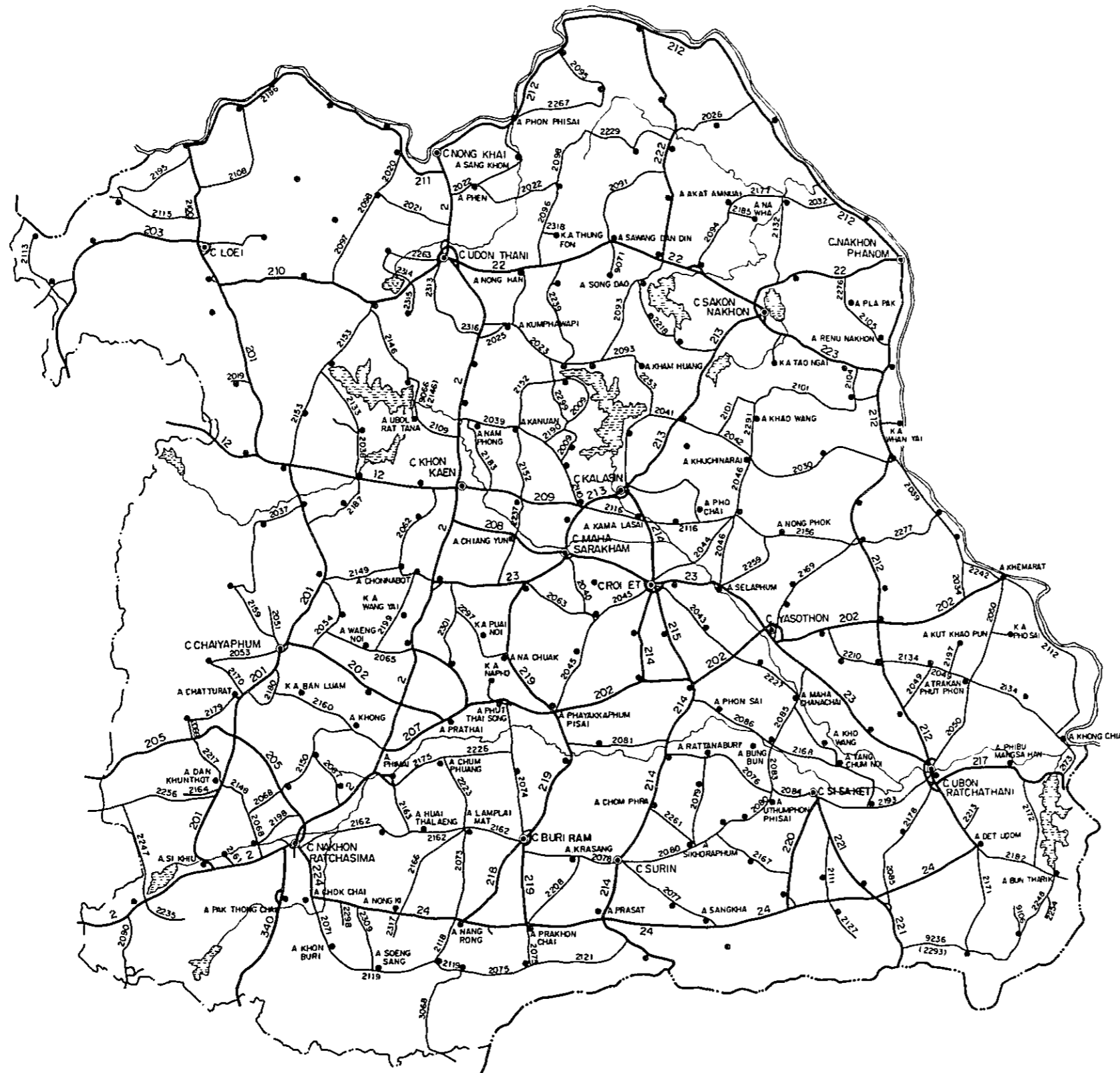
March 1983

A handwritten signature in cursive script, appearing to read 'Keisuke Arita', written in dark ink.

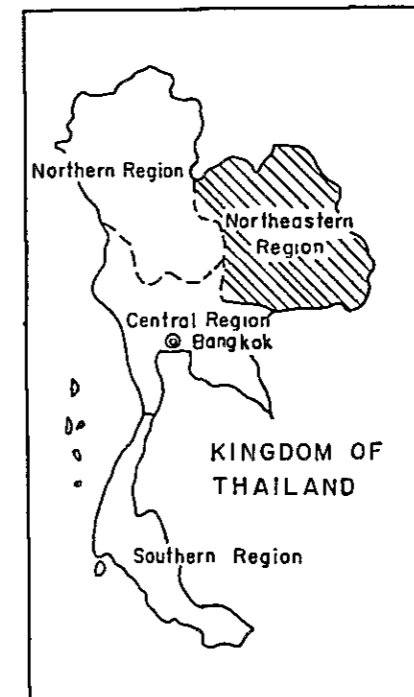
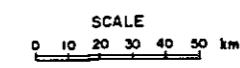
Keisuke Arita
President

Japan International Cooperation Agency

THE STUDY AREA



- LEGEND**
- NATIONAL HIGHWAYS
 - PROVINCIAL AND RURAL ROADS
 - CHANGWAT, AMPHOE
 - ☪ RIVER, RESERVOIR



ROAD DEVELOPMENT STUDY IN THE NORTHEASTERN REGION

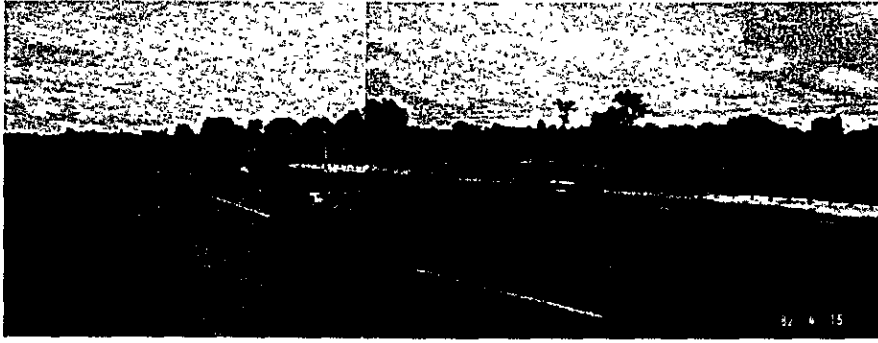
VOLUME 1 MAIN REPORT

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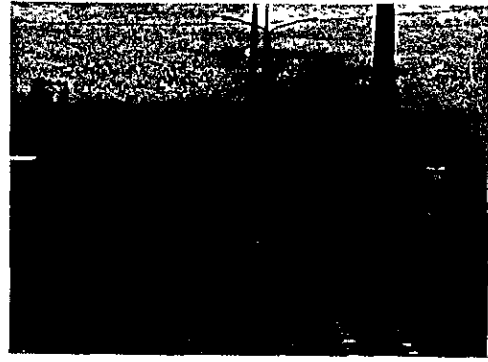
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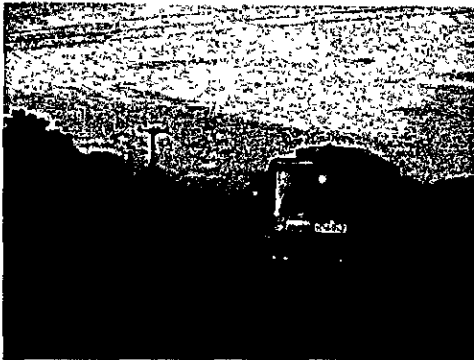
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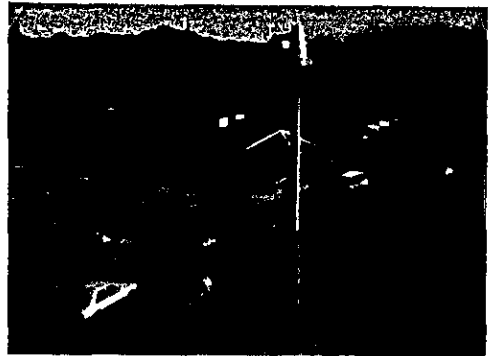
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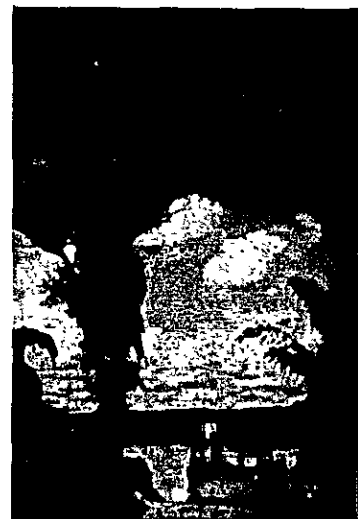
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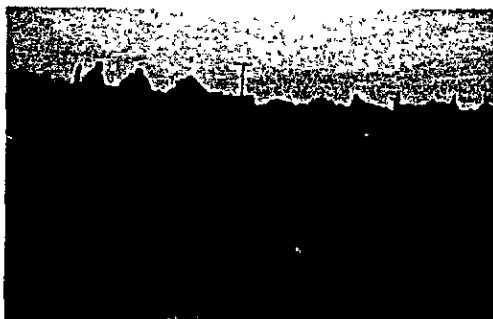
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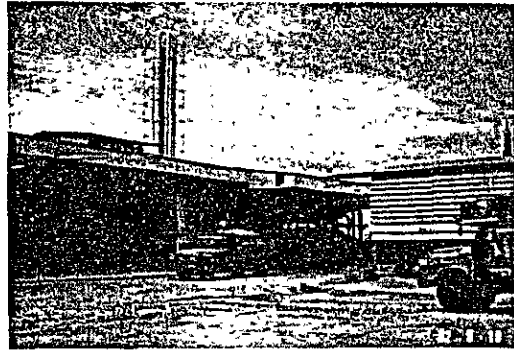
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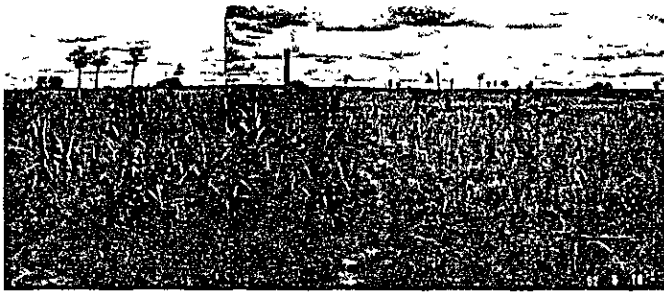
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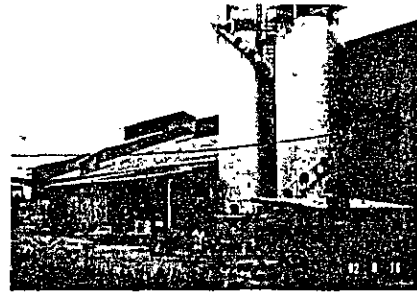
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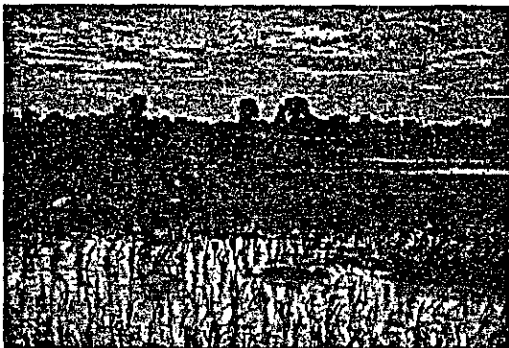
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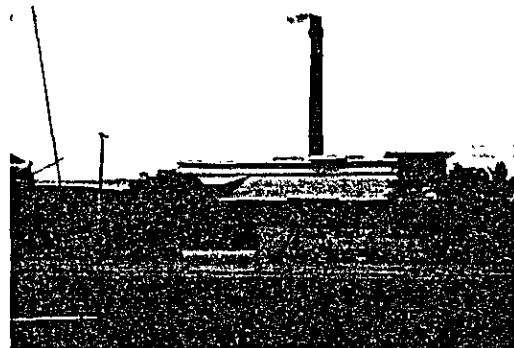
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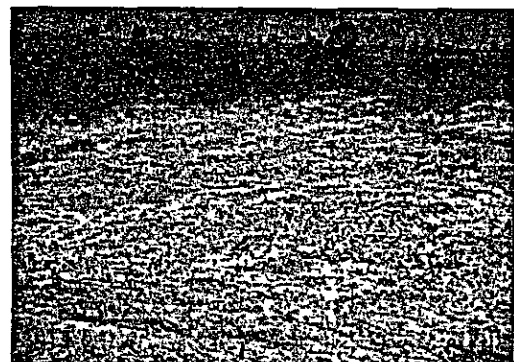
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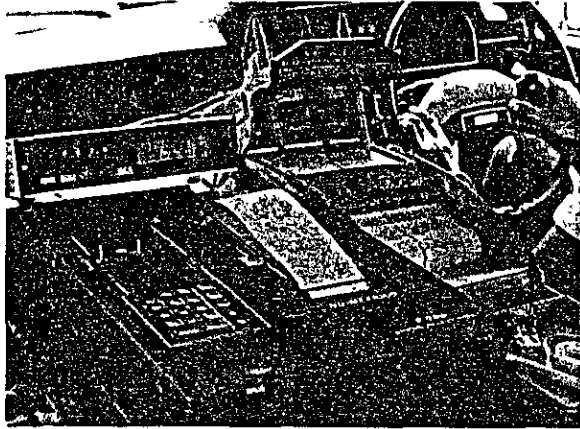
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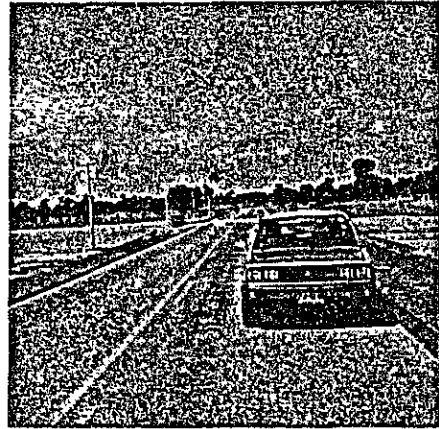
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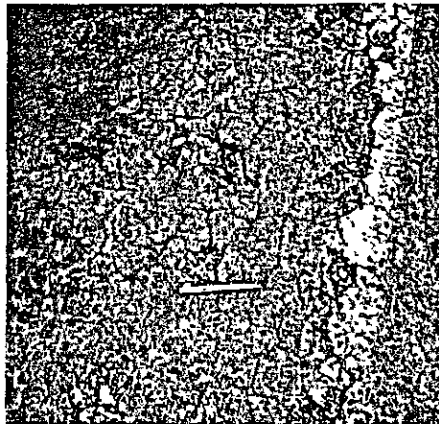
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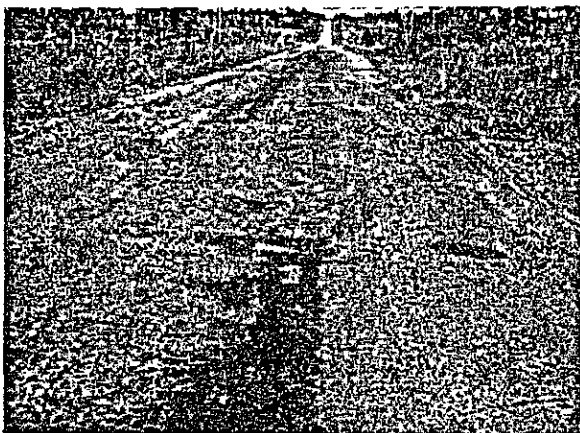
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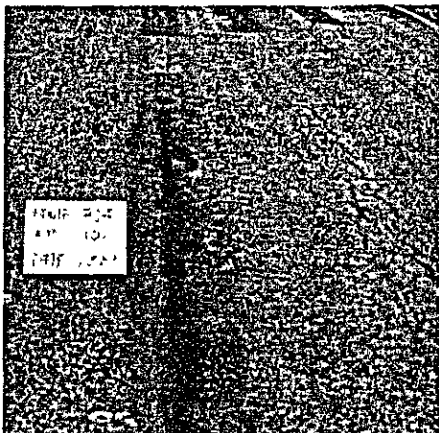
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SUMMARY AND RECOMMENDATIONS

SUMMARY AND RECOMMENDATIONS

1. Background and Objectives

Decentralization of social services is still an important item among the national objectives of Thailand. This objective may encourage development of backward rural areas aiming at poverty alleviation. In line with this national objective, the policy of road development has put emphasis on road construction in rural areas as well as rehabilitation of existing paved roads. The current road development plan places the objectives on: i) to encourage government policy on income distribution to rural areas, ii) to promote and stimulate increase of agricultural production, iii) to synchronize highway network and rural road system, and iv) induce rural development, especially in poverty-stricken areas.

The road development study in the Northeastern Region has been carried out since March 1982 by a study team organized by Japan International Cooperation Agency (JICA), with close collaboration of the Department of Highways (DOH) of Ministry of Communications of Thailand and other related agencies. The study aims mainly at: i) identification of high priority routes to be developed and ii) recommendation of a phased program based on pre-feasibility studies of the proposed routes.

This final report consists of three volumes: Vol.1 (Main Report), Vol.2 (Appendices) and Vol.3 (Route Report).

2. Characteristics of the Region

The Northeastern Region covers 169,000 square kilometers or 33% of the national land and holds the population of 16,400,000 or 34% of the national total in 1981. The economy of the Region is dominantly

agricultural. The agricultural sector earned 44% of the Gross Regional Product in 1980. Despite the vital position in the Region's economy, the sector has suffered from low productivity mainly due to unfavourable conditions of soils and water. An another reason is derived from lack of well connected road system between farms and markets along artery highways. The low productivity in agriculture and the consequent low income level resulted in exceptionally high rate of distribution of poverty-stricken areas in the Region.

Similarly with the other regions, the trunk transportation system of the Region has been developed to connect with Bangkok. While railways and airways are limited to two trunk routes to Nong Khai in the north bound and to Ubon Ratchathani in the east bound, the road networks are relatively dispersed over the Region stemming from the said two trunk routes. The total length of roads in the Region amounts at 12,600 km including 7,600 km of paved roads. Out of them, 4,800 km is classified as national highway and 7,800 km as provincial road under the DOH's management.

The cultivated area in the Region, 46 million rai in total, are mainly covered by paddy followed by cassava, kenaf, sugarcane, cotton and other upland crops. Past agricultural performance indicates that the production has not increased at rates of expansion of crop fields due to lower achievement of yield increase than the national average. For future agricultural development in the Region, crucial requirement may include strong measures to provide incentives to farmers as well as improvement of physical conditions for cultivation. In this connection, enhanced development of diversified infrastructure is much desired in rural areas. Improvement of road linkage between farms and markets as well as rural-urban linkages are the urgent requirement for the road sector.

3. Planning Framework

In view of the regional characteristics and the underlying national strategies for regional development, this Study placed its focus of planning on the following:

- a) To identify high priority routes to be improved and newly constructed from the viewpoints of;
- Socio-economic requirement to improve roads systems in rural areas, in view of the stimulation of agricultural and social activities and alleviation of poverty, and
 - Road network requirement to ensure better and efficient connection in the regional road network, including reinforcement of rural-urban linkages, national highway networks and bypasses.
- b) To identify high priority links of the existing paved roads to be rehabilitated.

Prior to the analysis of route/link identification, roads which were committed for implementation during the current sector plan period (1982-86) and were under study or design were excluded from the subject of this Study.

4. Identification of Routes for Improvement and New Construction

High priority links for improvement and new construction were identified based on the assessment of the following requirements:

- Socio-economic requirement.
 - road network requirement, including mainly requirement of national highways and requirement of bypasses.
- a) From socio-economic requirement;
- Area which is surrounded by paved roads, named "Block", was regarded as a spacial unit of the assessment of road requirement. Priority Blocks were selected by assessing the following elements:
- Road Network Value, a function of length of perimeter paved roads and population or land potential of each Block

- Agricultural potentials
- Poverty Index, assigned by the National Social and Economic Development Board
- Level of social services, in terms of density of hospitals and schools

For each selected priority Block, road links of high priority for development were selected by assessing the magnitude of Link Value, which is a function of link length and population or cultivable land in the area related with the subject link. In the selection of priority links, an attention was also paid to such links as short sections to be paved for network reinforcement and links to be paved to ensure the better access to activity centers. As the result, 66 links of 1,662.5 km was identified from socio-economic requirement and partially from road network consideration.

- b) From road network requirement;
- National highway requirement was assessed in priority Blocks, surrounded by national highways, selected by Road Network Value. Priority links were identified by analysis of inter-nodal gravity and function of national highway. As the result, 1 link of 95 km was identified from national highway requirement. Bypass requirement was assessed for congested links in/around cities selected through traffic counts. Level of congestion on the subject links was evaluated by means of peak hour traffic volume/highway service volume ratio, and the expected diversion of traffic to the planned bypasses from the congested links were estimated based on the O/D survey conducted. As the result, no priority link was identified for bypass requirement.

The high priority links thus identified theoretically were next examined in a practical manner based on the results of field reconnaissance. Prior to the examination, for some links proposed

along the east bound railway, a modal split analysis was performed and concluded that no significant competition would occur. The results of practical examination on the priority links was further scrutinized through discussions with the DOH in order to avoid the discrepancy from the DOH's policy.

Finally, 33 routes of 1,183.6 km in total were determined to be proposed routes for improvement and new construction.

5. Identification of Links for Rehabilitation

For all links of the existing paved roads, except for the links already committed for rehabilitation, deflection data compiled with supplemental survey were analysed. Based on the analysis in correlation between deflection and forecasted traffic volume of each link, links to be required of rehabilitation, overlay or reconstruction, were identified. The high priority links thus identified were further examined through field reconnaissance and discussions with the DOH.

Finally, 28 links of 774 km in total was decided to be proposed links for rehabilitation.

6. Evaluation of Proposed Routes for Improvement and New Construction

For the proposed routes, economic and social evaluation at pre-feasibility level was worked out in order to assess the priority ranking of them.

Data and information was obtained through road inventory survey, traffic survey, agro-economic survey and social survey. Traffic forecast was performed for each proposed route based on the analysis of the results of traffic counts, O/D survey, home interview survey. Construction quantities and costs were estimated basing on the preliminary design. Economic benefits were estimated in terms of vehicle operating costs savings, agricultural development benefits and

road maintenance cost savings. Based on the economic costs and benefits estimated assuming 1987 the opening year, economic internal rate of return was calculated for each proposed route to assess the priority among them from the viewpoint of economic viability.

On the other hand, in order to assess magnitude of social impacts of the proposed routes, quantification of the selected social indicators was attempted for each route. Eight indicators were selected to assess the social impacts under the four categories of criteria: i) alleviation of isolation, ii) impacts on health services, iii) impacts on educational services, and iv) alleviation of income disparity. Values of indicators quantified based on survey data were transformed into scores to implicate the magnitude of relative significance among proposed routes from viewpoint of social impacts.

7. Evaluation of Proposed Links for Rehabilitation

In correlation between the calculated design deflection and number of equivalent standard axles obtained from traffic forecast by DOH, overlay design was carried out and construction costs were calculated. Among the proposed links of 774 km, sections which require overlay of more than 40 mm were totaled at 370 km in 20 links and sections which require reconstruction to meet the standard was 98 km in total in 5 links.

In order to analyze the relationship between roughness of the paved road and vehicle operating costs, a survey was conducted to obtain roughness data and to assign rating of Present Serviceability Index. Analysing the survey results, a modified roughness - VOC relationship was elaborated referring to the models in the previous studies. Using this relationship, VOC savings were calculated for each proposed link. Although it was considered the proposed overlay of the critical sections among the proposed links would be justified for urgent implementation judging from the level of deterioration of the existing pavement, economic internal rate of return was also calculated for reference to check the priority order or urgency.

8. Priority Ranking and Phasing

Priority of the proposed routes ranked by economic viability or social impacts was further scrutinized from an overall viewpoint, including policies of the Thai Government, in order to prepare a phased program.

For the routes for improvement and new construction, first, from the economic viability 15 routes were picked up to be included into a group of high priority projects. Next, an attention was paid to the routes which are deemed to be significant in social impacts, and 3 routes were selected to be added to the priority project group. Eighteen routes thus selected are classified into Stage I Program and the remained 15 routes are considered to be included in Stage II Program. It is recommended to proceed immediately with feasibility studies for the projects in the Stage I Program.

Priority or urgency of the links for rehabilitation is to be judged primarily according to the degree of deterioration. In this view, out of the proposed links, selected segments totaled at 468 km were judged to be urgently rehabilitated and proposed to be classified into Stage I Program for immediate implementation. The remaining segments, 306 km in total, are considered to be included into Stage II Program.

The proposed phased program is shown in the tables and figures after next pages and summarized below.

	<u>Classification</u>	<u>Number of Project</u>	<u>Length (km)</u>	<u>Fund Requirement (Mn ฿)</u>
Stage I	Improvement and New construction	18 routes	666.9	1,269.8
	Rehabilitation (Overlay)	25 links (20 links)	468.0 (370.0)	560.9 (331.2)
	(Reconstruction)	(5 links)	(98.0)	(229.7)
	Total of Stage I	-	-	1,830.7
Stage II	Improvement and New Construction	15 routes	479.4	n.a.
	Rehabilitation	19 links	306.0	n.a.

PHASED PROGRAM (IMPROVEMENT AND NEW CONSTRUCTION)

1) STAGE I

Pro-posed Route	Origin	Destination	Length (Km)	Road Class	Surface Type ^{1/}	Const. Cost (Mn ฿) ^{2/}	IRR (%)	Social Impact
IM-28	C. Buri Ram	Lam Chi River	42.0	F4	DBST	96.1	27.0	B
IM-33	J. R. 2	A. Chokchai	51.5	F4	DBST	108.6	21.6	A
IM-5	A. Nam Phong	J. R. 209	29.1	F4	DBST	61.5	20.0	C
IM-8	B. Huai Koeng	A. Kumhawapi	16.7	F4	DBST	27.4	18.1	C
IM-19	A. Selaphum	B. Kham Phon Sung	46.0	F4	DBST	95.3	17.1	B
IM-31	A. Lamplai Mat	B. Nong Ki	59.7	F4	DBST	93.1	15.1	C
IM-30	A. Huai Thalaeng	B. Ka Sang	51.0	F4	DBST	96.4	14.6	C
IM-21	A. T. Phut Phon	A. Khemarat	65.3	F4	DBST	112.4	14.3	C
IM-12	A. S. Daen Din	A. Song Dao	18.1	F4	DBST	35.9	12.5	A
IM-10 ^{3/}	A. Phen	K. A. Song Khom	26.0	F4	DBST	45.6	12.4	B
IM-26	B. Non Dang	A. Rattana Buri	39.5	F4	DBST	74.3	11.8	A
IM-25 ^{3/}	A. Maha Chana Chai	A. Kho Wang	23.0	F4	DBST	39.9	11.6	B
IM-29	A. Prakhon Chai	A. Krasang	48.0	F4	DBST	95.5	11.5	C
IM-27	B. Nong Khao	A. Chom Phra	31.1	F4	DBST	52.0	11.3	C
IM-9	A. Nong Han	A. Khumphawapi	33.4	F4	DBST	72.6	11.1	C
IM-24	B. Na Suang	B. Na Yia	14.5	F4	DBST	25.7	10.6	A
IM-1	A. Khong	J. R. 2180	48.0	F4	DBST	91.5	9.6	A
IM-7	B. Khok Lat	B. Tha Yom	24.0	F4	DBST	46.0	8.1	A
Total of Stage I			666.9			1,269.8		

2) STAGE II

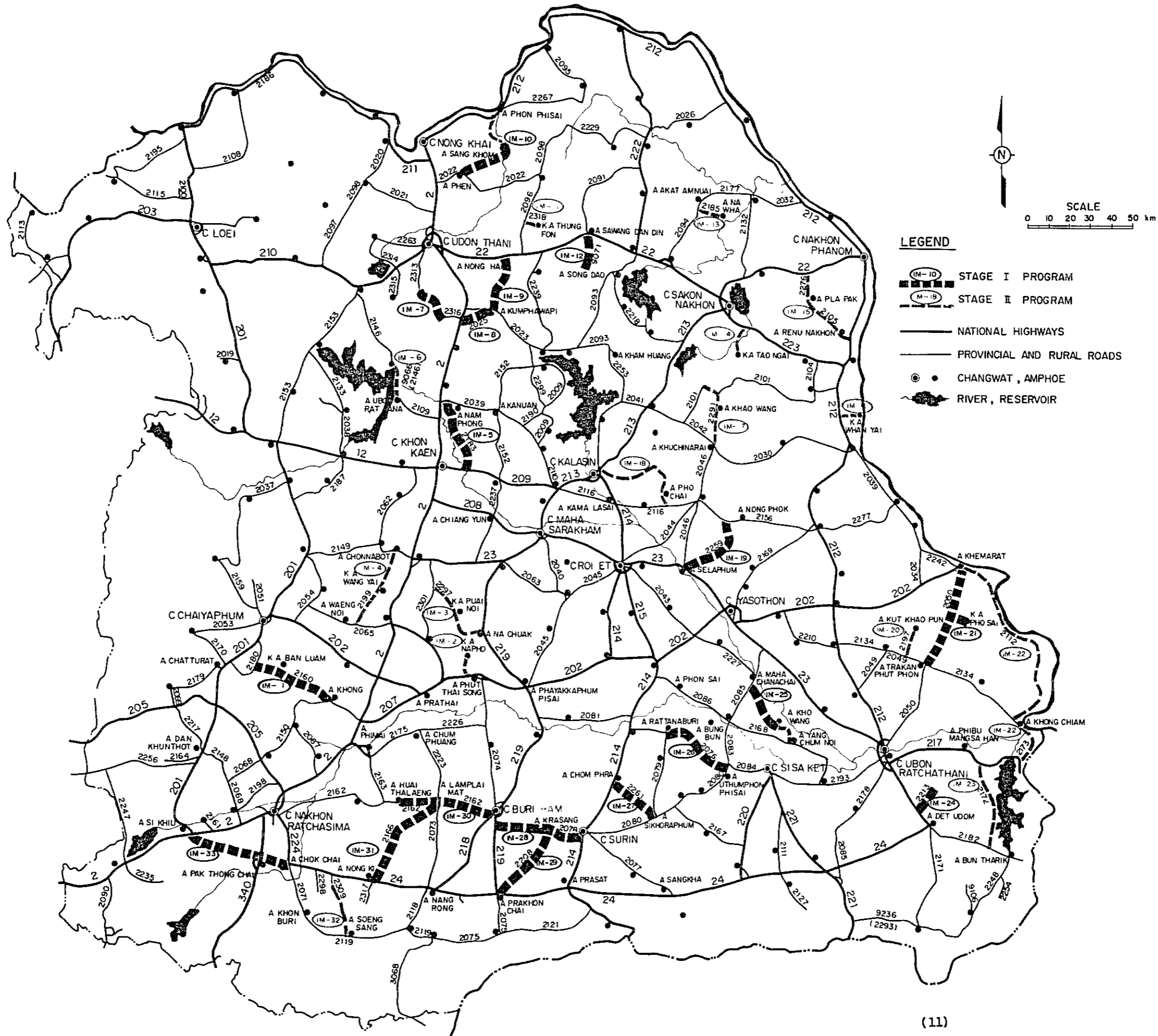
Pro-posed Route	Origin	Destination	Length (Km)	Road Class	Surface Type ^{1/}	Const. Cost (Mn ฿) ^{2/}	IRR (%)	Social Impact
IM-23	B. Don Chik	B. Nong Rieng	44.8	F4	DBST	74.2	10.7	C
IM-2	B. Waeo	K. A. Na Pho	9.4	F4	DBST	16.3	10.2	B
IM-17	A. Kuchinarai	B. Nong Rieng	30.4	F4	DBST	66.1	8.7	B
IM-20	B. Na Hai	A, Kut Khao Pun	17.2	F4	DBST	32.9	8.4	B
IM-18	C. Kalasin	B. K. Nong Bua	50.7	F4	DBST	98.2	7.5	B
IM-3	J. R. 2301	A. Na Chuak	30.6	F4	DBST	57.8	7.4	B
IM-13	B. Chuam	A. Na Wha	19.8	F4	DBST	37.5	6.6	B
IM-4	A. Chonnabot	B. Kut Ru	35.3	F4	DBST	60.6	6.2	B
IM-11	B. Thung Yai	K. A. Thung Fon	8.3	F4	DBST	18.8	5.1	A
IM-15	A. R. Nakhon	B. Ku Ru Khu	40.1	F4	DBST	75.4	5.1	C
IM-22	A. Khemarat	B. Hua Saphan	122.4	F4	DBST	217.1	4.5	A
IM-32	B. Yok Kham	B. Soeng Sang	29.0	F4	DBST	49.5	4.5	C
IM-6	B. Sok Chan	Ubolratana Dam	20.3	F4	DBST	62.4	4.0	A
IM-14	J. R. 223	K. A. Tao Ngai	12.0	F4	DBST	27.7	3.7	A
IM-16	J. R. 212	A. Whan Yai	9.1	F4	DBST	15.2	3.0	A
IM-25 ^{4/}	A. Kho Wang	J. R. 2168	15.2					
IM-10 ^{4/}	K. A. Song Khom	J. R. 212	22.1					
Total of Stage II			516.7					

Note: 1/ DBST : Double Bituminous Surface Treatment
 2/ Excluding price contingency
 3/ Section 1 (with ADT more than 300 in the 7th year)
 4/ Section 2 (with ADT less than 300 in the 7th year)

STAGE I PROGRAM FOR REHABILITATION

Proposed Route	Proposed Link Length (Km)	Const. Cost (Mn ₪)		IRR (%)
		Overlay	Reconst.	
RH-22	8	5.0		118.1
RH-2	10	7.5		91.9
RH-18	30	22.5		82.8
RH-5	23	17.3		69.7
RH-15	44	33.0		56.8
RH-6	25	18.7		48.8
RH-16	14	11.3		43.1
RH-17	9	6.8		34.5
RH-23	16	24.4		34.5
RH-24	16	29.8		29.8
RH-19 (1)	26	29.2		28.9
(2)	20		52.9	
RH-4	9	6.8		27.9
RH-20	6	15.7		25.7
RH-26	22		42.3	22.7
RH-21	13	13.9		20.7
RH-9	7	5.3		20.3
RH-10	5		8.6	19.6
RH-1	28	22.5		13.3
RH-28	18	12.5		13.1
RH-14	27		65.9	11.7
RH-3	46	34.5		11.0
RH-12	6	4.5		10.1
RH-13	24		60.0	9.9
RH-27	16	10.0		7.3
Total	468	331.1	229.7	

PHASED PROGRAM FOR IMPROVEMENT AND NEW CONSTRUCTION



- LEGEND**
- STAGE I PROGRAM (IM-10)
 - STAGE II PROGRAM (IM-19)
 - NATIONAL HIGHWAYS
 - PROVINCIAL AND RURAL ROADS
 - CHANGWAT, AMPHOE
 - RIVER, RESERVOIR

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PHASED PROGRAM FOR REHABILITATION

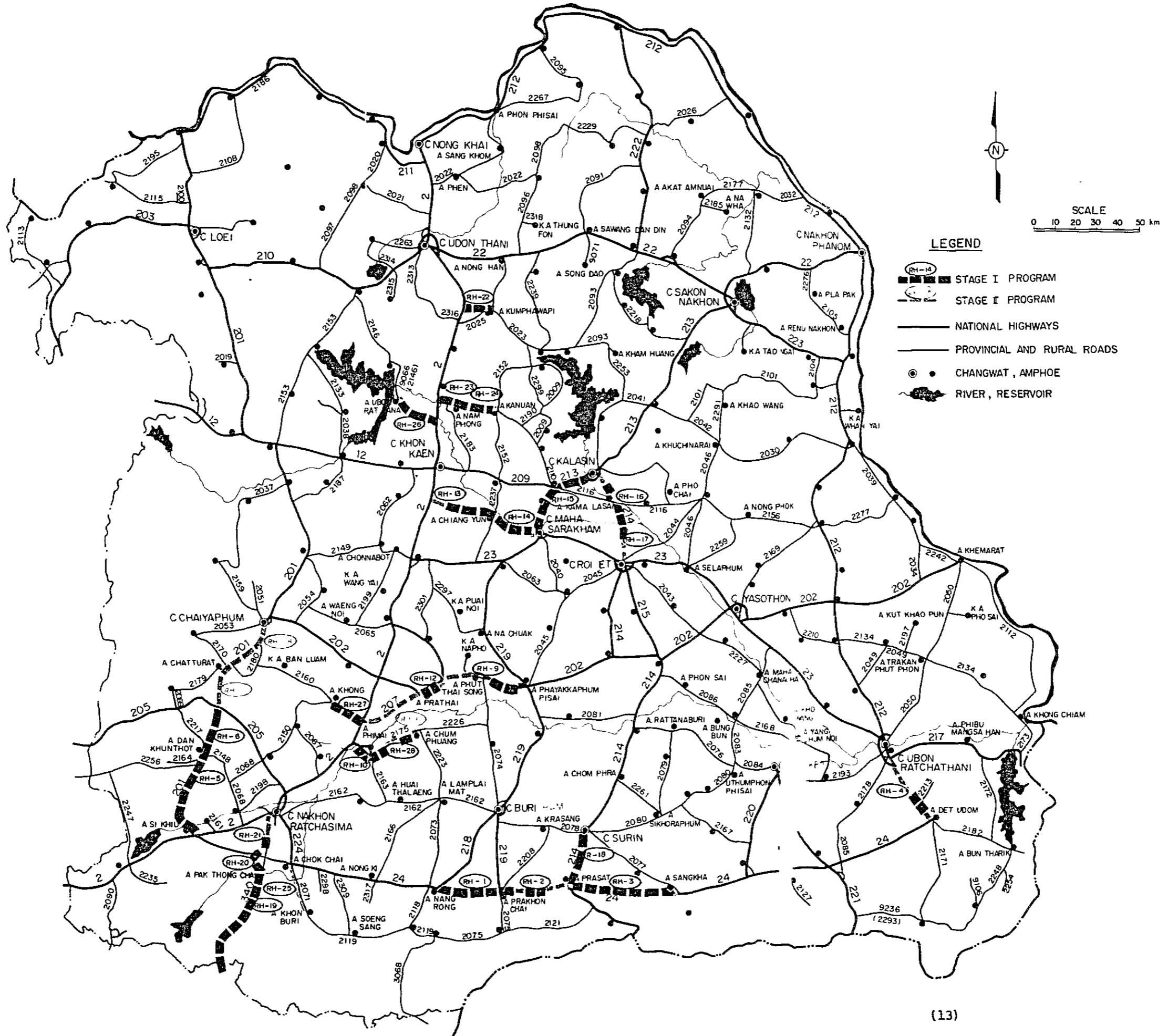


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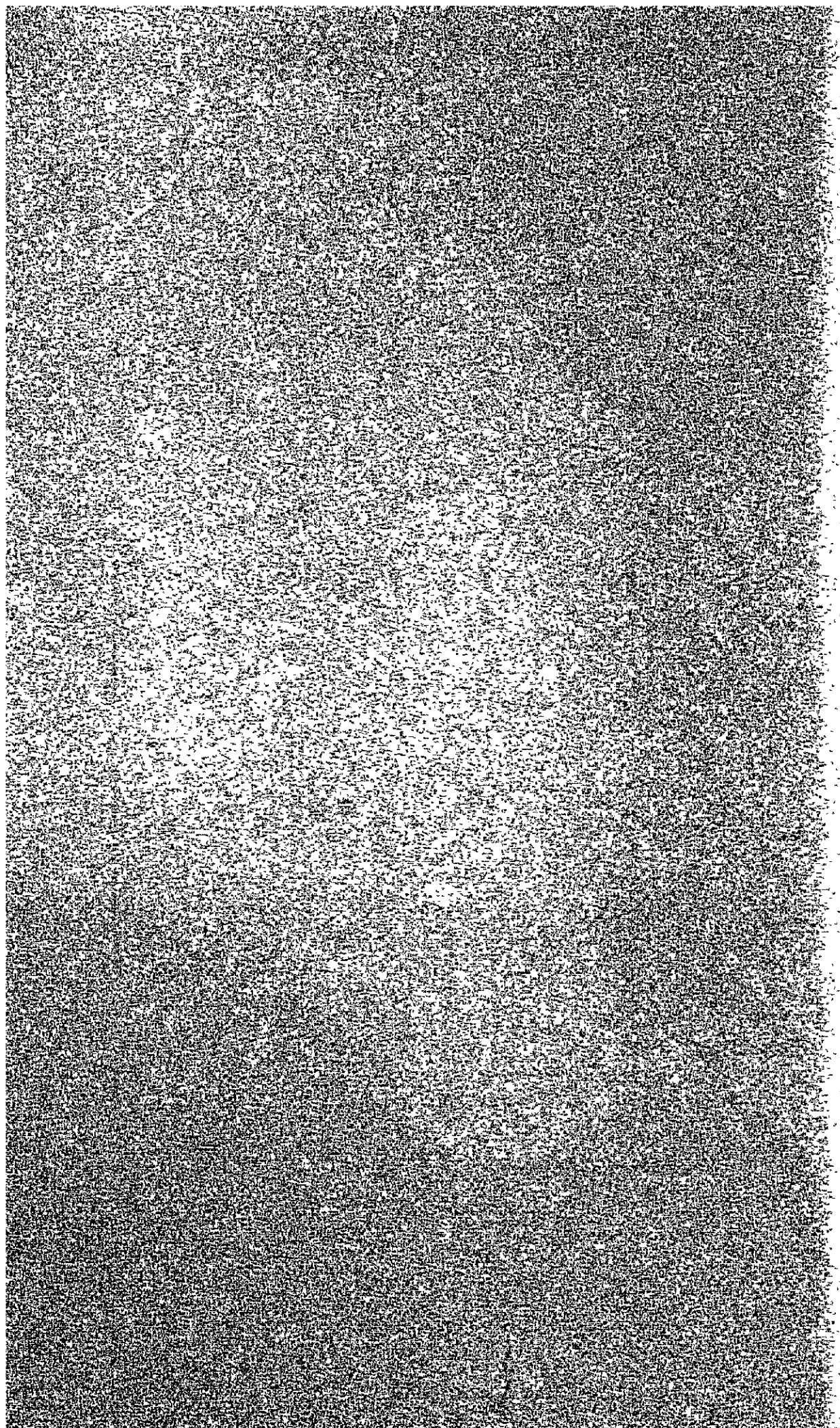


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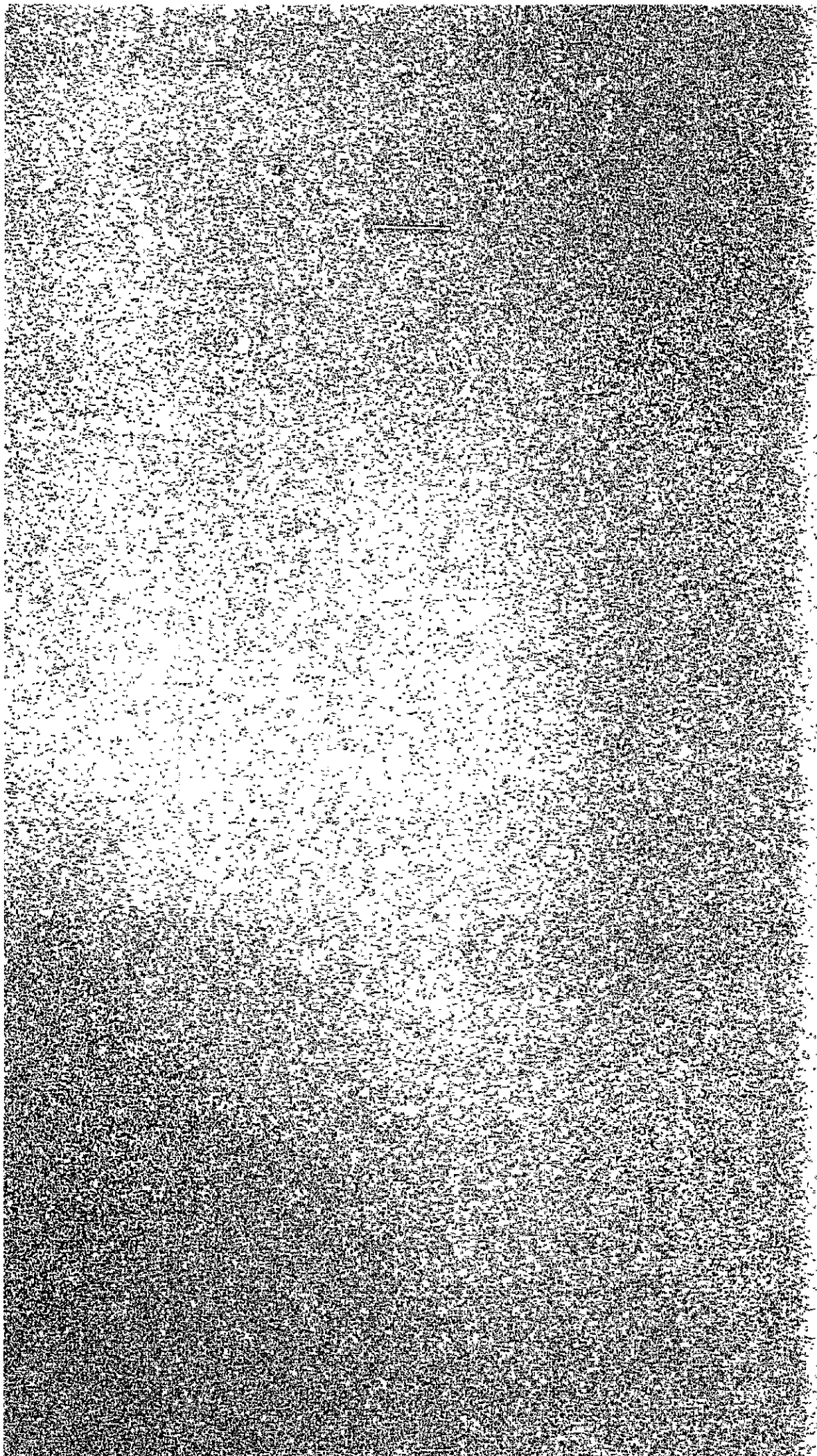
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GLOSSARY

AADT	: Annual Average Daily Traffic
AASHTO	: American Association of State Highway and Transportation Officials
AC	: Asphaltic Concrete
ADT	: Average Daily Traffic
ARD	: Accelerated Rural Development Office
Amphoe	: District
Ban	: Village
Changwat	: Province
DBST	: Double Bituminous Surface Treatment
DOH	: Department of Highways
ESA	: Equivalent Standard Axles
GDP	: Gross Domestic Product
GRP	: Gross Regional Product
HRB	: Highway Research Board
IRR	: Internal Rate of Return
JICA	: Japan International Cooperation Agency
MAC	: Ministry of Agriculture and Cooperatives
NESDB	: National Economic and Social Development Board
NSO	: National Statistical Office
O/D	: Origin and Destination
p. a.	: per annum
PM	: Penetration Macadam
PSI	: Present Serviceability Index
rai	: Unit of area (0.16 hectare)
RID	: Royal Irrigation Department
RMC	: Road Maintenance Cost
SRNT	: Studies of National and Provincial Road Network in Thailand
Tambon	: Sub-District
VOC	: Vehicle Operating Cost

CHAPTER 1
INTRODUCTION



CHAPTER 1

INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES OF THE STUDY

The Northeastern Region (the Region) which shares one third of the population and land area of the Kingdom of Thailand has been remained behind the national average in terms of GRP and per capita income. Exceptionally high rate of designated poverty-stricken areas in the Region well explains the present economic situation of the Region.

The less-advanced economy of the Region has originated basically from low productivities in the agricultural sector, of which main reasons are due to unfavorable soil conditions, insufficient irrigation facilities and unstable precipitation. Lack of well connected road systems between agricultural areas and arteries where major markets locate is also responsible for the low level of productivity. Development of road networks in the agricultural areas will contribute to a rise in living standard of local people in the Region by enabling expeditious transportation of agricultural products to markets and stimulating the production increase.

In consideration of the present situation of the Region, the Government of Thailand requested to the Government of Japan to carry out a road development study in the Region (the Study). The Government of Japan decided to conduct the Study and entrusted it to the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programs by the Government of Japan.

JICA organized a study team (the Study Team) consisting of experts of Nippon Koei Co., Ltd. and Katahira & Engineers Inc. to commence the Study at the end of March 1982.

The Study has proceeded for about 9 months in Thailand followed by home office works in Japan and the Final Report is scheduled to be submitted to the Department of Highways (DOH) of the Ministry of Communications by the end of March 1983.

The objectives of the Study as referred to in the Scope of Works on the Road Development Study in the Northeastern Region dated November 27, 1981 are:

- i) To carry out studies on road networks in the Region and their development needs in order to visualize road development for the short, medium and long term plans,
- ii) To identify high priority routes to be developed,
- iii) To carry out pre-feasibility study on roads which will be selected from the above-mentioned high priority routes by the DOH, and
- iv) To perform technology transfer to Thai counterpart personnel in the course of the Study.

The roads subject to the Study are national highways, provincial roads and all other roads which are or will be under the jurisdiction of the DOH in the following 17 Changwat of the Region:

Buri Ram	Nong Khai
Chaiyaphum	Roi Et
Kalasin	Sakon Nakhon
Khon Kaen	Si Sa Ket
Loei	Surin
Maha Sarakham	Ubon Ratchathani
Mukdahan	Udon Thani
Nakhon Phanom	Yasothon
Nakhon Ratchasima	

1.2 STUDY FRAMEWORK

The Study comprises following three processes:

- Analysis of Regional Characteristics,
- Identification of Proposed Routes, and
- Evaluation of Proposed Routes.

The study flows drawn schematically are shown in Figure 3.1 of Chapter 3.

1.3 WORK SCHEDULE OF THE STUDY

As shown in Figure 1.1, the Study is to be completed within about twelve months under the agreed approach and methodology.

The Inception Report which mentioned proposed work program and schedule, methodology and procedures of the Study was submitted after two months of the commencement of the Study.

Progress Report I which described the identification of proposed routes was submitted in three months after presentation of the Inception Report.

Progress Report II which discussed the evaluation of the proposed routes was submitted in four months after presentation of the Progress Report I.

Draft Final Report prepared in Japan, incorporating the comments by the DOH on the Progress Report I and II was submitted in February 1983.

This Final Report was prepared incorporating the DOH's comments on the Draft Final Report.

The Final Report consists of the following 3 volumes:

Volume 1: Main Report, which describes the methodologies, summarized results of study components and a proposed phased program.

Volume 2: Appendices, which compiles tables and figures of data and information relevant to the Study, especially of the identification process.

Volume 3: Route Report, which presents separately description and data of evaluation of each proposed route.

1.4 ORGANIZATION OF THE STUDY

The Study has been carried out by the Study Team under the supervision of the Steering Committee, consisting of Japanese Government officials, organized by JICA. In carrying out the Study, the Study Team has kept close collaboration with the Counterpart Team organized by the DOH. The organization for the Study is shown in Figure 1.2.

Figure 1.1 WORK SCHEDULE

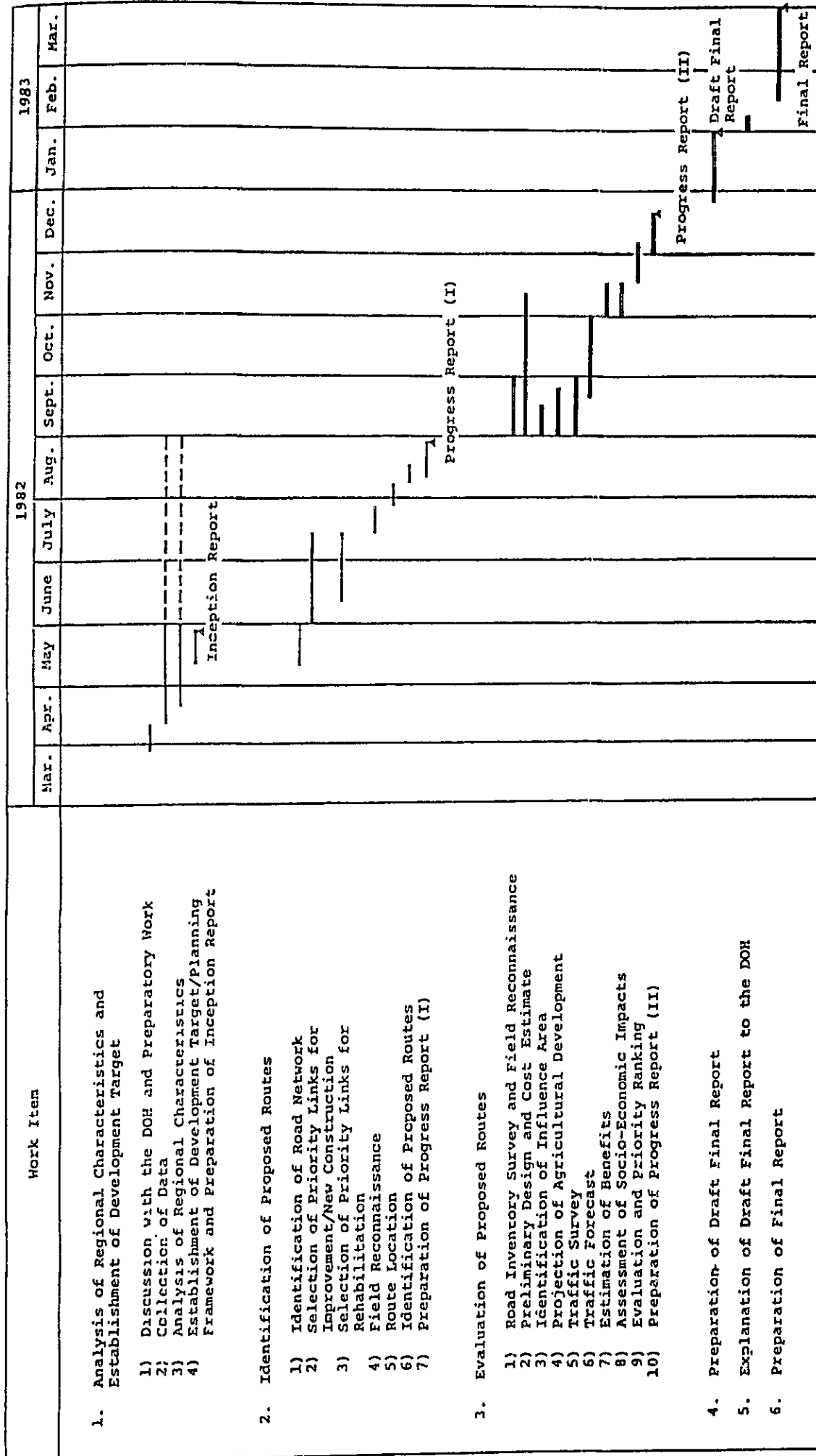


Figure 1.2

Figure 1.2 ORGANIZATION FOR THE STUDY

