CHAPTER IV

A CASE STUDY : GEOLOGICAL INFORMATION FOR LAND MANAGEMENT OF CHANGWAT PRACHUAP KHIRI KHAN

4.1 Changwat Prachuap Khiri Khan

Changwat Prachuap Khiri Khan is a province in western region of Thailand. It is on the upper pennisula that lies on west of the Gulf of Thailand. It is bounded by latitude 10°57′ to 12°39′ north and longitude 99°8′ to 100°04′ east with and area approximately 6357.62 km^2.

The climate type of study area belongs to tropical savanna climate (Aw) almost of area except in the south district (Approximate to the southern part of Amphoe Bang Saphan and Amphoe Bang Saphan Noi) that are tropical rainforest climate (Af) (Eelaart, 1972). The annual precipitation of the northern part is 1022.2 mm. and the southern part is 1145 mm.. The maximum monthly temperature occur in April and minimum in January with the values of 33° C and 20° C respectively. Mean annual temperature is about 27.6° C with an average relative humidity of approximately 75.5%. (DLD, 1990)

General geology of Changwat Prachuap Khiri Khan, a case study area is composed predominantly of Paleozoic sedimentary rocks. The most predominant of them are clastic sedimentary rocks of the Kaengkrachan groups and limestone of the Ratburi

groups. They are widespread through out the western part of the area. The Kaengkrachan group is Carboniferous rocks, consist of an interbedded sequence of pebbly mudstones, graywackes, laminated mudstones, shale, siltstones and sandstones. They are conformably overlain by permian limestone. The Permian limestones of Ratburi group are mainly light gray, massive limestones with subordinate shale and sandstone.

Granites are the most common intrusive rocks found in study area. They are Cretaceous in age (DMR.,1983), mainly porphyritic granite, biotite-hornblende muscovite granite and fine-grained tourmaline granite. They are predominantly found along the western part in central to southern of the area.

Besides, the eastern part of the area are the trend of regional metamorphic rocks and Permian Ratburi limestone which occur close to the shoreline, the metamorphic rocks such as at Khao Takiab, Khao Tao and small hill ranges of Pranburi. The main lithology of the metamorphic rocks are varies from schist-gneiss of Precambrian age to metasedimentary rocks such as quartzite, metaargillaceous (Silulian-Devonian) and some cataclastic rocks. Predominant limestones are occurred at Khao Sam Roi Yord, Khao Kun Kra Dai, Khao Chong Kra Chok and small island along the coast.

The area of Changwat Prachuap Khiri Khan, the coastal province, is selected to demonstrate the application of GILM designed. The reason in choosing Changwat Prachuap Khiri Khan for case study is due to the area covers variations of

geographical features, geological information, and landuses. Out of this, the area has potential to be developed due to its geographic location being situated in the upper penninsular and having its border joining with the Union of Myanmar, where trans-penninsular route joiningthe Andaman sea and the Gulf of Thailand can be expected. With this reasons, GILM prepared for the area Changwat Prachuap Khiri Khan shall benefits not only for academic purpose in this study but also for practical uses in the future.

4.2 Mapping Approach of GILM

For case study at Prachuap Khiri Khan, the PIU system is applied to construct GILM at regional scale. They are demonstrated on 26 thematic maps, which are developed through the stage of PGI, IGI, and UGI by basing on TM images integrated with existing information. The main existing data used in preparation of GILM were listed in the Chapter I. The information is planned for future works by using GIS in managing and developing information of Local scale.

However, the main purpose of GILM mapping of Changwat Prachuap Khiri Khan is aimed at experiment of GILM systemization and PIU system. So that, this work is scoped base on 6 principal concepts

1) All GILM maps shall be preparated on regional level base on remote sensing data. The level of scale of data acquisition is in scale 1:250,000, and presented in scale 1:500,000.

2) Series of map topics shall limit to design appropriately for illustration of GILM system.

3) This study try to selected the example of map topics from every groups of map topics which can demonstrated developing of maps through all 3 stages of information. And the selection of map topics should be mainly based on ability in data acquisition by remote sensing techniques.

4) Detail of information in each themes of map topics will be limited only geological aspects.

5) Methodology of synthesis information map in higher stage from the lowers one shall use directly sieving/overlay techniques. Reasonably, this can be demonstrate the relationship of information distinctly.

6) The GILM mapping in IGI and UGI stages are attempted to limit the criteria of mapping keys to be the most basic analysis and evaluation. Nevertheless, these base on appropriate accuracy and ability to readjust or increase more classes of mapping degree by add up of more factors of analysis and evaluation.

The procedure of Mapping approach of GILM are illustrated in figure 4.1. It consist of 2 stages in consequently. Firstly, Determined appropriate scope of GILM study, Secondly, GILM Map construction, all preparation of each map will be demonstrated in form of tables to show

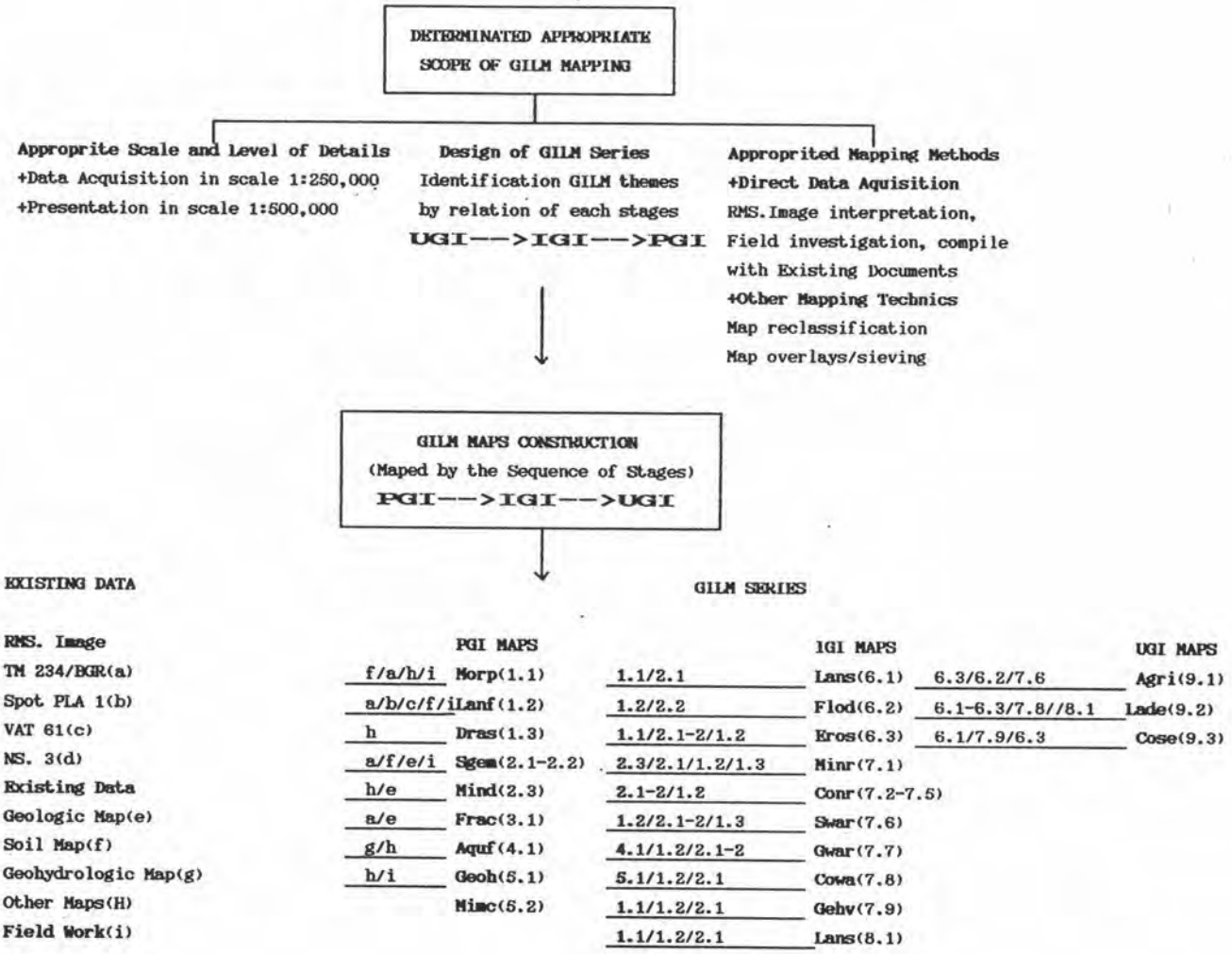


Figure 4.1 Flowchart of GILM mapping for a case study area

Note : GILM-Geological Information for Land Management, PGI-Primary Geological Information, IGI-Intermediat Geological Information, UGI- Ultimate Geological Information, Morp-Morphological Map, Lanf-Landform Map, Dras-Drainage System Map, Sgem-Surface geological material Map, Mind-mineral Distribution Map, Frac-Fracture Map, Aquf-Aquifer Map, Geoh-Geologic Heritage Site Map, Lans-Risk of Landslide Hazard Map, Flood-Risk of Flood Hazard Map, Eros-Erosion Susceptibility Map, Minr-Mineral Resource Potential Map, Conr-Construction Resources Potential Maps, Swar-Surface Water Resource Potential Map, Gwar-Groundwater Resource Potential Map, Cowa-Composite water resource map, Gehv-Geological Heritage Value Map, Last-Land Stability Map, Agri-Suitability Zone for Agriculture Map, Lade-Suitability Zone for Land Developement Map, Cose-Suitability Zone for Conservation Map

mapping techniques, data use, mapping unit, description of units, and their mapping keys.

Table check-list for designing of map topics used in preparation of GILM of this study are shown in table 4.1. The designing is identified by reverse sequence of stages. It start from determine UGI map topics, relate to IGI topics' identification and relate through PGI in final. So, table 4.1 will be also to illustrate the relationship of PGI, IGI, and UGI of GILM series. For the best result, map code should be designed for that particular maps. The first number is from number of group of topics, the second behind decimal point are number of map topics. In units mapping, the third number shall be design for particular units of each map.

Table 4.2 illustrated list of all names of map topics and names of mapping units of each map with their codes no.. It can be used in checking or consideration in development of Information through stages of Information by several mapping techniques.

Table 4.3 illustrate list of GILM map topics in form of file collection that used for diagnosis GILM works in Chapter 2.

4.3 PGI - Primary Geological Informations

GILM mapping in PGI stage are selected all 5 groups of map topics in the total of 10 map topics. They are 1) Landform and Process which consists of Morphological Map

Table 4.1 Relationship of PGI, IGI, and UGI ; check-listed for designing series of map topics in GILM Series of the case study area : Changwat Prachuap Khiri Khan

P G I													IGI	U G I		
Morphological (1.1)	Landform (1.2)	Drainage system (1.3)	Surface geological material (con. ed.) (2.1)	Surface geological material (uncon. ed.) (2.2)	Mineral distribution (2.3)	Fracture (3.1)	Aquifer (4.1)	Geological heritage site (5.1)	Mining and mineral concession (5.2)	Other data			Suitability zone for agriculture (9.1)	Suitability zone for land development (9.2)	Suitability zone for conservation (9.3)
⊠	●		⊠	●								Risk of landslide hazard (6.1)		⊠	⊠
	⊠	●		⊠							1	Risk of flood hazard (6.2)	⊠	●	
⊠	⊠		⊠	⊠								Erosion susceptibility (6.3)	●	⊠	⊠
	⊠	⊠	⊠		⊠	●			⊠			Mineral resource potential (7.1)			
				⊠							2	Construction sand potential (7.2)		●	
				⊠							2	Lateritic soil for road construction potential (7.3)			
			⊠		●							Aggregate rock potential (7.4)		●	
			⊠		●							Building/Dimension stone potential (7.5)			
	⊠	●	⊠	⊠								Surface water resource potential (7.6)	⊠		
	⊠						⊠					Groundwater resource potential (7.7)			
	●	●										Composite water resource potential (7.8)		⊠	
	●		●	●				⊠			3	Geoheritage value (7.9)			⊠
⊠	⊠		●	⊠								Land (slope) stability (8.1)		⊠	
												Other data			4

⊠ 1st relationship ⊠ 2nd relationship ⊡ Supporting data

* Other data

1 Topographic map & Landsat TM Image

2 Soil map

3 Surface water & Groundwater resource potential maps (7.6 & 7.7)

4 Landform map & Drainage system map (1.2 & 1.3)

Table 4.2 List of map topics and mapping units with their codes, designed for a case study.

1.1 MORPHOLOGICAL MAP
Nearly flat to slightly undulating terrain (1.1.1)
Undulating to rolling terrain (1.1.2)
Rolling to hilly terrain (1.1.3)
Hill & Mountain terrain (1.1.4)

1.2 LANDFORM MAP
Denudation slope, hill, and mountain landform (1.2.1)
Karstic denudation slope, hill and mountain landform (1.2.2)
Peidmont and included denudation remnants, Coelesing fan and infill valley (1.2.3)
- Steep slope (1.2.3.1)
- Moderate slope (1.2.3.2)
- Gentle slope (1.2.3.3)

River plain (1.2.4)
Relative terrace of river plain (1.2.5)
Tidal flat (1.2.6)
Former tidal flat (1.2.7)
Beach, beach ridge, spit, tombolo bars and coastal sand dune (possible rework by wind) (1.2.8)
Swamp and marsh (1.2.9)
Swales/runnel (1.2.10)

1.3 DRAINAGE SYSTEM MAP
Hua Hin system (1.3.1)
Pran Buri system (1.3.2)
Bang Pu-Nong Kao Niow system (1.3.3)
Sam Roi Yord - Klong Khao Daeng system (1.3.4)
Kui Buri system (1.3.5)
Prachuap Khiri Khan system (1.3.6)
Klong Wan - Wa Ko system (1.3.7)
Wanakorn - Thap Sakae system (1.3.8)
Ang Thong system (1.3.9)
Ban Krut system (1.3.10)
Ban Saphan - Bang Saphan Noi system (1.3.11)
Klong Tha Sae system (1.3.12)

2.1 SURFACE GEOLOGICAL MATERIAL (CONSOLIDATE ED.)
Arenaceous group (2.1.1)
- Arenaceous meta-sediment group (2.1.1.1)
- Sandstone group (2.1.1.2)

Argillaceous group (2.1.2)
Carbonate group (2.1.3)
Granitoid group (2.1.4)

2.2 SURFACE GEOLOGICAL MATERIAL (UNCONSOLIDATE ED.)
Alluvium - colluvium sandy loam to loamy sand with gravelly phases (2.2.1)
Alluvium - colluvium loamy sand to sandy loam with gravelly phase (2.2.2)
Alluvial sandy loam (2.2.3)
Alluvium loam (2.2.4)
Alluvium loam with clayey phase (2.2.5)
Alluvium clay (2.2.6)
Marine clay of former tidal flat (2.2.7)
Marine clayey silt to clayed sand of former tidal flat (2.2.8)
Marine clay/silt with saline saturate (2.2.9)
Clay to silty clay with saturate brackish to fresh water in swampy and marshy area (2.2.10)
Beach and dune sand (2.2.11)

2.3 MINERAL DISTRIBUTION
Au Gold
Cal Calcite
Dol Dolomite
Fe Iron
K-Fld Potassium feldspar
Gr Granite
Ilm Illmenite
Lcx Leucoxene
Lst Limestone
Mb Marble
Mnz Monazite
Nb-Ta Columbite-Tantalite
Qtz Quartz
Sn Tin
Rt Rutile
W Tungsten
Xnt Xenotime
Zrn Zircon

3.1 FRACTURE MAP
Lineament (possible fracture)

4.1 AQUIFER MAP
Beach sand aquifer (4.1.1)
Alluvium aquifer (4.1.2)
Colluvium aquifers (4.1.3)
Carbonate rock aquifer (4.1.4)
Argillaceous to Metaargillaceous sedimentaryu rock aquifer (4.1.5)
Metasedimentary rock aquifer (4.1.6)
Sandstone aquifer (4.1.7)
Granitic and Gneissic aquifers (4.1.8)

5.1 GEOLOGICAL HERITAGE SITES
Geological heritage site in Amphoe Hua Hin
- Hua Hin beach (5.1.1.1)
- Khao Takiab (5.1.1.2)
- Suan Son beach (5.1.1.3)
- Khao Tao (5.1.1.4)
- Khao Tao beach (5.1.1.5)
- Khao Krai Rai (5.1.1.6)
- Bo Fai beach (5.1.1.7)
- Pa La U waterfall (5.1.1.8)
- Dao cave and Kai Lon cave (5.1.1.9)
- Wiman cave (5.1.1.10)

Geological heritage site in Amphoe Pran Buri
- Keaw cave (5.1.2.1)
- Pran Buri estuary (5.1.2.2)
- Nong Kaow Niow bay (5.1.2.3)
- Kata cave (5.1.2.4)
- Praya Nakorn cave (5.1.2.5)
- Khao Kalok (5.1.2.6)
- Pran Buri forest park (5.1.2.7)
- Lam Sala beach (5.1.2.8)

Geological heritage site in Amphoe Kui Buri
- Khao Noi cave (5.1.3.1)
- Sai cave (5.1.3.2)
- Khao Sam Roi Yord National Park (5.1.3.3)
- Khao Reang (5.1.3.4)
- Khao Pratun cave (5.1.3.5)
- Phoriang beach (5.1.3.6)
- Sam Pra Ya beach (5.1.3.7)
- Thung Sam Roi Yord (Swamp area) (5.1.3.8)
- Khao Dang and Men cave (5.1.3.9)
- Khao Daeng river (5.1.3.10)

Table 4.2 (cont)

Geological heritage sites in Amphoe Muang Prachuap Khiri Khan
- Chong Singkorn (5.1.4.1)
- Khao Ta Mong Lai (5.1.4.2)
- Khao Lom Muak (5.1.4.3)
- Khao Kun Kra Dai cave (5.1.4.4)
- Prachuap Khiri Khan bay (5.1.4.5)
- Khao Chong Krachok (5.1.4.6)
- Ao Noi cave (5.1.4.7)
- Wa Ko beach (5.1.4.8)
- Manao bay (5.1.4.9)
- Song Kalon waterfall (5.1.4.10)
- Khao Hin Toen (5.1.4.11)

Geological heritage sites in Amphoe Tap Sakae
- Nong Hoi waterfall (5.1.5.1)
- Huai Yang waterfall (5.1.5.2)
- Wanakorn beach (5.1.5.3)
- Khao Lan waterfall (5.1.5.4)
- Khao Luang (5.1.5.5)

Geological heritage sites in Amphoe Bang Saphan
- Mae Rum Puang bay (5.1.6.1)
- Klang Ao forest park (5.1.6.2)
- Khao Ma Rong cave (5.1.6.3)
- Bo Thong Lang beach (5.1.6.4)

Geological heritage sites in Amphoe Bang Saphan Noi
- Pha Daeng cliff coast (5.1.7.1)
- Khao Bang Berd cave (5.1.7.2)
- Bang Bead field (5.1.7.3)

5.2 MINING AND MINERAL CONCESSION AREA
Mining Sites
Mineral Concessions Area
Abbreviation
Au Gold
Cal Calcite
Dol Dolomite
Fe Iron
K-Fld Potassium feldspar
Gr Granite
Ilm Illminite
Lcx Leucoxene
Lst Limestone
Mb Marble
Mnz Monazite
Nb-Ta Columbite-Tantalite
Qtz Quartz
Sn Tin
Rt Rutile
W Tungsten
Xnt Xenotime
Zrn Zircon

6.1 RISK OF LANDSLIDE HAZARD
High risk of landslide hazard (6.1.1)
High to moderate risk of landslide hazard (6.1.2)
Moderate risk of landslide hazard (6.1.3)
Low risk of landslide hazard (6.1.4)
Very low to non risk of landslide hazard (6.1.5)

6.2 RISK OF FLOOD HAZARD MAP
Very high risk of flood hazard (6.2.1)
High risk of flood of tidal area (6.2.2)
High risk of flood hazard (6.2.3)
Moderate risk of flood hazard (6.2.4)
Moderate to low risk of flood hazard (6.2.5)
Low risk of flood hazard (6.2.6)
Very low to non risk of flood hazard (6.2.7)

6.3 EROSION SUSCEPTIBILITY
Very high erosion susceptibility (6.3.1)
- 1st very high susceptible (6.3.1.1)
- 2nd very high susceptible (6.3.1.2)
- 3rd very high susceptible (6.3.1.3)

High erosion susceptibility (6.3.2)
- 1st high susceptible (6.3.2.1)
- 2nd high susceptible (6.3.2.2)

Moderate erosion susceptibility (6.3.3)
- 1st moderate susceptible
- 2nd moderate susceptible

Slight erosion susceptibility (6.3.4)
- 1st slight susceptible (6.3.4.1)
- 2nd slight susceptible (6.3.4.2)

Not to significant of erosion susceptibility (6.3.5)

7.1 MINERAL RESOURCES POTENTIAL
Mining interest potential (7.1.1)
Mineral exploration interest potential (7.1.2)
Mineralogy investigation interest potential (7.1.3)
Very low potential (7.1.4)

7.2 CONSTRUCTION SAND POTENTIAL
High potential of construction sand resource (7.2.1)
Moderate potential of construction (7.2.2)
Low potential of construction sand resource (7.2.3)
Non potential of construction sand resource (7.2.4)

7.3 LATERITIC SOIL POTENTIAL
High potential of lateritic soil resource (7.3.1)
Moderate potential of lateritic soil resource (7.3.2)
Low potential of lateritic soil resource (7.3.3)
Non potential of lateric soil resource (7.3.4)

7.4 AGGREGATE ROCK POTENTIAL
High potential of aggregate rocks resource (7.4.1)
Moderate potential of aggregate rocks resource (7.4.2)
Low potential of aggregate rocks resource (7.4.3)
Non potential of aggregate rocks resource (7.4.4)

7.5 BUILDING/DIMENSION STONES POTENTIAL
High potential of building/dimension stone resource (7.5.1)
Moderate potential of building/dimension stone resource (7.5.2)
Low potential of building/dimension stone resource (7.5.3)

Table 4.2 (cont)

Very low potential of building/dimension stone resource (7.5.4)
Non potential of building/dimension stone resource (7.5.5)

7.6 SURFACE WATER RESOURCE POTENTIAL
The Highland Region
High to moderate potential of surface water resource (7.6.1)
Moderate to low potential of surface water resource (7.6.2)
The Lowland Region
High potential of surface water resource (7.6.3)
Moderate to high potential of surface water resource (7.6.4)
Moderate potential of surface water resource (7.6.5)
Low potential of surface water resource (7.6.6)
Non Potential (7.6.7)

7.7 GROUNDWATER RESOURCE POTNETIAL
High potential of groundwater resource (7.7.1)
Moderate potential of groundwater resource (7.7.2)
Low potential of groundwater (7.7.3)
Very low potential of groundwater resource (7.7.4)
Non potential (7.7.5)

7.8 COMPOSITE WATER RESOURCE POTENTIAL
High potential of water resource (7.8.1)
Moderate potential of water resource; high potential of surface water resource (7.8.2)
Moderate potential of water resource; high potential of groundwater resource (7.8.3)
Low potential of water resource (7.8.4)
Very low to non potential of resource (7.8.5)

7.9 GEOLOGICAL HERITAGE VALUE
High value of geological heritage site/area (7.9.1)
High value of geological heritage site/area (7.9.2)
High value of geological heritage site/area (7.9.3)
Potential area for cave surveys and karst landform study (7.9.4)
general (7.9.5)

8.1 LAND (SLOPE) STABILITY
Stable area (8.1.1)
General stable area (8.1.2)
Moderate stable area (8.1.3)
Moderate to low slope stability area (8.1.4)
Low to Unstable stable area (8.1.5)

9.1 SUITABILITY ZONE FOR AGRICULTURE
Suitability zone for agriculture (9.1.1)
Suitability zone for agriculture (9.1.2)
Suitability zone for agriculture (9.1.3)
Suitability zone for agriculture (9.1.4)
Moderate Suitability for agriculture (9.1.5)
Moderate Suitability for agriculture (9.1.6)
Low Suitability for agriculture (9.1.7)
Not Suitability for agriculture (9.1.8)

9.2 SUITABILITY ZONE FOR LAND DEVELOPMENT
Suitability zone for land development (9.2.1)
- 1st suitable (high potential of water resource) (9.2.1.1)
- 2nd suitable (high potential of surface water but moderate for groundwater resource) (9.2.1.2)
- 3rd suitable (high potential of groundwater but moderate for surface water resource) (9.2.1.3)

Moderate suitability zone for land development (9.2.2)
- 1st moderate suitable (moderate potential of water resource) (9.2.2.1)
- 2nd moderate suitable (low potential of water resource) (9.2.2.2)

Low suitability zone for land development (9.2.3)
- 1st (moderate risk) (9.2.3.1)
- 2nd (high risk) (9.2.3.2)

Low suitability zone for land development (9.2.4)
Not suitability zone for land development (9.2.5)
Not suitability zone for land development (9.2.6)

9.3 SUITABILITY ZONE FOR CONSERVATION
Most suitability zone for conservation; High value of geological heritage area (9.3.1)
Most suitability zone for conservation; susceptible zone which the land development can be induced landslide hazard and severe erosion. (9.3.2)
Moderate suitability zone for conservation; watershed area of Thung (swamp) Sam Roi Yoi (9.3.3)
Moderate suitability zone for conservation; interesting area for cave surveying and karst topography investigation (9.3.4)
Moderate suitability zone for conservation; susceptible area that land development can be induced landslide hazard and severe erosion (9.3.5)
Moderate suitability zone for conservation; susceptible geo-ecological area as tidal environment (9.3.6)
general (9.3.7)

Table 4.3 To illustrate GILM map topics of Changwat Prachuap Khiri Khan : a case study area. The series of maps are limited in regional level, systemization of GILM by PIU system, Mapping approach base on TM image interpretation and integrate with existing informations and developed through the stage of PGI, IGI, and UGI by sieving/overlay technics.

Sorces/location/coverage	Stages/Groups of Map Topics/Map Topics	Sca	Sit	Hab	Deg	Diagnosis features of series
Sasin Chalermlarp, 1996	PGI-PRIMARY GEOLOGICAL INFORMATION					1) GILM for multi-purposes
	(1) Landform and Process					2) Grouped by both of subjects
Prachuap Khiri Khan,	Physiographic map (1.1)	s	a	t	l	(groups of topics) and
Thailand	Landform map (1.2)	s	a	t	l	by degree of inference (stage)
	Drainage system map (1.3)	s	a	t	l	3) 3 stages of relativeness
Province (Changwat)	(2) Geological Material					(PGI-->IGI-->UGI)
	Geological material map (solid ed.) (2.1)	s	a	t	l	4) high updatable
	Geological material map (drift ed.) (2.2)	s	a	t	l	
	Mineral distribution map (2.3)	s	a	t	l	
	(3) Geological Structure					
	Fracture map (3.1)	s	a	t	l	
	(4) Geohydrology					
	Aquifer map (4.1)	s	a	t	l	
	(5) Miscellaneous					
	Geological heritage site map (5.1)	s	a	t	l	
	Mining and mineral cocession area map (5.2)	s	a	t	l	
	IGI-INTERMEDIAT GEOLOGICAL INFORMATION					
	(6) Geological Hazard					
	Risk of landslide hazard Map (6.1)	s	a	t	m	
	Risk of flood hazard map (6.2)	s	a	t	m	
	Erosion susceptibility map (6.3)	s	a	t	m	
	(7) Geological Resource					
	Mineral resource potential map (7.1)	s	a	t	m	
	Construction sand potential map (7.2)	s	a	t	m	
	Lateritic soil for road construction potential map (7.3)	s	a	t	m	
	Aggregate rock potential map (7.4)	s	a	t	m	
	Building/Dimension stone potential map(7.5)	s	a	t	m	
	Surface water resource potential map (7.6)	s	a	t	m	
	Ground water resource potential map (7.7)	s	a	t	m	
	Composite of surface and ground water resource potential map (7.8)	s	a	t	m	
	Geoheritage value map (7.9)	s	a	t	m	
	(8) Geotechnical Properties					
	Land (slope) stability map (8.1)	s	a	t	m	
	UGI-ULTIMATE GEOLOGICAL INFORMATION					
	(9)					
	Suitability zone for agriculture map (9.1)	s	a	t	h	
	Suitability zone for land development (9.2)	s	a	t	h	
	Suitability zone for conservation map (9.3)	s	a	t	h	

NOTE

Diagnosis features of individual maps

Sca-Function of scale : S=Small scale map (regional level)

Sit-Situation of map : A=Applied geoscience map

Hab-Habit of information : T=Thematic map Deg -Degree of inference : L=Low, M=Medium, H=High

Dignosis features of series of maps

1=Aim of works ; 2= Grouping of Map Topics ; 3=Relationship of maps ; 4=Updating of information

(1.1), Landform Map (1.2), and Drainage System Map (1.3); 2) Geological Material which consists of Surface Geological Material in Consolidate Edition Map (2.1), Surface Geological Material in Unconsolidate Edition Map (2.2) and Mineral Distribution Map (2.3); 3) Geological Structure which consists of Fracture Map (3.1); 4) Geohydrology consists of Aquifer Map (4.1); and 5) Miscellaneous which consists of Geological Heritage Sites Map (5.1), and Mining and Mineral Concession Map (5.2).

1. Landform and Process

1.1 Morphological Map

Map showing distribution of areas having different nature of terrain classified according to its shape of land surface by base of the assumption of gradient or slope which can influence land use planning, such as Mountain and Hill (approximate of > 35% slope), Rolling to hilly terrain (app. 15-35% slope), Undulating to rolling terrain (app. 5-15% slope), and Nearly flat to slightly undulating terrain (app. 0-15% slope). Their elevation may be also indicated or are used to classified nature of terrains.

The map units were defined according to soils survey report of Changwat Prachuap Khiri Khan (DLD,1976). The identification of units was preliminary bounded by application of soil units grouping, compile with landsat image interpretation base on shapes of land expressions. Topographic map, at scale 1:50,000 were carried out to

confirm the identification of each unit. This map may be replaced by slope map when detailed physiography is need, particularly in large scale mapping.

The technicality of mapping in each unit are present conclusively in table 4-MC1.1

1.2 Landform map

Map showing geomorphic form of the land surface, classified relate with their origin process. The classified units are Denudation slope, hill and mountain, Piedmont coalescing fan and infill valleys, River plain and their relative terraces, Former tidal flat, Tidal flat, Beach, beach ridge, spit, tombolo, bar, included area possible rework by wind dune, Swampy and marshy area, and Lagoon channel. The mapping system were applied from Van Zuidam (1985) which can efficiantly mapping in regional level and can indicate to main geomorphic process, effecting on the area.

The identification of units were provided by landsat image interpretation, compile with soils units grouping from soil map. This map may be readjusted to increase for detail subunit and landform features, particularly in large scale mapping.

The technicality of mapping in each unit are present conclusively in table 4-MC1.2

Table 4-MC 1.1 The technicality of morphological mapping

MAP CODE/TOPIC 1.1 MORPHOLOGICAL MAP INFORMATION STAGE PGI GROUP OF MAP TOPICS LANDFORM ANF PROCESS

MAPPING METHOD Soil units regrouping, compiled with Landsat image interpretation, and confirmation by contour lines gradient of topographic map.

DATA USES : Soil map (DLD, 1976), landsat Image-5 TM BGR, Topograpic map, scale 1:250,000 and 1:50,000

Code	Unit	Mapping Keys	Remark
1.1.1	Nearly flat to slightly undulating terrain ; Low relief and assumption of gradient are 1-5%	soil series no. 1-30	Boundary of each unit should be separated by contour lines gradient data in level scale 1:50,000, compiled base on Landsat image checking for shape or configulation of each unit. (The mophological unit of soil series no. are referred from Soil survey reports of Changwat Prachuap Khiri Khan (DLD,1976)
1.1.2	Undulating to rolling terrain ; Low to moderate relief and assumption of gradient are 5-16%	soil series no. 31-49	
1.1.3	Rolling to hilling terrain ; Moderate relief and assumption of gradient are 16-35%	soil series no. 50-59	
1.1.4	Hill & Mountain terrain ; High relief and assumption of gradient are >35%	soil series no. 60	

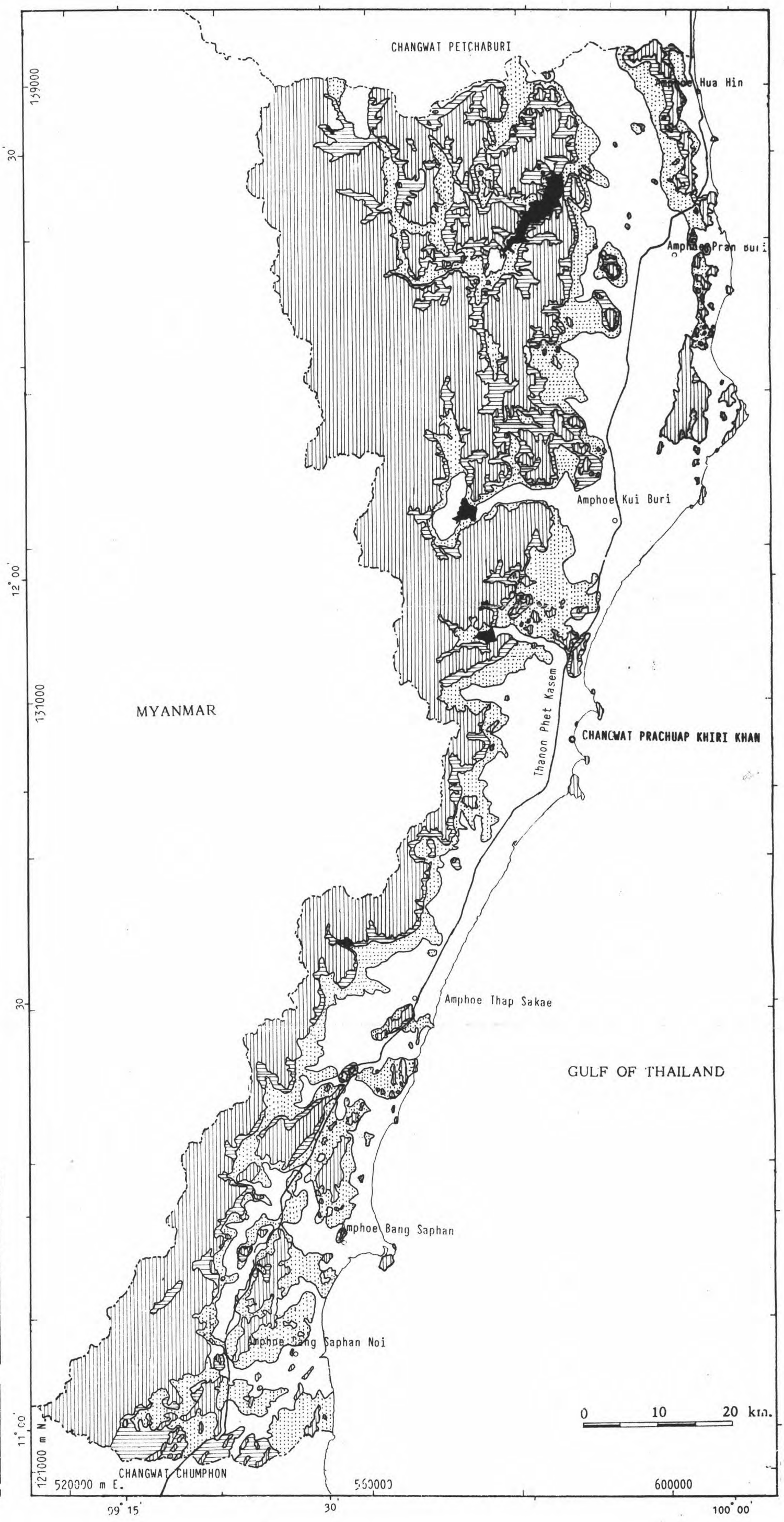
* Referred the no. of soil series from Soil map of Changwat Prachuap Khiri Khan (DLD,1976)

1.1 MORPHOLOGICAL MAP

Code	Unit
1.1.1	Nearly flat to slightly undulating terrain ; Low relief and assumption of gradient are 1-5%
1.1.2	Undulating to rolling terrain ; Low to moderate relief and assumption of gradient are 5-16%
1.1.3	Rolling to hilling terrain ; Moderate relief and assumption of gradient are 16-35%
1.1.4	Hill & Mountain terrain ; High relief and assumption of gradient are >35%

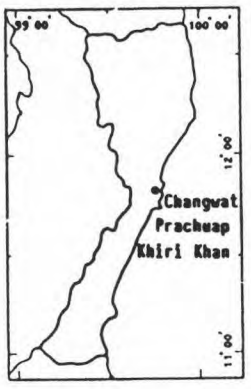
NOTE

1) This map must be used with table 4-MC 1.1
2) Mapping units are combined data from Soil map (DLD, 1976); Landsat-5 TM BGR ; and Topographic map (1:50,000 & 1:250,000)



Location map

Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

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Dept. of Geology, Graduate School
Chulalongkorn University, 1995

Table 4-MC 1.2 The technicality of landform mapping

MAP CODE/TOPIC 1.2 LANDFORM MAP INFORMATION STAGE PGI GROUP OF MAP TOPICS LANDFORM ANF PROCESS
MAPPING METHOD Landsat image interpretation
DATA USES : Landsat image-5 TM BGR

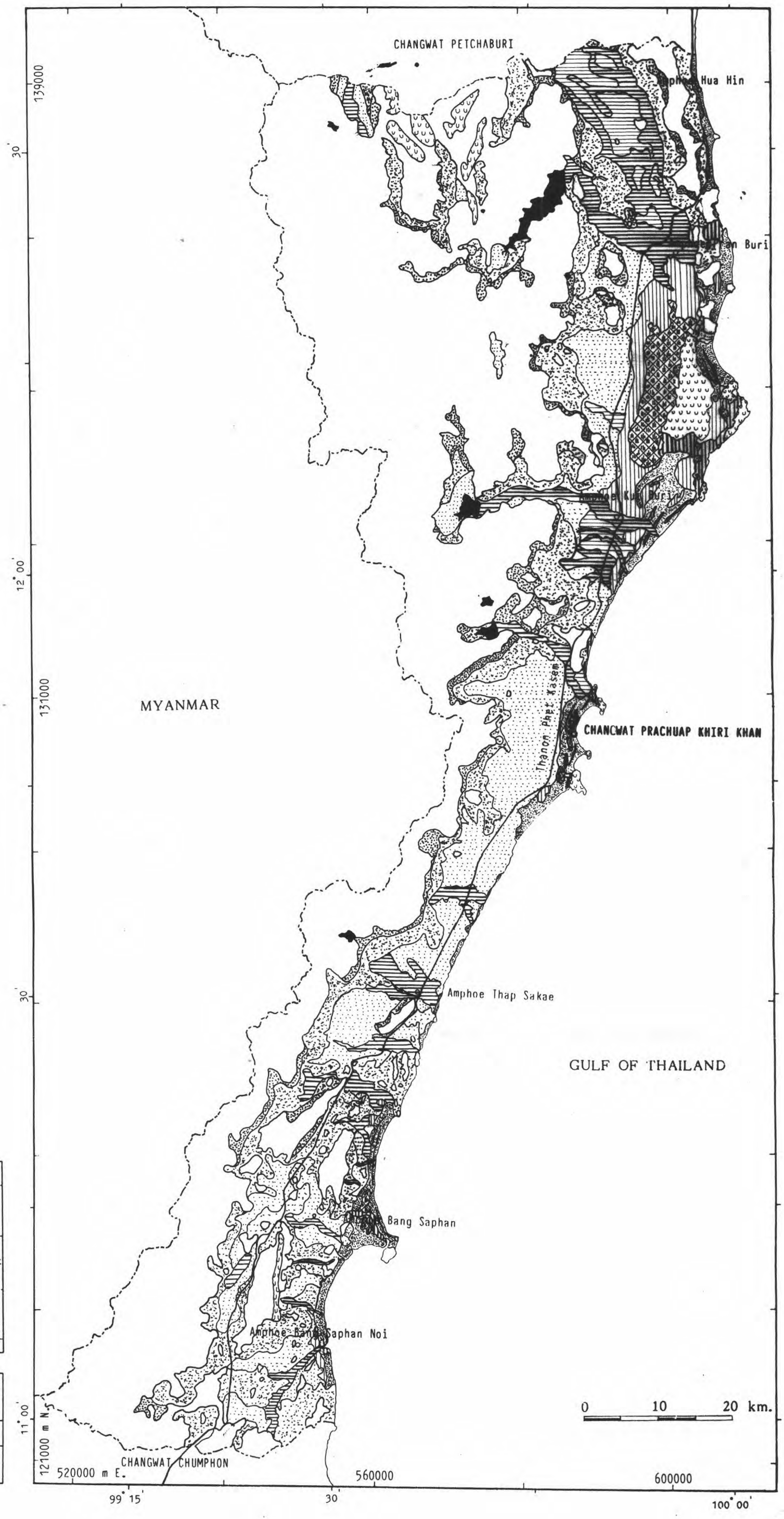
Code	Unit	Mapping Keys	Remark
1.2.1	Denudation slope, hill, and mountain landform :	Moderately steep to very steeply sloping topography, moderately to severely dissected area which are results of predominantly degradational processes.	
1.2.2	Karstic denudation slope, hill and mountain landform ;	A very rugged, developed with conical hills and depression or sinkhole. Drainage pattern are denditric and medium texture, angularity reflecting jointing control with some of internal character through the highly permeable soil and bedrock. Non to some of sag and swale gullies.	
1.2.3 1.2.3.1 1.2.3.2 1.2.3.3	Peidmont and included denudation remnants, Coelesing fan and infill valley : Steep slope (≈ >16%) Moerate slope (≈5-15%) Gentle slope (≈<5%).	Gentle to moderatly steeply sloping and/or undulating to rolling topography, moderate to severely dissected of colluvial, alluvial, and included residual deposite area which have relation to upland zones.This unit would be devided into 3 subunits to illustrated relative slope steepness	
1.2.4	River plain	Flat to nearly flat topography, seasonally to occasionally flooded area, basically subject to silting up by fluvial accumulation.	
1.2.5	Relative terrace of river plain	Area consist of a higher bench on the both side of the riverplain.	
1.2.6	Tidal flat ;	A marshy, sandy to muddy coastal flatland which is alternately covered and exposed as the tidal rise and fall.	
1.2.7	Former tidal flat ;	Flat to nearly flat area formed by regressive sea level change in the ancient tidal flat area.	
1.2.8	Beach, beach ridge, spit, tombolo bars and coastal sand dune (possible rework by wind) ;	Sandy coastal land, gentle to moderately steep slope topography, elongated forms possibly with deflation hollows and dunes.	
1.2.9	Swamp and marsh ;	A saturate, poorly drainage area intermittenly to permanently water--covered, having aquatic, grasslike to shrubs and trees.	
1.2.10	Swales/runnel	Nearly flat elongated depressions between beach ridges, recent one are frequently flooded and old ones are rarely flooded.	

1.2 LANDFORM MAP

Code	Unit
1.2.1	Denudation slope, hill, and mountain landform
1.2.2	Karstic denudation slope, hill and mountain landform
1.2.3	Peidmont and included denudation remnants, Coelesing fan and infill valley
1.2.3.1	Steep slope (~ >16%)
1.2.3.2	Moderate slope (~5-15%)
1.2.3.3	Gentle slope (~<5%).
1.2.4	River plain
1.2.5	Relative terrace of river plain
1.2.6	Tidal flat
1.2.7	Former tidal flat
1.2.8	Beach, beach ridge, spit, tombolo bars and coastal sand dune (possible rework by wind)
1.2.9	Swamp and marsh
1.2.10	Swales/runnel

NOTE

1) This map must be used with table 4-MC 1.2
2) Mapping units are combined data from Landsat- TM 5 BGR and Soil map (DLD,1976)



Location map

Study area

A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

1.3 Drainage System Map

Map showing drainage and watershed system, related to the coastal cells of each systems. The system of area is composed of 12 systems as Hua Hin system, Pran Buri system, Bang Pu-Nong Kao Nioew system, Sam Roi Yord-Khlong Khao Daeng system, Kui Buri system, Prachuap Khiri Khan system, Khlong Wan-Wa Ko system, Wanakorn-Thap Sakae system, Ang Thong system, Ban Krut system, Bang Saphan-Bang Saphan Noi system, and Khlong Tha Sae system.

The drainage systems classified base on data carried from topographic map, at scale 1:250,000. This map can be readjusted to increase more of subsystem of each system by add up of data from large scale topographic map or remote sensing images, particularly in large scale mapping.

The technicality of mapping in each unit are present conclusively in table 4-MC1.3

2. Geological Material

2.1 Surface geological material in consolidate edition

Map showing distribution in the part of surface consolidate (rock) materials being classified according to their physical properties which effect to landforms, surface and groundwater, and uses of materials. The material of a case study area can be group into 5 groups as the arenaceous

Table 4-MC 1.3 The technicality of drainage system mapping

MAP CODE/TOPIC 1.3 DRAINAGE SYSTEM MAP INFORMATION STAGE PGI GROUP OF MAP TOPICS LANDFORM ANF PROCESS
MAPPING METHOD Referred drainage data, and drainage devide mapping from topographic map in scale 1:250,000
DATA USES : Topographic map scale 1:250,000

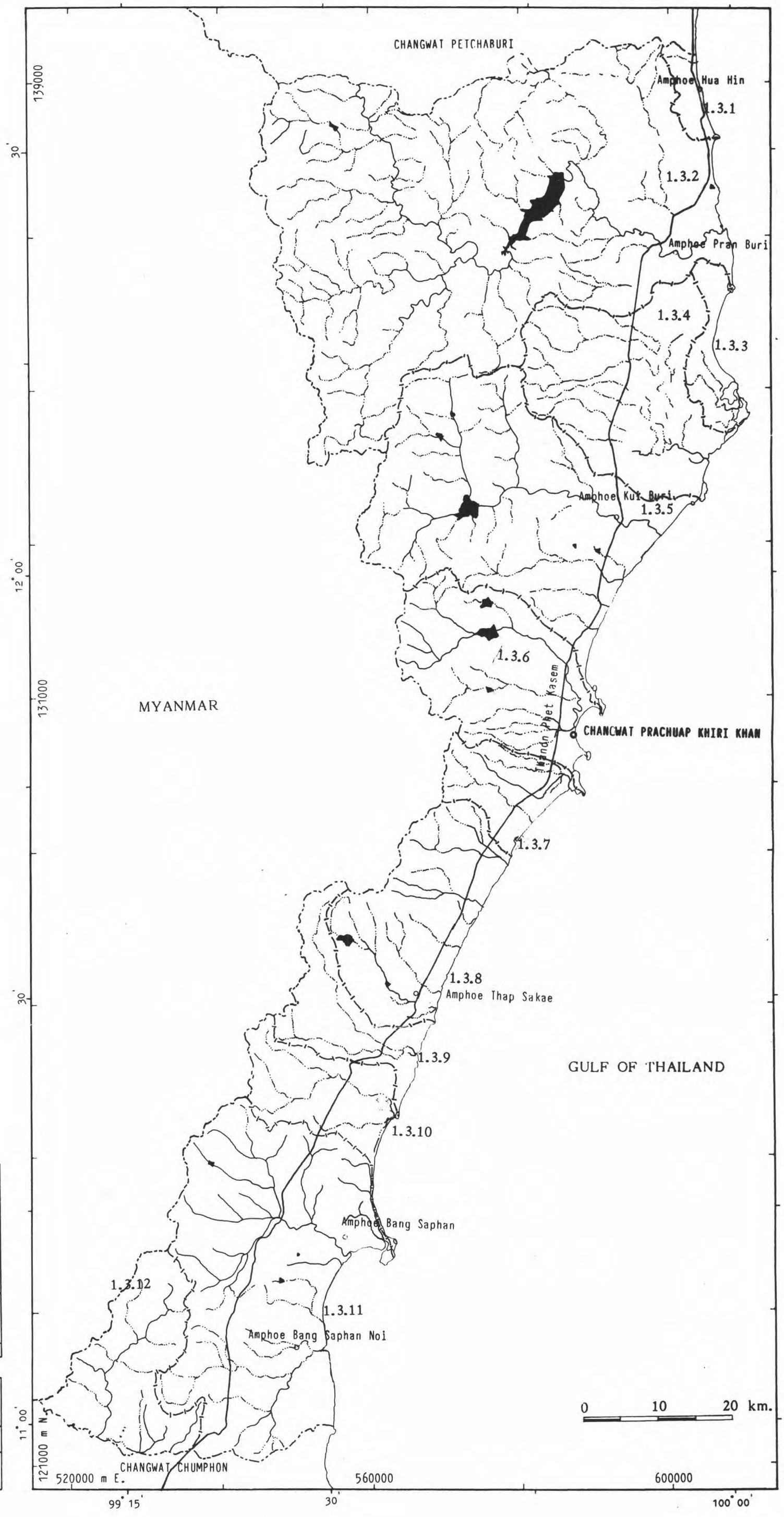
Code	Unit	Mapping Keys	Remark
1.3.1	Hua Hin system	The part of watershed area at the east of Khao Hin Lek Fai, on the north of Pran Buri system.	
1.3.2	Pran Buri system	The watershed area of Pran Buri river which be relative to the coastal cell between Khao Thung Sai Yai and Khao Kalok headlands.	
1.3.3	Bang Pu-Nong Kao Niow system	The watershed area of northern part of eastside of Khao Sam Roid Yord which be relative to the coastal cell between Khao Kalok and Khao Ko Rom Headlands. The main drainage of system is Klong Bang Pu.	
1.3.4	Sam Roi Yord - Khlong Khao Daeng system	The watershed area of Thung Sam Roi Yord (swamp)and Klong Khao Daeng which be relative to the coastal cell between Khao Ko Rom and Khao Khwang headlands.	
1.3.5	Kui Buri system	The watershed area of Klong Kui, Huai Bo Nok , Klong Chai Thong, and Khlong Ko which be relative to coastal cell between Khao Khwang and Khao Khan Bandai headlands.	
1.3.6	Prachuap Khiri Khan system	The watershed area of Klong Nang Rom which be relative to the coastal cell between Khao Khan Bandai and Khao Klong Wan headlands.	
1.3.7	Khlong Wan - Wa Ko system	The watershed area of Thung Lak Met, Klong Wan, Klong Wa Thon, and Huai Pong Chan which are relative to the coastal cell between Khao Klong Wan and Laem Ma Ka headlands.	
1.3.8	Wanakorn - Thap Sakae system	The watershed area of Klong Hin Chuang, Huai Kok Ma, Huai Yang, Klong Ket Tia, Klong Tap Sakae which be relative to the coastal cell between Khao Wat Namtha Wararam headlands.	
1.3.9	Ang Thong system	The watershed area of Klong Nam Chut, Klong Ang Thong which be relative to the coastal cell between Khao Namtha Wararam and Khao Pak Klong headlands.	
1.3.10	Ban Krut system	The watershed area of Klong Krut, Klong Wang Hin which be relative to the coastal cell between Khao Pak Klong and Khao Hua Pia Headlands.	
1.3.11	Bang Saphan - Bang Saphan Noi system	The watershed area of Klong Mae Ram Pung, Klong Bang Saphan Yai, Klong Bang Saphan Noi which be relative to the coastal cell between Khao Hua Pin and Khao Boet headlands.	
1.3.12	Khlong Tha Sae system	The part of watershed area at the west of Bang Sapan- Bang Saphan Noi system.	

1.3 DRAINAGE SYSTEM MAP

Code	Unit
1.3.1	Hua Hin system
1.3.2	Pran Buri system
1.3.3	Bang Pu-Nong Kao Niow system
1.3.4	Sam Roi Yord - Khlong Khao Daeng system
1.3.5	Kui Buri system
1.3.6	Prachuap Khiri Khan system
1.3.7	Khlong Wan - Wa Ko system
1.3.8	Wanakorn - Thap Sakae system
1.3.9	Ang Thong system
1.3.10	Ban Krut system
1.3.11	Bang Saphan - Bang Saphan Noi system
1.3.12	Khlong Tha Sae system

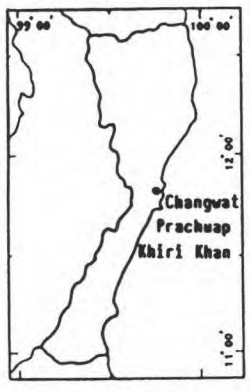
NOTE

1) This map must be used with table 4-MC 1.3
2) Mapping units are based on data from Topographic map (1:250,000)



Location map

Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

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Table 4-MC 2.1 The technicality of surface geological material mapping in consolidate edition.

MAP CODE/TOPIC 2.1 SURFACE GEO. MATERIAL (CONSOLIDATE ED.) INFORMATION STAGE PGI GROUP OF MAP TOPIC GEOLOGICAL MATERIAL
MAPPING METHOD Landsat image interpretation, compiled base on geological maps
DATA USES : Landsat image 5 TM BGR , Geologic maps, scale 1:250,000 (ND47-15, 1976), (ND47-3, 1977), (ND47-7,1977) , scale 1:500,000 (Western sheet, 1983)

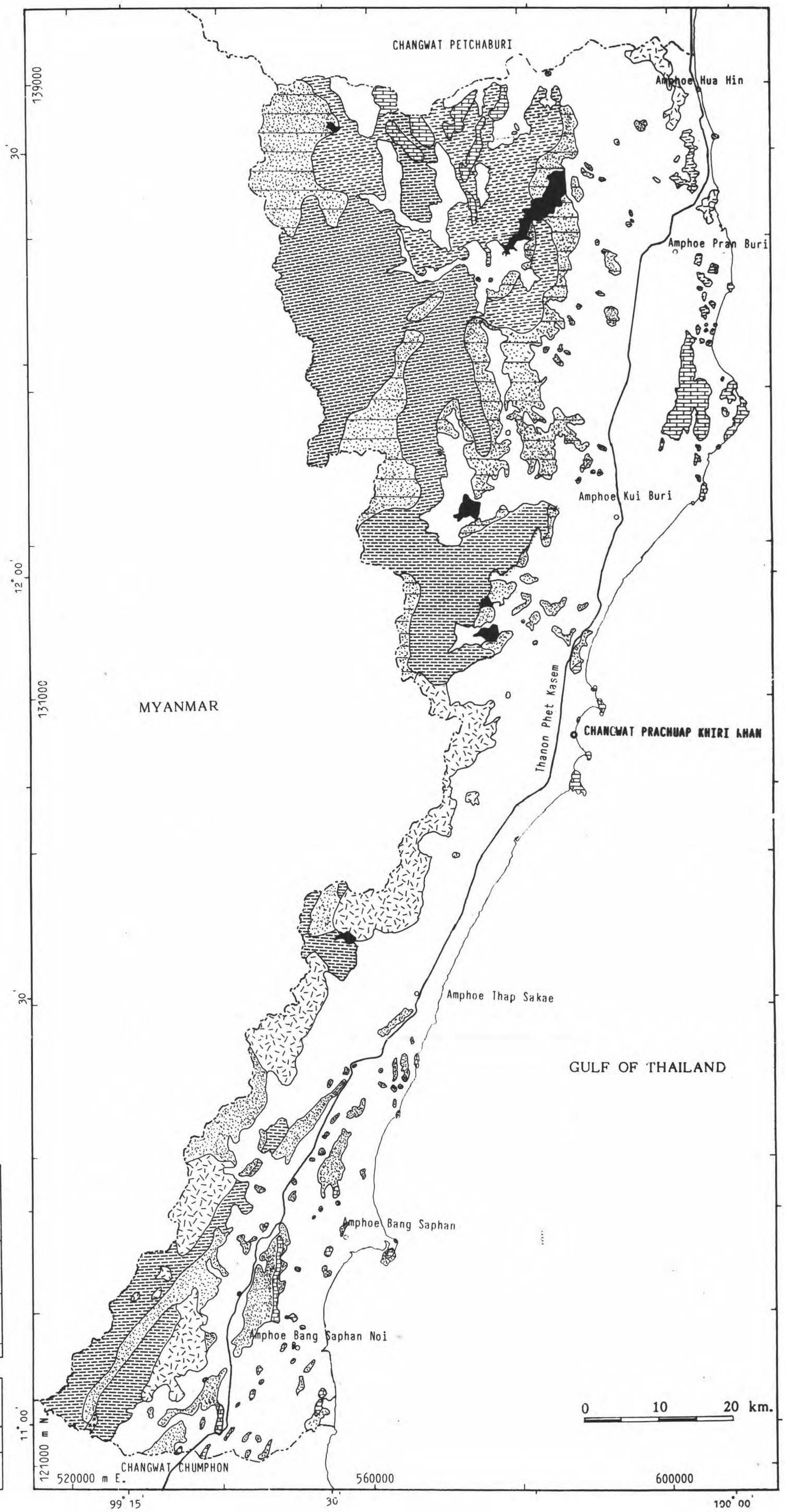
Code	Unit	Mapping Keys	Remark
2.1.1	Arenaceous group ; sedimentary rocks consisting wholly or in part of sand-size fragments, or having a sandy texture or appearance; pertaining to sand or arenite such as orthoquartzite, graywacke, arkose, calcarenite, and included to locally metasandstone and metasiltstone. This unite could be devided into 2 subunits, they are	This unit tend to be relatively resistant to weathering. Topography are massive, bold with steepsideslopes. The residual soils tend to be very shallow along the ridgelines but thicker at lower elevations, owing to the accumulation of colluvium. Dendritic drainage is general with usually coase texture. Few gullies are observed in V-Shape form.	base on Khao Chao formation, Khao Pra formation in Kaeng Kra Chan Group, Khao Sawoe Rat, Khao Tap Tim and Pran buri formations (ND47-15) Ban Ao Noi, Mae Ramphung, Fang Daeng formations (ND47-3)
2.1.1.1	Arenaceous meta sediment group		
2.1.1.2	Sandstone group		
2.1.2	Argillaceous group ;Grouping to rocks composed of clay minerals, or having notable proportion of clay in their composition such as shale, tuffaceous shale, calcareous shale, mudstone, pebbly mudstone, pebbly shale and argillitic rocks.	Very rugged with sharp ridges and steep hillsides and is highly dissected. Ridgeline are rounded to sharp but tend to parallel to one another. Elevations of hill tops and valley bottom tend to repeat over the region	base on Kaeng Krachan group
2.1.3	Carbonate group ; sedimentary and metamorphic rocks formed of carbonates of calcium, magnesium, and/or iron, e.g.limestone, dolomite and marble.	A very rugged, developed with conical hills and depressions or sinkhole. Drainage pattern are internal drainage, tangularity reflecting joint control with some of dendritic and medium texture. Non to some of sag and swale gullies.	base on Rat Buri group
2.1.4	Granitoid group ; A group of course grain intrusive rocks pertaining to or composed of granite to granite gneiss.	Massive rounded, domelike hill are common The top of the hill are softly rounded; the sideslope are steeper. A drainage pattern of medium texture is common. U-shape gully cross section can observed.	base on all lithologic units of granite and related rocks.

2.1 SURFACE GEOLOGICAL MATERIAL (CONSOLIDATE EDITION)

Code	Unit
2.1.1	**Arenaceous group ;** sedimentary rocks consisting wholly or in part of sand-size fragments, or having a sandy texture or appearance; pertaining to sand or arenite such as orthoquartzite, graywacke, arkose, calcarenite, and included to locally metasandstone and metasiltstone. This unite could be devided into 2 subunits, they are
2.1.1.1	**Arenaceous meta sediment group**
2.1.1.2	**Sandstone group**
2.1.2	**Argillaceous group ;**Grouping to rocks composed of clay minerals, or having notable proportion of clay in their composition such as shale, tuffaceous shale, calcareous shale, mudstone, pebbly mudstone, pebbly shale and argillitic rocks.
2.1.3	**Carbonate group ;** sedimentary and metamorphic rocks formed of carbonates of calcium, magnesium, and/or iron, e.g.limestone, dolomite and marble.
2.1.4	**Granitoid group ;** A group of course grain intrusive rocks pertaining to or composed of granite to granite gneiss.

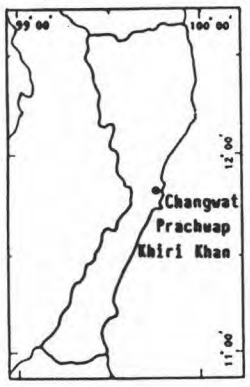
NOTE

1) This map must be used with table 4-MC 2.1
2) Mapping units are combined data from Landsat-TM 5 BGR and Geological Map (DMR.)



Location map

Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

group, argillaceous group, carbonate group, and granitoid group. The map units classified base on remote sensing interpretation, and referred by correlate to existing data such geological map of DMR. in various scales and confirmed by field checked.

The technicality of mapping in each of unit are present conclusively in table 4-MC2.1

2.2 Surface geological material in unconsolidate edition

Map showing distribution of superficial deposits being classified according to their physical properties and specific character in geology which effect to landforms, surface and ground water, and use of material. The superficial material units which be classified in to mapping units as Alluvium-colluvium sandy loam to loamy sand with gravelly phase, Alluvium-colluvium loam to sandy loam with gravelly phase, Alluvium sandy loam, Alluvium loam, Alluvium loam with clayey phase, Alluvium clay, Marine clay of former tidal flat, Marine clay with saline saturate, Marine clayey silt to clayey sand, Beach and dune sand, Clay to silty clay with saturate brackish/fresh water in swamp area (locally peat and shell deposit). The map units classified base on landform units which were correlated from existing data such soil map of DLD. in various scales and confirmed by field checked.

Table 4-MC 2.2 The technicality of surface geological material mapping in unconsolidate edition

MAP CODE/TOPIC 2.2 SURFACE GEO. MATERIAL (UNCONSOLIDATE ED.) INFORMATION STAGE PG1 GROUP OF MAP TOPICS GEOLOGICAL MAT.
MAPPING METHOD Soil units regrouping, compiled with boundary base on landform map (1.2)
DATA USES : Soil map (DLD,1976), Landform map (1.2)

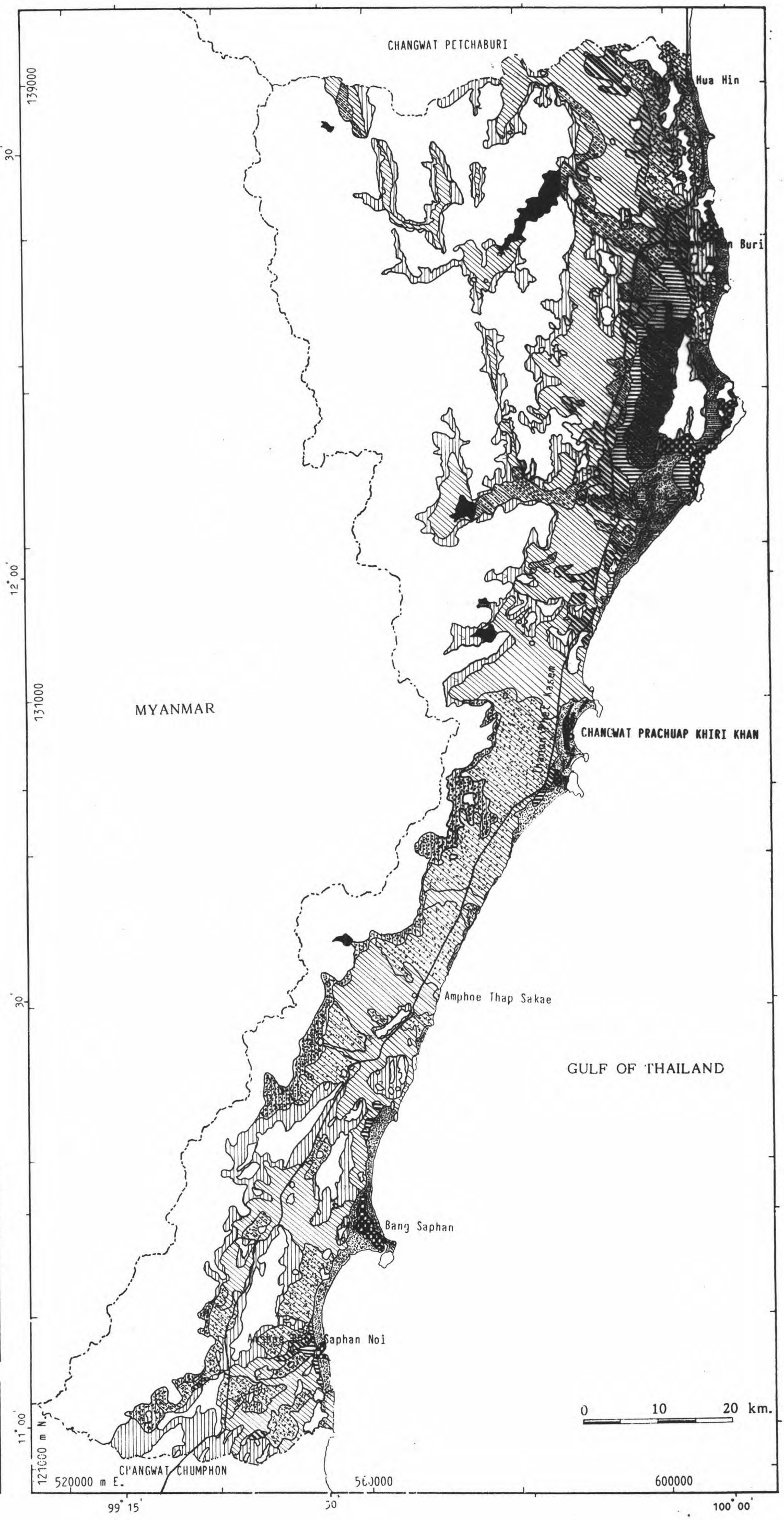
Code	Unit	Mapping Keys	Remark
2.2.1	Alluvium-colluvium sandy loam to loamy sand with gravelly phases ;Detrital deposits made by mass wasting process to stream alluvial fan usually at the foot of slope in in the size of sandy loam to loamy sand with gravelly phase, locally included with residual soil.	soil series no. 32, 33, 34, 39, 40 base on boundary of landform unit 1.2.3.1 -1.2.3.2	
2.2.2	Alluvium-colluvium loam to sandy loam with gravelly phase ;Detrital deposits made by mass wasting process to stream alluvial fan usually at the foot of slope in the size of loamy sand to sandy loam with gravelly phase, locally included with residual soil.	soil series no. 19, 20,24,25,32,33,34,39 45,56,59 base on boundary landform unit 1.2.3.1 -1.2.3.2	
2.2.3	Alluvial sandy loam ;Detrital depositsmade by streams on river bed, flood plains and alluvial fans in sandy loam size.	soil series no. 32, 33, 34, 39, 40	
2.2.4	Alluvium loam ;Detrital deposits made bystreams on river bed, flood plains andalluvial fans in loam size	soil series no. 8,21,23,26,28,29,30,35, 36,42,43,46,47,48	
2.2.5	Alluvium loam with clayey phase ; Detrital deposits made by stream on river bed, flood plains and alluvial fans in loam with clayey phase size.	soil series no. 27, 45Y	
2.2.6	Alluvium clay ;Detrital deposits made bystreams on river bed, flood plains and alluvial fans in clay size.	soil series no. 13-18, 44,	
2.2.7	Marine clay of former tidal flat ;Marine deposits in former tidal environment of sediment in clay size, locally coveredby thin layers of rainwash to flood deposite.	soil series no. 2-7	
2.2.8	Marine clayey silt to clayed sand of former tidal flat ;Marine deposits informer tidal environment of sediment inclayey silt to clayey sand sizes, locally covered by thin layers of rainwash to flood deposite.	soil series no. 10	
2.2.9	Marine clay/silt with saline saturate;Marine deposits in tidal environment ofsediment in clay/silt size.	soil series no. 1	
2.2.10	Clay to silty clay with saturate brackish to fresh water in swampy and marshy area ;Swampy and marshy deposite with brackish to fresh water saturate in clay to silty clay sizes.	The same boundary as Unit 1.2.9 of Map 1.2	
2.2.11	Beach and dune sand : Beach and dune sand of beach ridge, tombolo etc.	Soil series no. 11, 12	

2.2 SURFACE GEOLOGICAL MATERIAL (UNCONSOLIDATE EDITION)

Code	Unit
2.2.1	Alluvium-colluvium sandy loam to loamy sand with gravelly phases
2.2.2	Alluvium-colluvium loam to sandy loam with gravelly phases
2.2.3	Alluvial sandy loam
2.2.4	Alluvium loam
2.2.5	Alluvium loam with clayey phase ;
2.2.6	Alluvium clay
2.2.7	Marine clay of former tidal flat
2.2.8	Marine clayey silt to clayed sand of former tidal flat
2.2.9	Marine clay/silt with saline saturate
2.2.10	Clay to silty clay with saturate brackish to fresh water in swampy and marshy area
2.2.11	Beach and dune sand

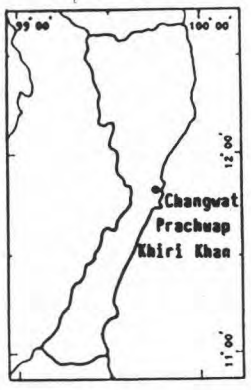
NOTE

1) This map must be used with table 4-MC 2.2
2) Mapping units are combined data from Soil map (DLD,1976) and Landform map (1.2)



Location map

Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

The technicality of mapping in each of unit are present conclusively in table 4-MC2.2

2.3 Mineral Distribution Map

Map showing mineral distribution sites which were located on the existing data as the Mineral resources map of DMR. (1992), and Mining concession map of DMR. (1992). From these data, mineral deposits in the area have been explorated are Gold, Calcite, Dolomite, Iron, Potassium feldspar, Illmenite, Leucoxene, Limestone, Monazite, Columbite-Tantalite, Quartz, Tin, Rutile, Tungsten, Xenotime, and Zircon.

3. Geological Structure

3.1 Fracture (lineament) Map

Map showing fracture trace feature, mapping by lineament interpretation from Landsat Image. This lineament trace is expected to possible fracture structure. The criteria of lineament mapping is illustrated in table 4-MC3.1 (after Sonthaya Choksattakig, 1992)

4. Geohydrology

4.1 Aquifer Map

Map showing distribution of aquifer in the study area. The map units were referred and readjusted from the

Table 4-MC 2.3 The technicality of mineral distribution mapping

MAP CODE/TOPIC 2.3 MINERAL DISTRIBUTION MAP INFORMATION STAGE PGI GROUP OF MAP TOPIC GEOLOGICAL MATERIAL

MAPPING METHOD Referred information from Mineral and Natural Resource map (DMR.,1992)

DATA USES : Mineral and Natural Resource map (DMR.,1992)

Code	Unit		Mapping Keys	Remark
	Au	Gold	Referred data after DMR.,1992	
	Cal	Calsite		
	Dol	Dolomite		
	Fe	Iron		
	K-Fld	Potassium feldspar		
	Gr	Granite		
	Ilm	Illmenite		
	Lcx	Leucoxene		
	Lst	Limestone		
	Mb	Marble		
	Mnz	Monazite		
	Nb-Ta	Columbite-Tantalite		
	Qtz	Quartz		
	Sn	Tin		
	Rt	Rutile		
	W	Tungsten		
	Xnt	Xenotime		
	Zrn	Zircon		

2.3 MINERAL DISTRIBUTION MAP

Unit	
Au	- Gold
Cal	- Calsite
Dol	- Dolomite
Fe	- Iron
K-Fld	- Potassium feldspar
Gr	- Granite
Ilm	- Illmenite
Lcx	- Leucoxene
Lst	- Limestone
Mb	- Marble
Mnz	- Monazite
Nb-Ta	- Columbite-Tantalite
Qtz	- Quartz
Sn	- Tin
Rt	- Rutile
W	- Tungsten
Xnt	- Xenotime
Zrn	- Zircon

NOTE

1) This map must be used with table 4-MC 2.3
2) Mapping units are referred data from Mineral resource map (DMR.,1992) and Mining concession map (DMR.,1992)

CHANGWAT PETCHABURI

Amphoe Hua Hin

Amphoe Pran Buri

Amphoe Kui Buri

MYANMAR

Thanon Phet Kasem

CHANGWAT PRACHUAP KHIRI KHAN

Amphoe Thap Sakae

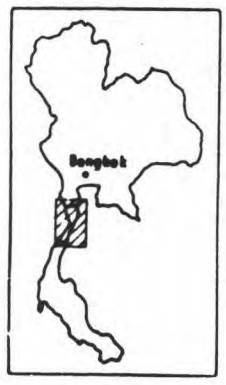
GULF OF THAILAND

Amphoe Bang Saphan

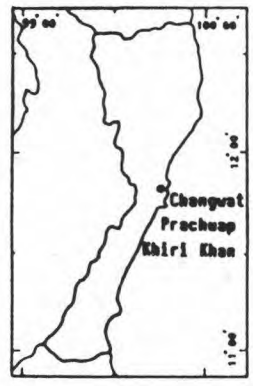
Amphoe Bang Saphan Noi

CHANGWAT CHUMPHON

Location map



Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

0 10 20 km.

520000 m E. 560000 600000

121000 m N

99° 15' 30 100° 00'

Table 4-MC 3.1 The technicality of fracture mapping by lineament interpretation from Landsat image

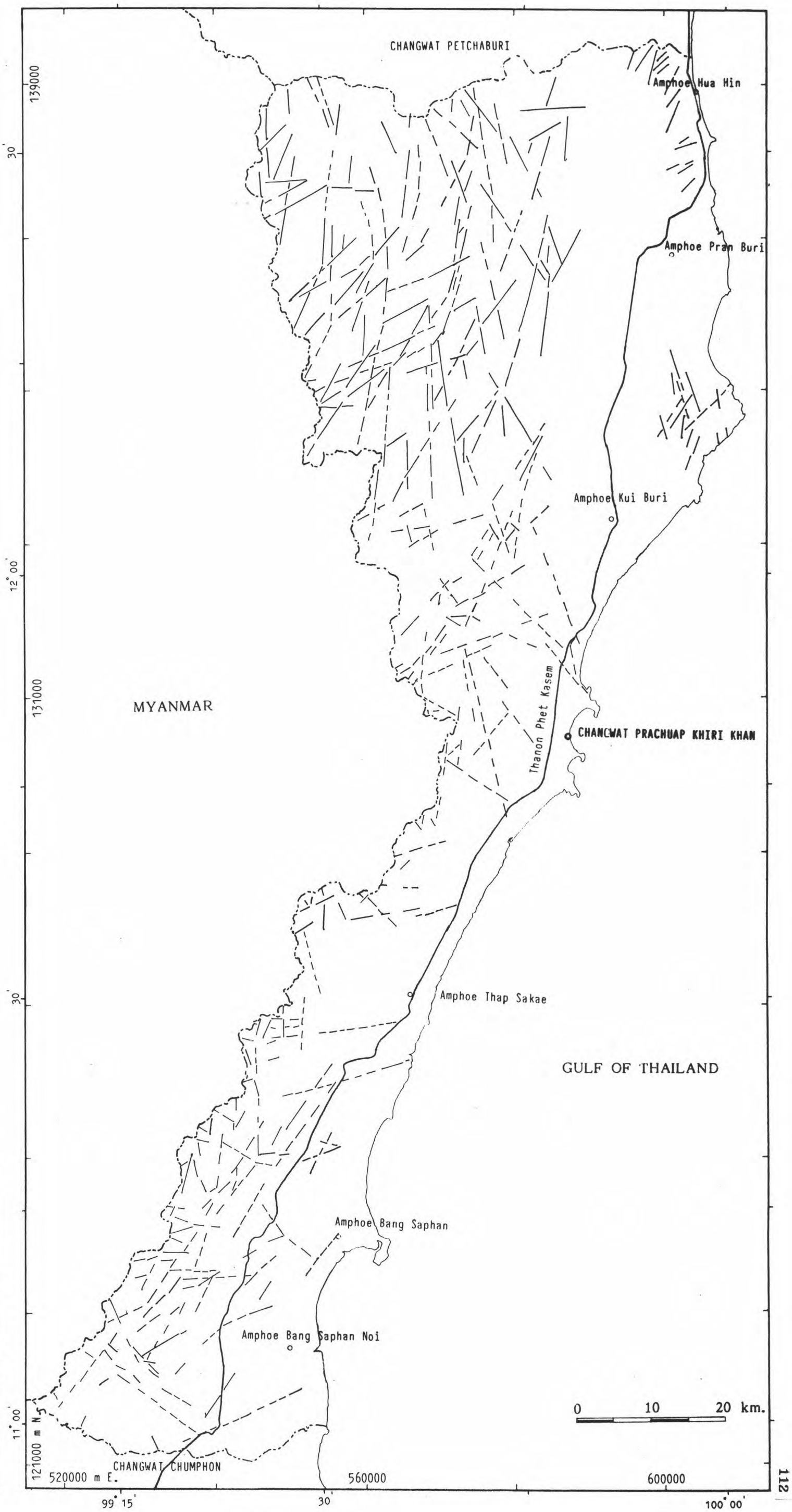
MAP CODE/TOPIC 3.1 FRACTURE MAP **INFORMATION STAGE** PGI **GROUP OF MAP TOPIC** GEOLOGICAL STRUCTURE **MAPPING METHOD** Landsat image interpretation **DATA USES :** Landsat image 5 TM BGR			
Code	**Unit**	**Mapping Keys**	**Remark**
	Lineament (possible fracture)	**Criteria of Lineament Delineation** 1. The contrast of two morphological features (reflecting difference in lithology) between the lines is considered to be the prime linearments or fractures 2. The deep, sharp, long, and straightened V-shape streams may indicate major fractures. 3. The slightly curved line or curvilinear objects with narrow width, particularly those following streams are also excellent indicators. 4. Straightened and sharp lines, either as stream valleys or ridges, are used for small linearment patterns. 5. Edges of basins, which are sharp and straighten are used for long lineament. 6. The streams which show patterns different from the other may also be applied, such as curve-like anular streams.	(Referred from Sonthaya Chokdsattakig, 1992)

3.1 FRACTURE MAP

Lineament (possible fracture)

NOTE

1) This map must be used with table 4-MC 3.1
2) Mapping detail are based on data from Landsat-TM 5 BGR (scale 1:125,000)



Location map

Study area

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hydrogeological map of Thailand, Scale 1:500,000 (DMR, 1976, 1978), and recompiled with the geological material and landform map. The record of well report in Changwat Prachuap Khiri Khan were carried out to confirm the identification of each unit. The mapping units of this map are consisted of Beach sand aquifer, Colluvium aquifer, Carbonate rock aquifer, Argillaceous to metaargillaceous rock aquifer, Metasedimentary rock aquifer, Sandstone aquifer, and Granitic and Gneissic aquifer.

The technicality of mapping in each unit are present conclusively in table 4-MC4.1.

5. Miscellaneous

5.1 Geological heritage Site Map

Geological heritage sites of study area are selected and identified in this study. These are very flexible in consideration. All of sites being mapped are relative significantly in geology. The map can be add up the new sites or get out of some sites by discussion with the expert and detail surveys in the futures. The name of site (in English-Thai) with geologic feature are demonstrated in table 4-MC 5.1

The data source of map were taken mainly from tourism data, they are from Map of Tourism Site of Thailand by Remote Sensing and Natural Resource Project (Chulalongkorn University), 1986.

Table 4-MC 4.1 The technicality of Aquifer mapping

MAP CODE/TOPIC 4.1 AQUIFER MAP INFORMATION STAGE PGI GROUP OF MAP TOPIC GEOHYDROLOGY

MAPPING METHOD Referred informations from geohydrological map, compiled with Record of well (DMR.,1993) and conformed base on landform and geological material informations

DATA USES : Geohydrological map (DMR, 1976,1978), Record of well (DMR.,1993), Landform map (1.2), Geological materials maps (2.1, 2.1)

Code	Unit	Mapping Keys	Remark
4.1.1	Beach sand aquifer;Consist of beach sand and dune sand; deposited along old and recent shoreline, generally not over 200 feet in thickness. The aquifer yield 5-10 gpm. of fresh to brackish water to most shallow well.	referred boundary from map 1.2 : unit 1.2.8 (beach, beach ridge, spit, tombolo , bars and coastal dune)	
4.1.2	Alluvium aquifer ;Consist of alluviums of minor flood plains, small valleys, and shallow burried channels. Thicknesses are commonly not exceeding 200 feet. The yields of 20-100 gpm.from sandy with minor gravel and clay beds are common. Potable water can be locally obtained to a limited extent but brackish to salty water is generally yielded by most well in the coastal area.	referred data from DMR.	
4.1.3	Colluvium aquifers ;Consisted of tallus, piedmont deposits, and in-situ decomposed bedrocks which located along the foot-hills and areas of relatively high altitudes. Composed mostly of rockfragments, debris sands, gravels, pebbles and boulders in clay to sandy clay matrix.The formations are generally poorly sorted and range in thickness from 5-30 m.. Although, the aquifer is less productice with a yield range of none to 20 gpm., it is important source of water for rural domastic uses in many places. Water quality is usually potable but locally inferior due to iron or hardness.	referred data from DMR.	
4.1.4	Carbonate rock aquifer ;Relative large quatity of groundwater occur in solution cavity, and also in its secondary producing zones which comprise bedding planes, contact zone between limestone and interbedding shale and occaionally the fault zones. Average yield is 100 gpm. but yield up to 500 gpm. can be expected from highly cavernous. Waterquality in many place are inferior due to hardness.	referred data from DMR.	

(table 4-MC4.1, cont.)

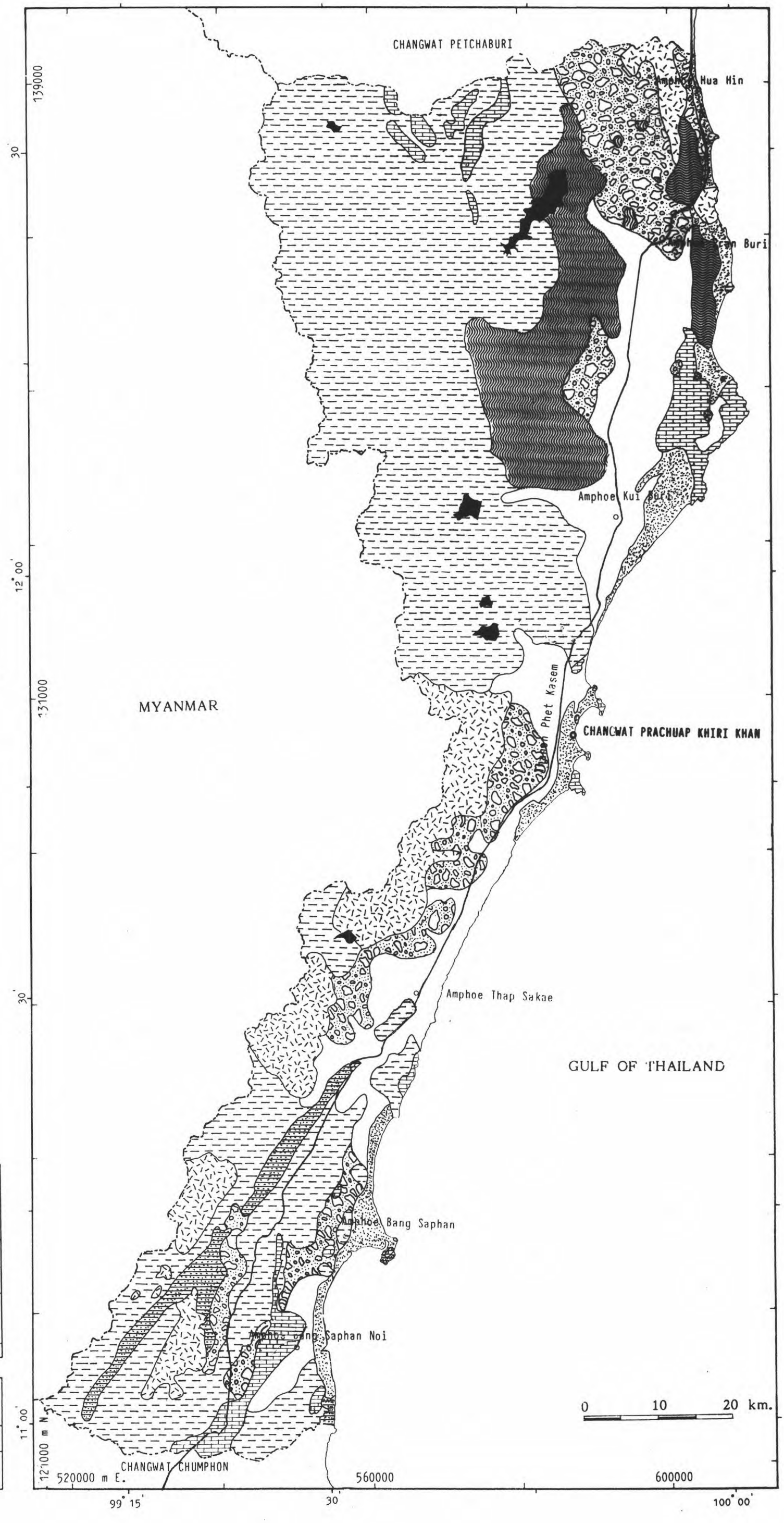
Code	Unit	Mapping Keys	Remark
4.1.5	**Argillaceous to Metaargillaceous sedimentary rock aquifer** ;Consisted of clastic sedimentary rocks of which quartzitic sandstone, feldspartic sandstones, phyllitic to slaty shales and graywackes are predominated. Groundwater occurs only in the secoundary openings , i.e.joints, fractures, contact zone ,and faults. These openings are usually small inmagnitude and are not well interconnected. Average yield of well penetrated is about 20 gpm.. Water quality is generally good but in many places inferior due to high concentration of iron.	referred boundary from DMR.	
4.1.6	**Metasedimentary rock aquifer** ; Consisted of poorly to well bedded quartzite, metashale, and metasilt. The rock arecomplexly folded, contorted of crumpled; and subject to various degree of faulting or fracturing, but the fissure system is not well interconnected. Groundwater is devoid in many places although some well penetrating the relatively recent fissures may yield sufficient amount of water for domestic purpose.	referred data from DMR.	
4.1.7	**Sandstone aquifer** ; Consist of massive and thick-bedded fine to medium arkosic sandstone. Groundwater occure in joint and fracture zone of rock which are generally complex but not well interconnected. Yield range from meager 30 gpm. with occasional yield slightly over 50 gpm. Water quality is gennerally good.	referred data from DMR.	
4.1.8	**Granitic and Gneissic aquifers** ; A combination of granite, granodiorite and associated intrusive rock and gneisses. Groundwater yields mainly from jointed systems or decomposed zones at a rate of meager to about 30 gpm., although yield of 50 gpm. has been obtained.	referred data from DMR.	

4.1 AQUIFER MAP

Code	Unit
4.1.1	**Beach sand aquifer**;Consist of beach sand and dune sand deposites along old and recent shoreline.
4.1.2	**Alluvium aquifer** ;Consist of alluviums of minor flood plains, small valleys, and shallow burried channels.
4.1.3	**Colluvium aquifers** ;Consisted of tallus, piedmont deposits, and in-situ decomposed bedrocks which located along the foot-hills and areas of relatively high altitudes.
4.1.4	**Carbonate rock aquifer** ;Relative large quatity of groundwater occur in solution cavity, and also in its secondary producing zones.
4.1.5	**Agillaceous to Metaagillaceous sedimentary rock aquifer** ;Consisted of clastic sedimentary and low grade metaclastic sedimentary rocks in argillaceous groups.
4.1.6	**Metasedimentary rock aquifer** ; Consisted of poorly to well bedded quartzite, metashale, and metasilt.
4.1.7	**Sandstone aquifer** ; Consist of massive and thick-bedded fine to medium arkosic sandstone.
4.1.8	**Granitic and Gneissic aquifers** ; A combination of granite, granodiorite and associated intrusive rock and gneisses.

NOTE

1) This map must be used with table 4-MC 4.1
2) Mapping units are modified from Hydrogeological Map (DMR.,1976;1978)



Location map

Study area

A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

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Table 4-MC 5.1 The technicality of geological heritage sites mapping

MAP CODE/TOPIC 5.1 GEOLOGICAL HERITAGE SITES INFORMATION STAGE PGI GROUP OF MAP TOPIC MISCELLANEOUS
MAPPING METHOD Referred and selected data from previous works, field investigation
DATA USES : Map of Tourism Sites of Thailand (Remote Sensing and Natural Resource Project: CU., 1986) ,

Code	Unit	Mapping Keys	Remark
	1 Geological heritage site in Amphoe Hua Hin		
5.1.1.1	Hua Hin beach (หาดหัวหิน)	beach landform	tourism area
5.1.1.2	Khao Takiab (เขาตะเกียบ)	gneiss exposure	tourism area
5.1.1.3	Suan Son beach (หาดสวนสน)	beach landform, significant of sand dune landform	tourism area
5.1.1.4	Khao Tao (เขาเต่า)	Precambrian gneiss outcrop	
5.1.1.5	Khao Tao beach (หาดเขาเต่า)	coastal sand dune	tourism area
5.1.1.6	Khao Krai Kat (เขาไกรลาส)	Precambrian gneiss outcrop	tourism area
5.1.1.7	Bo Fai beach (หาดบ่อฝ้าย)	beach landform	
5.1.1.8	Pa la U waterfall (น้ำตกปาละอู)	waterfall	National park (Kaeng Krachan)
5.1.1.9	Dao cave and Kai Lon cave (ถ้ำดาวและถ้ำไก่หล่น)	karst feature	tourism area
5.1.1.10	Wiman cave (ถ้ำวิมาน)	karst feature	tourism area
	2. Geological heritage site in Amphoe Pran Buri		
5.1.2.1	Keaw cave (ถ้ำแก้ว)	karst feature	tourism area
5.1.2.2	Pran Buri estury (ปากน้ำปราณบุรี)	deltaic landform	
5.1.2.3	Nong Kaow Niow bay (อ่าวหนองข้าวเหนียว)	beach landform/chenier features	
5.1.2.4	Kata cave (ถ้ำกะทะ)	karst feature	
5.1.2.5	Praya Nakorn cave (ถ้ำพระยานคร)	karst feature	National Park, Historical site, Identical locality of Changwat Prachuap Khiri Khan
5.1.2.6	Khao Kalok (เขากะโหลก)	karst feature	tourism area
5.1.2.7	Pran Buri forest park	beach landform	Forest park
5.1.2.8	Lam Sala beach (หาดแหลมศาลา)	beach landform	tourism area
	3. Geological heritage site in Amphoe Kui Buri		
5.1.3.1	Khao Noi cave (ถ้ำเขาน้อย)	karst feature	
5.1.3.2	Sai cave (ถ้ำไทร)	karst feature	tourism area
5.1.3.3	Khao Sam Roi Yord National Park (อุทยานแห่งชาติเขาสามร้อยยอด)	karst topography areas, anciant shorelines, anciant and recent sea notch, sea cave, marine terrace, saveral features of coastal landforms	National park
5.1.3.4	Khao Reang (เขาแรง)	Limestone mountain, Sea cliff	
5.1.3.5	Khao Pratun cave (ถ้ำเขาประทุน)	karst feature	
5.1.3.6	Phoriang beach (หาดโพธิเรียง)	beach landform	
5.1.3.7	Sam Pra Ya beach (หาดสามพระยา)	beach landform, tidal flat	tourism area
5.1.3.8	Thung Sam Roi Yord (Swamp area) (ทุ่งสามร้อยยอด)	anciant lagoon, biostrata of anciant bivalves, peat swamp landform	tourism area (ecotourism) birdwatching site
5.1.3.9	Khao Dang and Men cave (เขาแดงและถ้ำเม่น)	marine terrace, sea notch, anciant oysters indicated sea level changes in Men cave	tourism area

(table 4-MC 5.1, cont.)

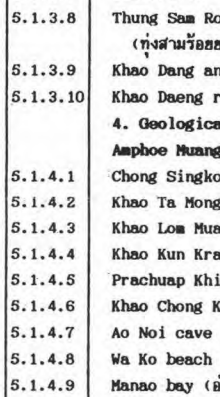
Code	Unit	Mapping Keys	Remark
5.1.3.10	Khao Daeng river (คลองเขาแดง)	recticular drainage pattern	tourism area
	4. Geological heritage sites in Amphoe Muang Prachuap Khiri Khan		
5.1.4.1	Chong Singkorn (ช่องสิงขร)	no data	Thailand-Myanmar border
5.1.4.2	Khao Ta Mong Lai (เขาตาม่องล่าย)	karst feature	tourism area
5.1.4.3	Khao Lom Muak (เขาล้มหมวก)	karst feature	tourism area
5.1.4.4	Khao Kun Kra Dai cave (ถ้ำเขาคั่นกระได)	karst feature	tourism area
5.1.4.5	Prachuap Khiri Khan bay (อ่าวประจวบ)	coastal bay	tourism area
5.1.4.6	Khao Chong Krachok (เขาช่องกระจก)	karst features, sea notch, sea cave	tourism area, scenic wonder Identical locality of Changwat
5.1.4.7	Ao Noi cave (ถ้ำอ่าวน้อย)	karst feature	tourism area
5.1.4.8	Wa Ko beach (หาดหว้ากอ)	beach landform	Historical site
5.1.4.9	Manao bay (อ่าวมะนาว)	coastal bay	tourism area
5.1.4.10	Song Kalon waterfall (น้ำตกสองกะลอน)	waterfall	
5.1.4.11	Khao Hin Toen (เขาหินเทิน)	Tor features of remnant weathering granitic terrain	tourism area, scenic wonder geologic features
	5. Geological heritage sites in Amphoe Tap Sakae		
5.1.5.1	Nong Hoi waterfall (น้ำตกหนองหอย)	waterfall	
5.1.5.2	Huai Yang waterfall (น้ำตกห้วยยาง)	waterfall	National park
5.1.5.3	Wanakorn beach(หาดวนกร)	beach landform, marine terrace, cliff coast of granite wash	National park
5.1.5.4	Khao Lan waterfall (น้ำตกเขาล้าน)	waterfall	
5.1.5.5	Khao Luang (เขาหลวง)	the highest montain of Changwat Prachaup Khiri Khan	
	6. Geological heritage sites in Amphoe Bang Saphan		
5.1.6.1	Mae Rum Puang bay (อ่าวแม่รำพึง)	coastal bay	tourism area
5.1.6.2	Klang Ao forest park (วนอุทยานกลางอ่าว)	no data	Forest park
5.1.6.3	Khao Ma Kong cave (ถ้ำเขาม้าร้อง)	karst feature	tourism area
5.1.6.4	Bo Thong Lang beach (หาดบ่อทองหลาง)	pocket beach feature	tourism area
	7. Geological heritage sites in Amphoe Bang Saphan Noi		
5.1.7.1	Pha Daeng cliff coast (หน้าผาทะเลฝั่งแดง)	cliff coast features of ancient river terrace?, ferricrete hard pan	
5.1.7.2	Khao Bang Berd cave (ถ้ำเขาบางเบิด)	karst feature	
5.1.7.3	Bang Bead field (ทุ่งบางเบิด)	no data	

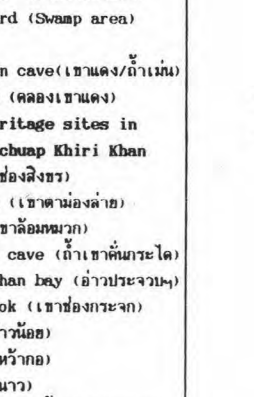
5.1 GEOLOGICAL HERITAGE SITES

Code	Unit
	1 Geological heritage site in Amphoe Hua Hin
5.1.1.1	Hua Hin beach (หาดหัวหิน)
5.1.1.2	Khao Takiab (เขาตะเกียบ)
5.1.1.3	Suan Son beach (หาดสวนสน)
5.1.1.4	Khao Tao (เขาเต่า)
5.1.1.5	Khao Tao beach (หาดเขาเต่า)
5.1.1.6	Khao Krai Rat (เขาไกรลาส)
5.1.1.7	Bo Fai beach (หาดบ่อฝ้าย)
5.1.1.8	Pa la U waterfall (น้ำตกปาละอู)
5.1.1.9	Dao and Kai Lon caves (ถ้ำดาว,ถ้ำไก่หล่น
5.1.1.10	Wiman cave (ถ้ำวิมาน)
	2. Geological heritage site in Amphoe Pran Buri
5.1.2.1	Keaw cave (ถ้ำแก้ว)
5.1.2.2	Pran Buri estury (ปากน้ำปราณบุรี)
5.1.2.3	Nong Kaow Niow bay (อ่าวหนองข้าวเหนียว)
5.1.2.4	Kata cave (ถ้ำกะทะ)
5.1.2.5	Praya Nakorn cave (ถ้ำพระยานคร)
5.1.2.6	Khao Kalok (เขากะโหลก)
5.1.2.7	Pran Buri forest park
5.1.2.8	Lam Sala beach (หาดแหลมศาลา)
	3. Geological heritage site in Amphoe Kui Buri
5.1.3.1	Khao Noi cave (ถ้ำเขาน้อย)
5.1.3.2	Sai cave (ถ้ำไทร)
5.1.3.3	Khao Sam Roi Yord National Park
5.1.3.4	Khao Reang (เขาแร้ง)
5.1.3.5	Khao Pratun cave (ถ้ำเขาประทุน)
5.1.3.6	Phoriang beach (หาดโพธิเรียง)
5.1.3.7	Sam Pra Ya beach (หาดสามพระยา)
5.1.3.8	Thung Sam Roi Yord (Swamp area) (ทุ่งสามร้อยยอด)
5.1.3.9	Khao Dang and Men cave(เขาแดง/ถ้ำเม่น)
5.1.3.10	Khao Daeng river (คลองเขาแดง)
	4. Geological heritage sites in Amphoe Muang Prachuap Khiri Khan
5.1.4.1	Chong Singkorn (ช่องสิงขร)
5.1.4.2	Khao Ta Mong Lai (เขาตามองล่าย)
5.1.4.3	Khao Lom Muak (เขาล้อมหมวก)
5.1.4.4	Khao Kun Kra Dai cave (ถ้ำเขาคั่นกระได)
5.1.4.5	Prachuap Khiri Khan bay (อ่าวประจวบฯ)
5.1.4.6	Khao Chong Krachok (เขาช่องกระจก)
5.1.4.7	Ao Noi cave (ถ้ำอ่าน้อย)
5.1.4.8	Wa Ko beach (หาดหว้ากอ)
5.1.4.9	Manao bay (อ่าวมะนาว)
5.1.4.10	Song Kalon waterfall(น้ำตกสองกะลอน)
5.1.4.11	Khao Hin Toen (เขาหินเทิน)
	5. Geological heritage sites in Amphoe Tap Sakae
5.1.5.1	Nong Hoi waterfall (น้ำตกหนองหอย)
5.1.5.2	Huai Yang waterfall (น้ำตกห้วยยาง)
5.1.5.3	Wanakorn beach(หาดวนกร)
5.1.5.4	Khao Lan waterfall (น้ำตกเขาล้าน)
5.1.5.5	Khao Luang (เขาหลวง)
	6. Geological heritage sites in Amphoe Bang Saphan
5.1.6.1	Mae Rum Puang bay (อ่าวแม่รำพึง)
5.1.6.2	Klang Ao forest park(วนอุทยานกลางอ่าว)
5.1.6.3	Khao Ma Rong cave (ถ้ำเขาม้าร้อง)
5.1.6.4	Bo Thong Lang beach(หาดบ่อทองหลาง)
	7. Geological heritage sites in Amphoe Bang Saphan Noi
5.1.7.1	Pha Daeng cliff coast(หน้าผาทะเลฝั่งแดง
5.1.7.2	Khao Bang Berd cave (ถ้ำเขาบางเบิด)
5.1.7.3	Bang Bead field (ทุ่งบางเบิด)

NOTE

1) This map must be used with table 4-MC 5.1
2) The two first code numbers of each site are code of map (5.1), and only last two numbers are used in this map.





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5.2 Mining and Mineral Concession Area Map,

Mining sites is the closest relative manmade feature with geology. This data shall be available in analysis of mineral resource potential map in IGI stages. The data of map was referred from the DMR.(1992).

4.4 IGI-Intermediate Geological Information,

GILM mapping in IGI stage are selected all of 3 groups of map topics in the total of 9 themes of map topics. They are; 1) Hazard and Deterioration which consists of Risk of Landslide Hazard Map(6.1), Risk of Flood Hazard Map (6.2), Erosion Susceptibility Map (6.3); 2) Geological Resource which consists of Mineral Resource Potential Map (7.1), Construction Sand Resource Potential Map (7.3), Lateritic soil for road construction potential map (7.3), Aggregate rock potential map (7.4), Building/Dimension stones potential map (7.5), Surface Water Resource Potential Map (7.6), Groundwater Resource Potential Map (7.7), Composite water resource potential map (7.8), and Geological heritage Value Map (7.9); Geotechnical Properties group consists of only one of Land (slope) Stability Map (8.1).

6. Hazard and deterioration

6.1 Risk of Landslide Hazard Map

Map showing degree of possibility of particular land to occur landslide hazard by analysis of primary geological

Table 4-MC 5.2 The technicality of mininig and mineral concession mapping

MAP CODE/TOPIC 5.2 MINING AND MINERAL CONCESSION AREA INFORMATION STAGE PGI GROUP OF MAP TOPICS MISCELLANEOUS

MAPPING METHOD Refered data from previous works

DATA USES : Mineral and fossil fuel resource map of Thailand (DMR.,1992), Mineral concession area map of Changwat Prachuap Khiri Khan (DMR.,1992)

Code	Unit	Mapping Keys	Remark
	Mining Sites Mineral Concessions Area **Abbrevation** Au Gold Cal Calsite Dol Dolomite Fe Iron K-Fld Potassium feldspar Gr Granite Ilm Illmenite Lcx Leucoxene Lst Limestone Mb Marble Mnz Monazite Nb-Ta Columbite-Tantalite Qtz Quartz Sn Tin Rt Rutile W Tungsten Xnt Xenotime Zrn Zircon	Data are referred from 2 sources 1) Mineral and Fossil Fuel Resource Map of Thailand (DMR.,1992) 2) Mineral Concession Map of Changwat Prachuap Khiri Khan (DMR.,1992)	

5.2 MINING AND MINERAL CONCESSION AREA MAP

Legend

+ Mining Sites

Mineral Concessions Area

Abbrevation

Au	-	Gold
Cal	-	Calsite
Dol	-	Dolomite
Fe	-	Iron
K-Fld	-	Potassium feldspar
Gr	-	Granite
Ilm	-	Illmenite
Lcx	-	Leucoxene
Lst	-	Limestone
Mb	-	Marble
Mnz	-	Monazite
Nb-Ta	-	Columbite-Tantalite
Qtz	-	Quartz
Sn	-	Tin
Rt	-	Rutile
W	-	Tungsten
Xnt	-	Xenotime
Zrn	-	Zircon

NOTE

1) This map must be used with table 4-MC 5.2
2) Mapping units are referred data from DMR.(1992)

CHANGWAT PETCHABURI

Amphoe Hua Hin

Amphoe Pran Buri

Amphoe Kui Buri

CHANGWAT PRACHUAP KHIRI KHAN

Thanon Phet Kasem

Amphoe Thap Sakae

Amphoe Bang Saphan

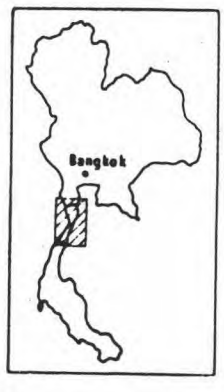
Amphoe Bang Saphan Noi

CHANGWAT CHUMPHON

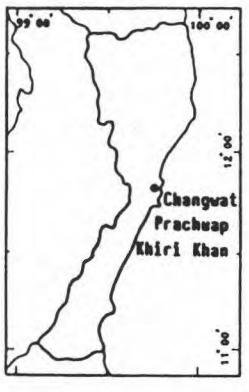
MYANMAR

GULF OF THAILAND

Location map



Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

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Chulalongkorn University, 1995

informations as Morphology of land, Geological Material, and Landform. The mapping units can be classed into degree; High risk, High to moderate risk, Moderate risk, Low risk, and Very low-non risk. The analytic method of mapping were modified from basis terrain analysis by Way (1973), key to landforms and their susceptibility to landslides (Van Zuidam, 1986), and derived from a case study of the Southern Thailand in 1988 (NRCT,1991).

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC6.1.

6.2 Risk of Flood Hazard Map

Map showing degree of possibility of particular land to occur flood hazard by analysis of primary geological informations as Landform and Drainage system. The mapping units can be classed into 7 units; Very high risk of flood hazard, High risk of flood of tidal area, High risk of flood hazard, Moderate risk of flood hazard, Moderate to low risk of flood hazard, Low risk of flood hazard, and Very low risk of flood hazard.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI

Table 4-MC 6.1 The technicality of risk of landslide hazard mapping

MAP CODE/TOPIC 6.1 RISK OF LANDSLIDE HAZARD INFORMATION STAGE IGI GROUP OF MAP TOPIC HAZARD AND DETERIORATION

MAPPING METHOD Sieving/overlay

DATA USES : Morphological map (1.1), Surface geologial material map Consolidate ed. (2.1)

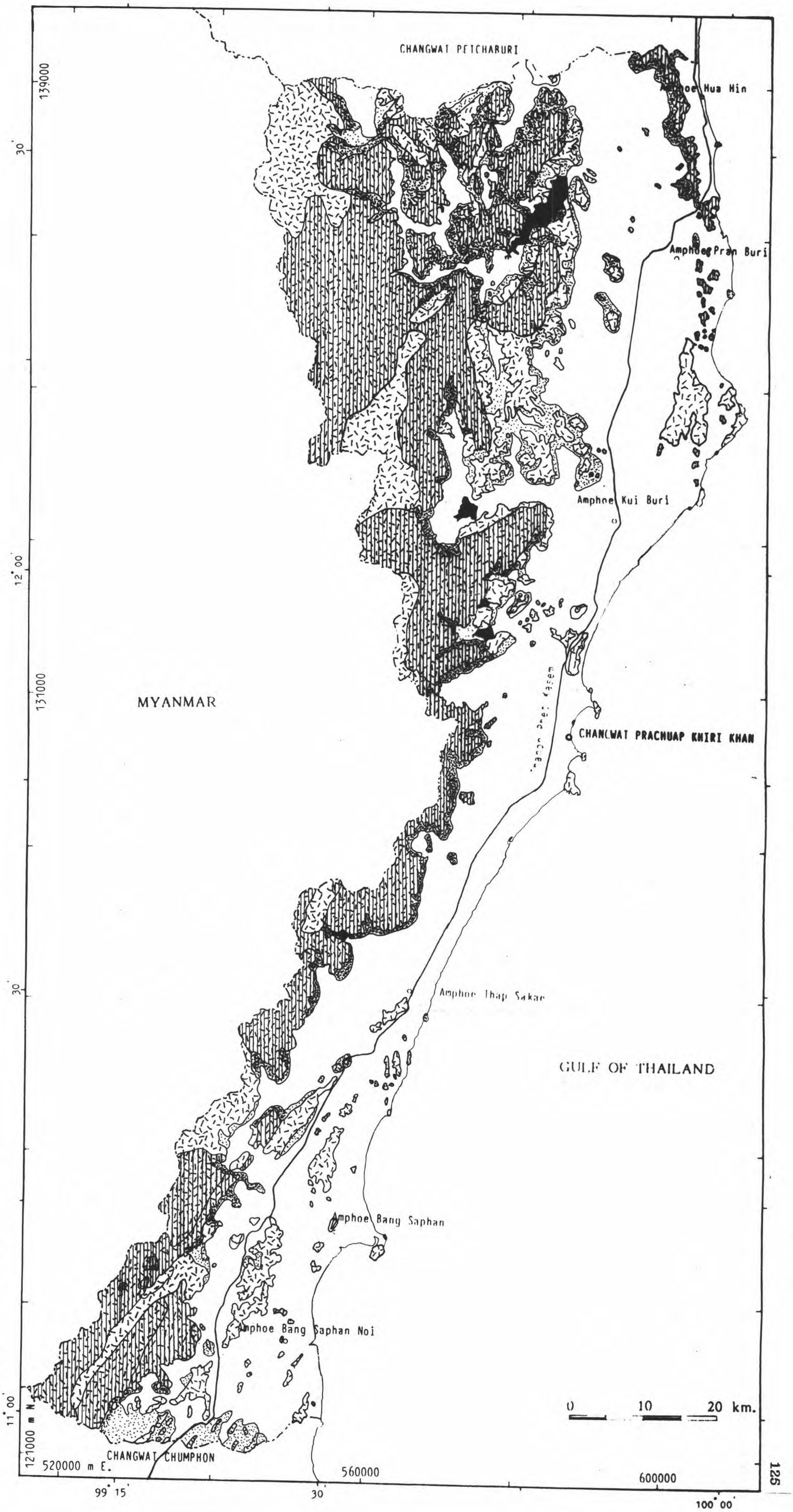
Code	Unit	Mapping Keys	Remark
6.1.1	**High risk of landslide hazard ;** risk to landslide hazard under the conditions as long heavy landfall, deforestation and openned the natural slope	Combiation of Map 1.1 : unit 1.1.4 with map 2.1 : unit 2.1.2 and 2.1.4	Hill and Mountain terrain , Argillaceouce - granitoid groups of surface materials (consolidate ed.)
6.1.2	**High to moderate risk of landslide hazard ;** risk to landslide hazard under the severe changed of landscape such natural slope openning, severe deforestation.	Map 1.1 : the other area of Unit 1.1.4	Hill and Mountain terrain, The other groups of surface materials
6.1.3	**Moderate risk of landslide hazard ;** risk from effectual results of landslide hazard in the relative upland.	Map 1.1 : unit 1.1.3 which continue from unit 6.1.1	Rolling and Hilly terrain that continue with high risk of landslide hazard area
6.1.4	**Low risk of landslide hazard ;** risk from effectual results of landslide hazard in the relative upland.	Map 1.1 : the other area of unit 1.1.3	The other area of rolling and hilly terrain
6.1.5	**Very low to non risk of landslide hazard**	The other area	

6.1 RISK OF LANDSLIDE HAZARD MAP

Code	Unit
6.1.1	**High risk of landslide hazard** ; risk to landslide hazard under the conditions as long heavy rainfall, deforestation.
6.1.2	**High to moderate risk of landslide hazard** ; risk to landslide hazard under the severe changed of landscape such natural slope openning, severe deforestation.
6.1.3	**Moderate risk of landslide hazard** ; risk from effectual results of landslide hazard in the relative upland.
6.1.4	**Low risk of landslide hazard** ; risk from effectual results of landslide hazard in the relative upland.
6.1.5	**Very low to non risk of landslide hazard**

NOTE

1) This map must be used with table 4-MC 6.1
2) Mapping units are combined data from Physiographic map (1.1), Surface geological material map (2.1).
3) Criteria of mapping key are applied from Ways (1973), Van Zuidam (1986), and NRCT (1991).



Location map

Study area

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maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are presented conclusively in table 4-MC6.2

6.3 Erosion Susceptibility Map

Map showing degree of susceptibility of particular land to erosion hazard by analysis of primary geological informations as Morphology of land, Geological Material, and Landform. The mapping units can be classed into 5 degree; Very high susceptible, High susceptible, Moderate susceptible, Slightly susceptible, and Not to insignificant. The analytical method of mapping were modified from basis terrain classification in erosion studies by Van Zuidam (1986).

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC6.3.

Table 4-MC 6.2 The technicality of risk of flood hazard mapping

MAP CODE/TOPIC 6.2 RISK OF FLOOD HAZARD MAP INFORMATION STAGE IGI GROUP OF MAP TOPIC HAZARD AND DETERIOLATION
MAPPING METHOD Seiving/overlay PGI maps, compiled with data from Landsat image and topographic maps
DATA USES : Landform map (1.2), Geological material in unconsolidate ed.(2.2), Landsat Image TM 5 BGR, Topographic map in scale 1:250,000 and 1:50,000.

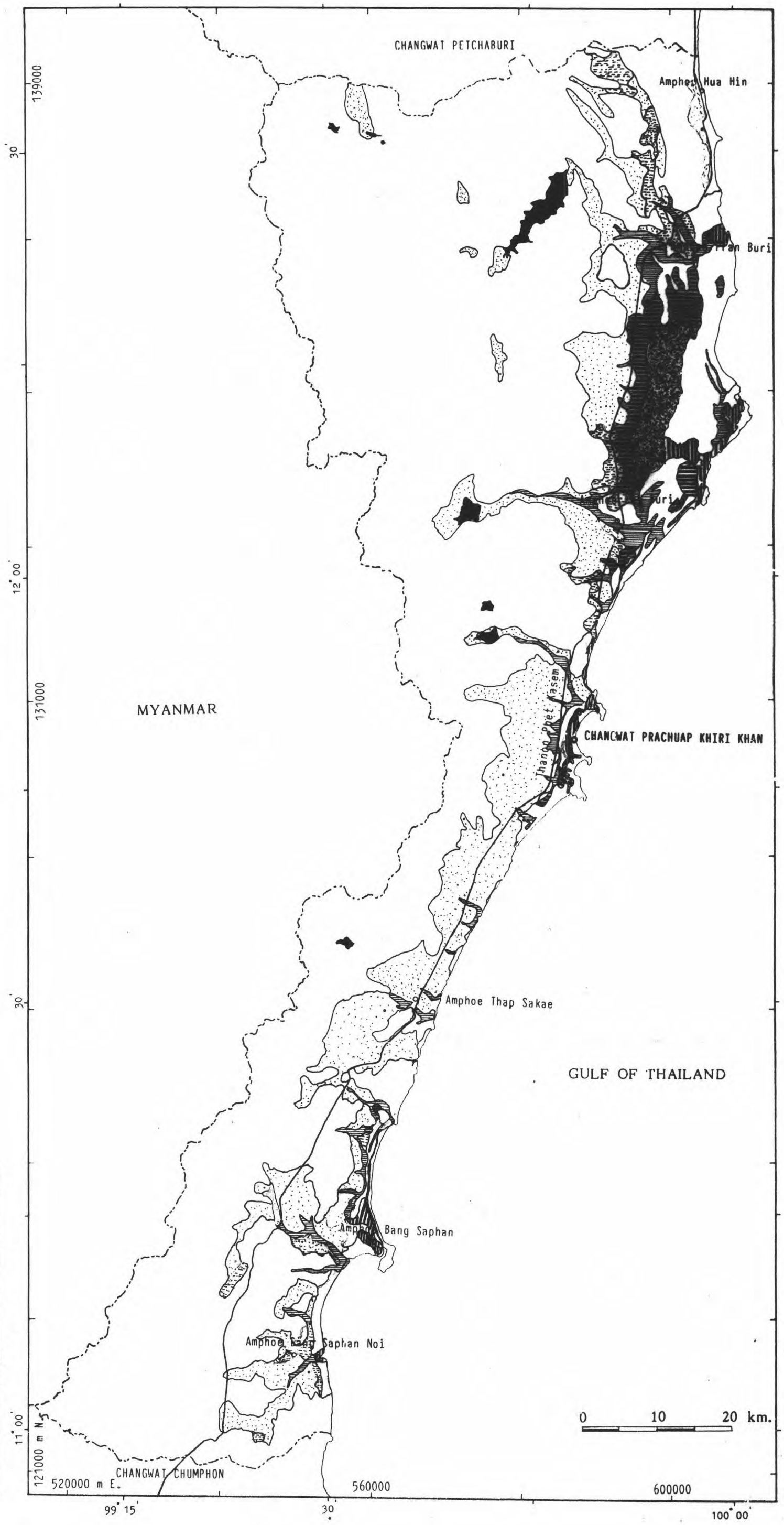
Code	Unit	Mapping Keys	Remark
6.2.1	Very high risk of flood hazard ; this part gets submergd in flood time. Depth of stagnation is deepest, swampy in dry season also.	Map 1.2 : Unit 1.2.9	Swamp and marsh landform
6.2.2	High risk of flood of tidal area ; this part is influence by daily/seasonal high tide or the daily ebb and flow	Map 1.2 : Unit 1.2.6	Tidal flat landform
6.2.3	High risk of flood hazard ; this part gets submerge in flood time	Map 1.2 : unit 1.2.4 or 1.2.7 or 1.2.10 combine with map 2.2 : unit 2.2.6/2.2.7 selected only area that are rice field, from TM and topographic maps	River plain, former tidal flat swale/runnel landforms, Alluvium and marine clay surface materials
6.2.4	Moderate risk of flood hazard ; this part gets submerged in flood time but the water drain of well and the period stanation is short.	Map 1.2 : Unit 1.2.4 or 1.2.7 or 1.2.10 that be left from unit 6.2.2	River plain, former tidal flat swale/runnel landform, other surface materials
6.2.5	Moderate to low risk of flood hazard ; this part gets submerged by sheet flood in flood time but the water drain of well.	Combination of map 1.2 : unit 1.2.3.3 map 2.2 : unit 2.2.6	Coelescing fan in gentle slope landform, alluvium clay surface material
6.2.6	Low risk of flood hazard ; this part gets submerged by sheet flood in extraordinary flood time but the the water drain of well	map 1.2 : unit 1.2.3.3 which does not position on Map 2.2 : Unit 2.2.6	Coelescing fan in gentle slope landform, the other surface materials.
6.2.7	Very low to non risk of flood hazard ; in general, the area never submerged in flood time but in locally can be geted sheet flood and /or forest flood flowing but the water drain of well.	The other area	

6.2 RISK OF FLOOD HAZARD MAP

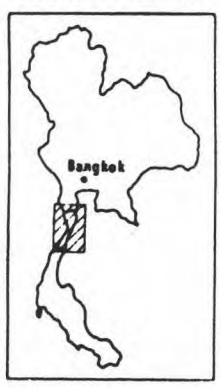
Code	Unit
6.2.1	**Very high risk of flood hazard ;** this part gets submergd in flood time. Depth of stagnation is deepest, swampy in dry season also.
6.2.2	**High risk of flood of tidal area ;** this part is influence by daily/seasonal high tide or the daily ebb and flow
6.2.3	**High risk of flood hazard ;** this part gets submerge in flood time
6.2.4	**Moderate risk of flood hazard ;** this part gets submerged in flood time but the water drain of well and the period stanation is short.
6.2.5	**Moderate to low risk of flood hazard ;** this part gets submerged by sheet flood in flood time but the water drain of well.
6.2.6	**Low risk of flood hazard ;** this part gets submerged by sheet flood in extraordinary flood time but the the water drain of well
6.2.7	**Very low to non risk of flood hazard ;** in general, the area never submerged in flood time but in locally can be geted sheet flood and /or forest flood flowing but the water drain of well.

NOTE

1) This map must be used with table 4-MC 6.2
2) Mapping units are combined data from Landform map (1.2), Surface geological material map (2.2)



Location map



Study area

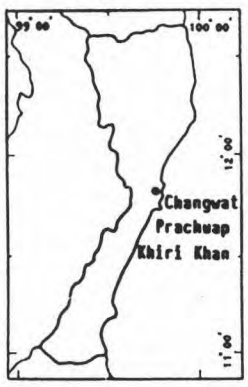


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Table 4-MC 6.3 The technicality of erosion susceptibility mapping

MAP CODE/TOPIC 6.3 EROSION SUSCEPTIBILITY INFORMATION STAGE IGI GROUP OF MAP TOPIC HAZARD AND DETERIORATION

MAPPING METHOD Seiving/overlay PGI maps

DATA USES : Morphological map (1.1), Surface geological material map (2.1 and 2.2), Landform map (1.2)

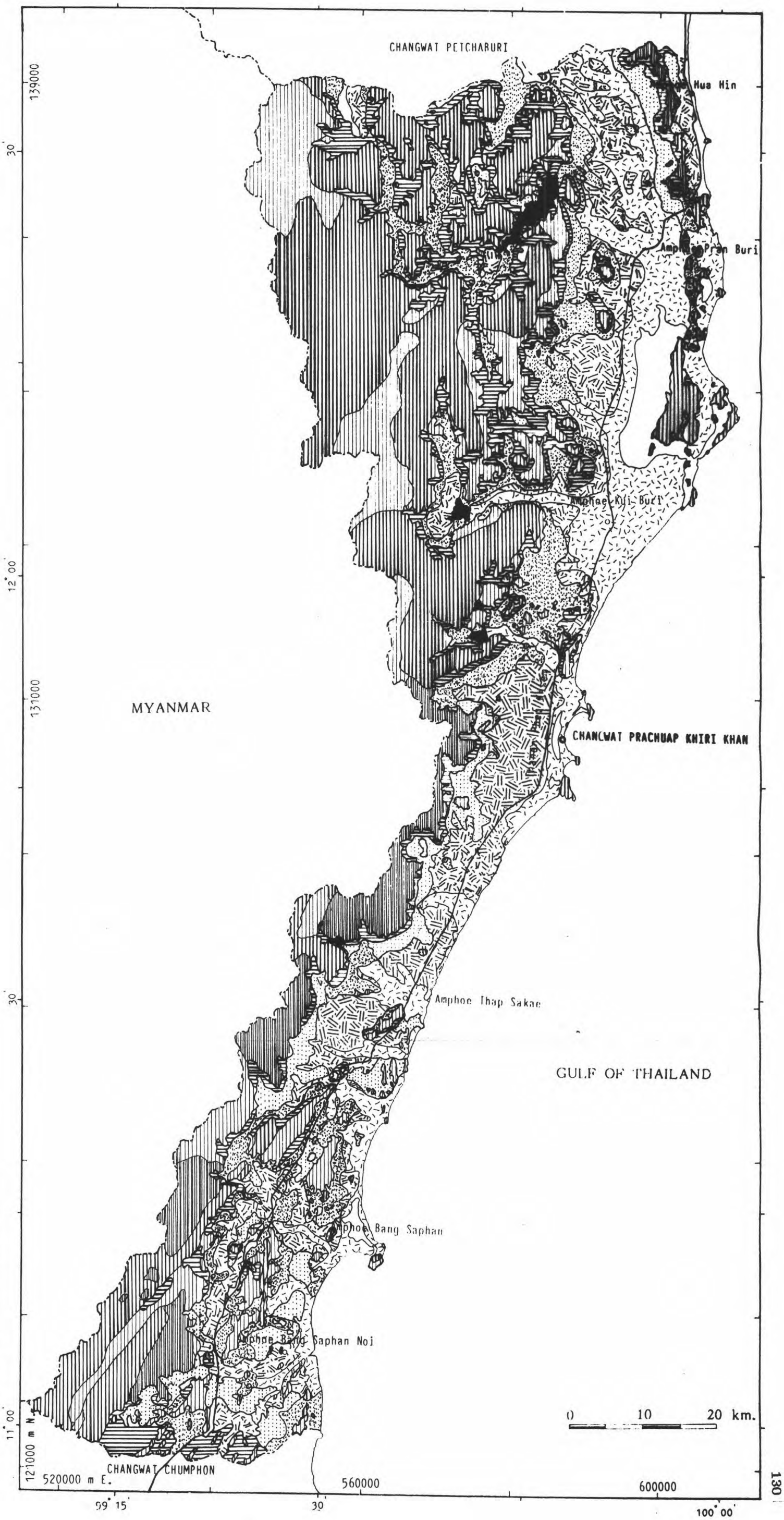
Code	Unit	Mapping Keys	Remark
6.3.1.	**Very high erosion susceptibility ;**	Combination of map 1.1 : unit 1.1.4 with	Hill and mountain terrain,
6.3.1.1	1st very high susceptible	- Map 2.1 : unit 2.1.2 and 2.1.3	Argillaceous, Carbonate mat.
6.3.1.2	2nd very high susceptible	- Map 2.1 : unit 2.1.4	Granitoid mat.
6.3.1.3	3rd very high susceptible	- Map 2.1 : unit 2.1.1	Arenaceous mat.
6.3.2.	**High erosion susceptibility ;**	Combination of map 1.1 : unit 1.1.3 with	Rolling and hilly terrain,
6.3.2.1	1st high susceptible	- Map 2.2 : all units except 2.2.1	Not be sandy materials
6.3.2.3	2nd high susceptible	- Map 2.2 : unit 2.2.1	Sandy loam to loamy sand mat.
6.3.3	**Moderate erosion susceptibility ;**	Combination of map 1.1 : unit 1.1.2 with	Undulating to rolling terrain,
6.3.3.1	1st moderate susceptible	- Map 2.2 : all units except 2.2.1/2.2.3	Not be sandy materials
6.3.3.2	2nd moderate susceptible	- Map 2.2 : Unit 2.2.1, 2.2.3	Sandy loam to loamy sand mat.
6.3.4	**Slight erosion susceptibility ;**	Combination of map 1.1 : unit 1.1.1 with	Nearly flat terrain,
6.3.4.1	1st slight susceptible	- Map 1.2 : unit 1.2.3	Coelescing fan landform
6.3.4.2	2nd slight susceptible	- Map 1.2 : all units except 1.2.6/1.2.9	area not be tidal flat/ swamp
6.3.5	**Not to signigficant of erosion susceptibility ;**	Map 1.2 : unit 1.2.6 and 1.2.9	Tidal flat/ swamp & marsh

6.3 EROSION SUSCEPTIBILITY

Code	Unit
6.3.1.	**Very high erosion susceptibility ;**
6.3.1.1	1st very high susceptible
6.3.1.2	2nd very high susceptible
6.3.1.3	3rd very high susceptible
6.3.2.	**High erosion susceptibility ;**
6.3.2.1	1st high susceptible
6.3.2.3	2nd high susceptible
6.3.3	**Moderate erosion susceptibility ;**
6.3.3.1	1st moderate susceptible
6.3.3.2	2nd moderate susceptible
6.3.4	**Slight erosion susceptibility ;**
6.3.4.1	1st slight susceptible
6.3.4.2	2nd slight susceptible
6.3.5	**Not to signigficant of erosion susceptibility ;**

NOTE

1) This map must be used with table 4-MC 6.3
2) Mapping units are combined data from Morphological map (1.1), Surface geological material maps (2.1-2.2), and Landform map (1.2)
3) Criteria of mapping keys are applied from Van Zuidam (1986).



Location map

Study area

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7. Geological Resource Potential

7.1 Mineral Resource Potential Map

Map showing potential degree particular land to exploitation of the mineral resources by analysis of primary geological informations as Geological material, Mineral distribution site, landform, Mining and mineral concession, Drainage systems, and supporting data as fracture (lineament). The mapping units can be classed into 4 degree; Mining interest potential, Mineral exploration interest potential, Mineralogy investigation interest potential, and low to non potential.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC7.1.

7.2 Construction Sand Resources Potential Map

Map showing potential degree particular land to exploitation of construction sand by map reclassification of primary geological informations as Geological Material and Landform. The mapping units can be classed into 4 degree; High potential, Moderate potential, Low potential and Non potential. The analysis of potential was applied from Soil

Table 4-MC 7.1 The technicality of mineral resource potential mapping

MAP CODE/TOPIC 7.1 MINERAL RESOURCES POTENTIAL INFORMATION STAGE IGI GROUP OF MAP TOPIC GEOLOGICAL RESOURCE

MAPPING METHOD Seiving/overlay PGI maps

DATA USES : Mineral distribution map (2.3), Mining and mineral cocession area map (5.2), Surface geological material in consolidate edition (2.1), Landform map (1.2), Drainage system map (1.3)

Code	Unit	Mapping Keys*	Remark
7.1.1	**Mining interest potential**	Map 1.2 : unit 1.2.3.1/1.2.3.2 and 1.2.8 and map 2.1 : unit 2.1.4 overlay on site/area of mine or mineral concession from Map 5.2, compiled with drainage systems and coastal cell from Map 1.3	Units 1.2.3.1/1.2.3.1 are Moderate to high slope of piedmont and coelescing fan landform, 1.2.8 is beach and coastal dune ; unit 2.1.4 is the granitoid group materials
7.1.2	**Mineral exploration interest potential**	Area of landform/ surface material or drainage/coastal cell systems which contained mineral occurences site/area from Map 2.3	
7.1.3	**Mineralogy investigation interest potential**	Area of landform / surface material or drainage/coastal cell systems which have relations with mineral occurences	
7.1.4	**Very low potential**	The other area	

* Consideration of each mapping units are base on basic geology of mineral deposits and occurences.

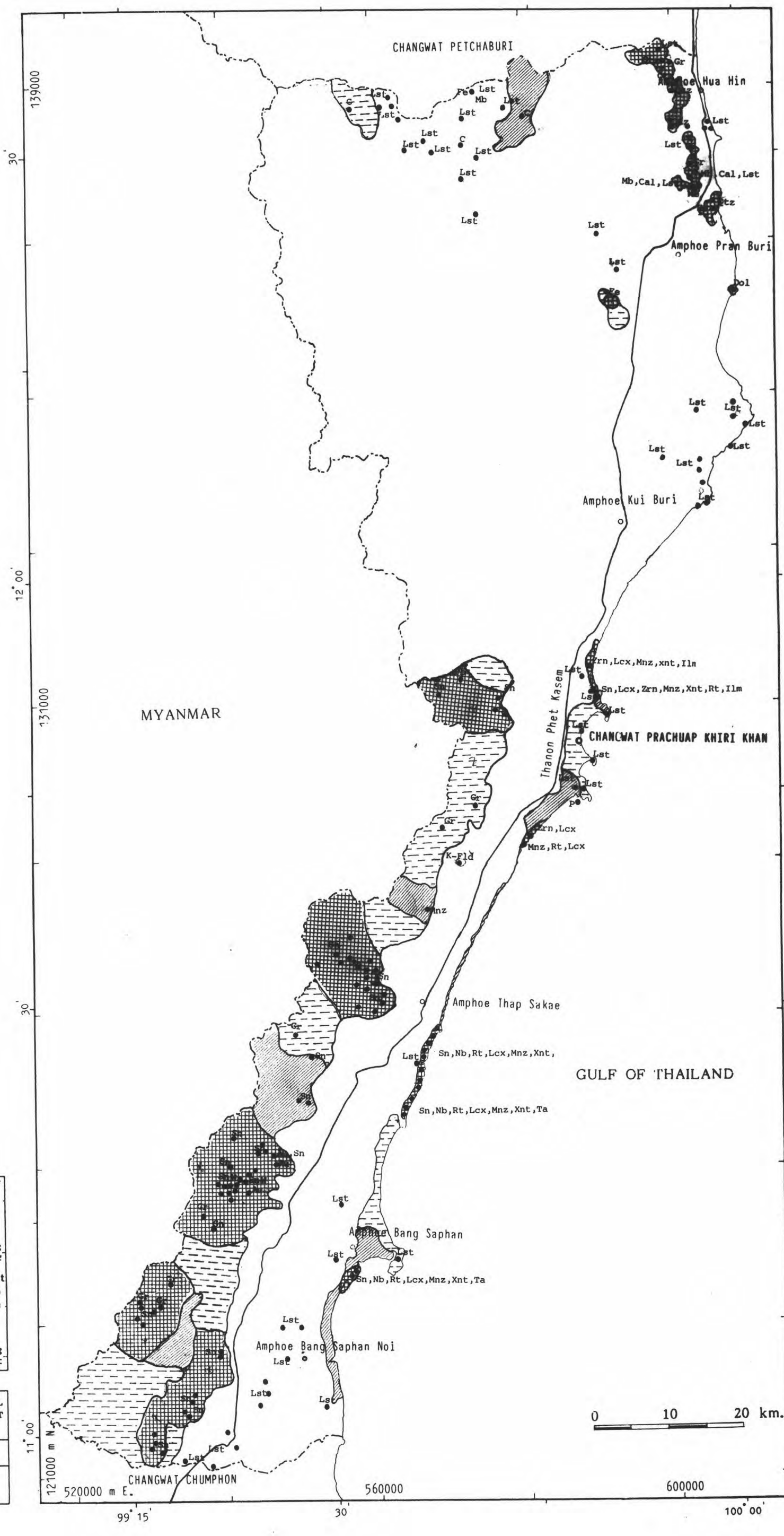
7.1 MINERAL RESOURCES POTENTIAL MAP

Code	Unit
7.1.1	Mining interest potential
7.1.2	Mineral exploration interest potential
7.1.3	Mineralogy investigation interest potential
7.1.4	Very low potential

NOTE

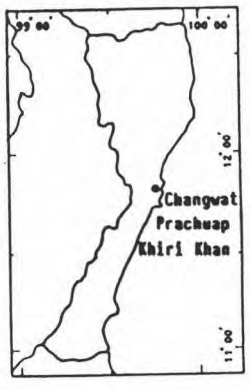
1) This map must be used with table 4-MC 7.1
2) Mapping units are combined data from Mineral distribution map (2.3), Mining Concession map (5.2), Surface geological material map (2.1), Landform map (1.2), and Drainage sysem map (1.3)
3) Abbreviation of Minerals distribution site:

Au - Gold
Cal - Calsite
Dol - Dolomite
Fe - Iron
K-Fld - Potassium feldspar
Gr - Granite
Ilm - Illmenite
Lcx - Leucoxene
Lst - Limestone
Mb - Marble
Mnz - Monazite
Nb-Ta - Columbite-Tantalite
Qtz - Quartz
Sn - Tin
Rt - Rutile
W - Tungsten
Xnt - Xenotime
Zrn - Zircon



Location map

Study area



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Dept. of Geology, Graduate School
Chulalongkorn University, 1995

survey report of Changwat Prachuap Khiri Khan (1976), compile with boundary of landform units and Surface materials.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC7.2.

7.3 Lateritic Soil for Loose surface Road Construction Potential Map

Map showing potential degree particular land to exploitation of the Lateritic soil for loose surface road construction by analysis of primary geological informations as Geological Material and Landform. The mapping units can be classed into 4 degree; High potential, Moderate potential, Low potential and Non potential. The analysis of potential was applied from Soil survey report of Changwat Prachuap Khiri Khan (1976), compile with boundary of landform and geological material units.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

Table 4-MC 7.2 The technicality of construction sand resource potential mapping

MAP CODE/TOPIC 7.2 CONSTRUCTION SAND POTENTIAL INFORMATION STAGE 1G1 GROUP OF MAP TOPICS GEOLOGICAL RESOURCE

MAPPING METHOD Map reclassification

DATA USES : Surface material map in unconsolodate ed. (2.2)) , Soil map (DLD, 1976)

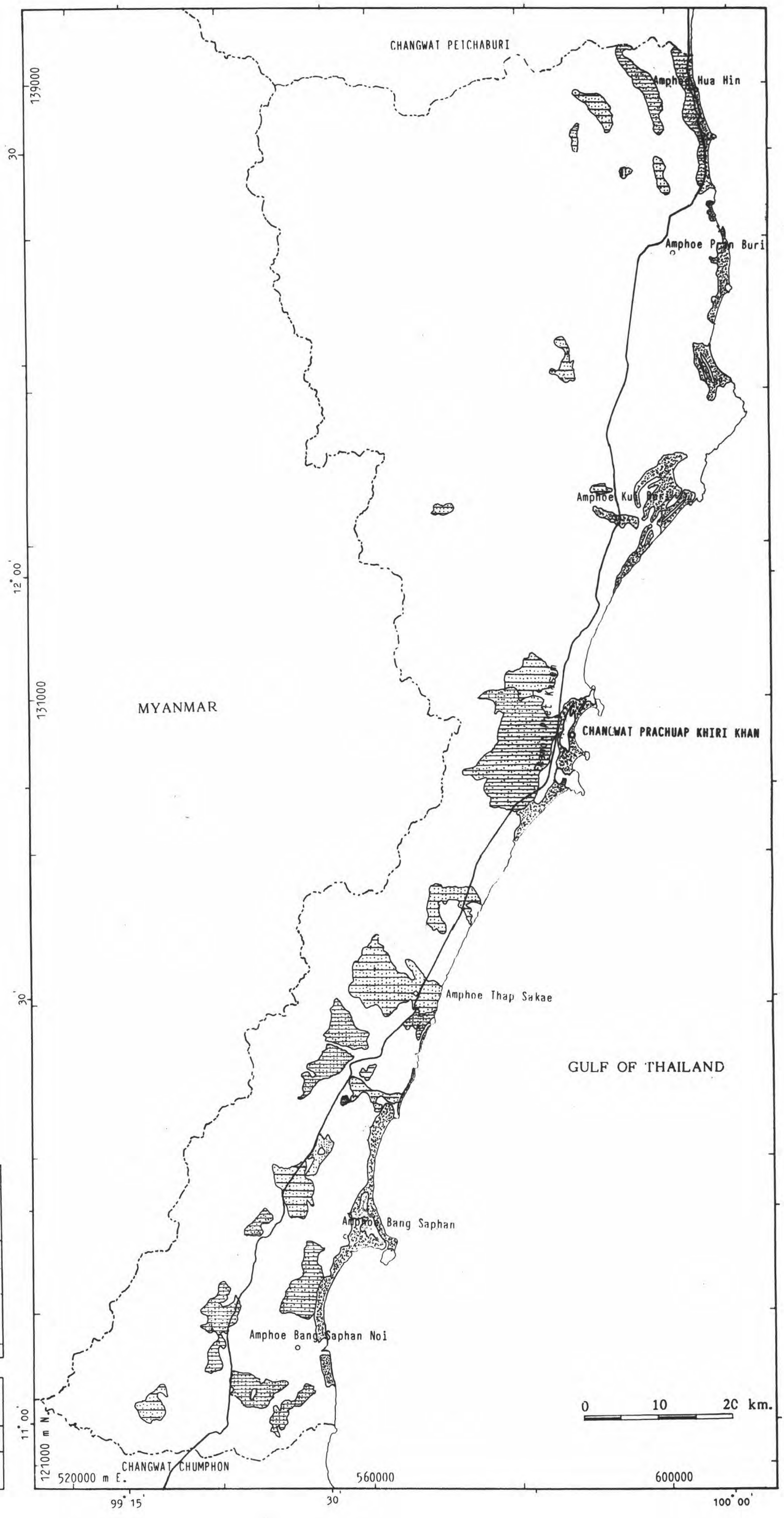
Code	Unit	Mapping Keys	Remark
7.2.1	**High potential of construction sand resource**	Selected Unit 2.2.11/2.2.3/2.2.1 which position on Soil series no. 11, 12, 22, 39 from Soil map.	Units 2.2.11 = beach and dune sand, 2.2.3 = alluvial sandy loam, 2.2.1=alluvial-colluvial loamy sand to sandy loam. The criteria as soil series no. are referred from Soil survey report of Changwat Prachuap Khiri Khan (DLD,1976)
7.2.2	**Moderate potential of construction sand resource**	Selected Unit 2.2.11/2.2.3/2.2.1 which position on Soil series no. 19, 24, 32, 33, 34, 40, 41 from Soil map	
7.2.3	**Low potential of construction sand resource**	The other area of Unit 2.2.11/2.2.3/ 2.2.1	
7.2.4	**Non potential of construction sand resource**	The other area	

7.2 CONSTRUCTION SAND POTENTIAL MAP

Code	Unit
7.2.1	High potential of construction sand resource
7.2.2	Moderate potential of construction sand resource
7.2.3	Low potential of construction sand resource
7.2.4	Non potential of construction sand resource

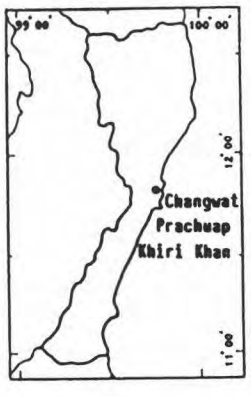
NOTE

1) This map must be used with table 4-MC 7.2
2) Mapping units are combined data from Surface material map (2.2) with Soil Map (DLD,1976)



Location map

Study area



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Chulalongkorn University, 1995

The technicality of mapping in each unit are present conclusively in table 4-MC7.3

7.4 Aggregate Rocks Resources Potential Map

Map showing potential degree particular land to exploitation of the aggregate rocks by analysis of primary geological informations as Geological Material and Landform. The mapping units can be classed into 4 degree; High potential, Moderate potential, Low potential and Non potential. The analysis of potential was applied from basis terrain analysis by Way (1973).

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC7.4

7.5 Building/Dimension Stones Resource Potential Map

Map showing potential degree particular land to exploitation of the building or dimension stones by analysis of primary geological informations as Geological Material and Landform. The mapping units can be classed into 4 degree; High potential, Moderate potential, Low potential and Non potential. The analysis of potential was applied from basis terrain analysis by Way (1973).

Table 4-MC 7.3 The technicality of lateritic soil (for loose surface road construction) mapping

MAP CODE/TOPIC 7.3 LATERITIC SOIL POTENTIAL INFORMATION STAGE 1GI GROUP OF MAP TOPICS GEOLOGICAL RESOURCE
MAPPING METHOD Map reclassification
DATA USES : Surface material map in unconsolidate ed. (2.2) , Soil map (DLD, 1976)

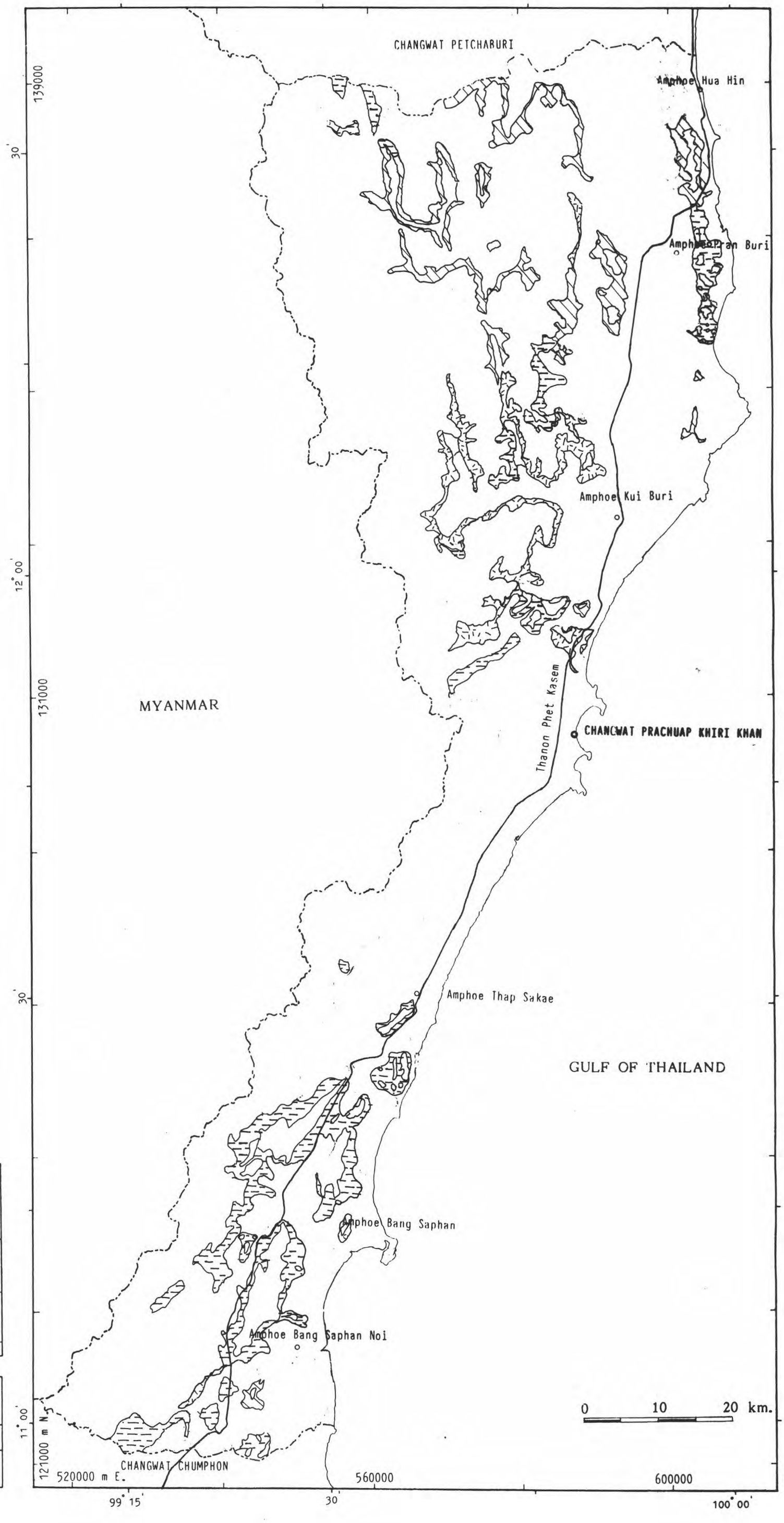
Code	Unit	Mapping Keys	Remark
7.3.1	High potential of lateritic soil resource	Selected Unit 2.2.1/2.2.2 which position on Soil series no. 44, 53, 54 from Soil map.	Unit 2.2.1 and 2.2.2 are the alluvium-colluvium, that are possible to relate of laterite and the weahering zone of bed rocks. The criteria as soil series no. are referred from Soil survey report of changwat Prachuap Khiri Khan (DLD,1976) (This is the mapping in only preliminary level)
7.3.2	Moderate potential of lateritic soil resource	Selected Unit 2.2.1/2.2.2 which position on Soil series no. 30, 31 from Soil map	
7.3.3	Low potential of lateritic soil resource	The other area of Unit 2.2.1/2.2.2	
7.3.4	Non potential of lateritic soil resource ;	The other area	

7.3 LATERITIC SOIL POTENTIAL MAP

Code	Unit
7.3.1	High potential of lateritic soil resource
7.3.2	Moderate potential of lateritic soil resource
7.3.3	Low potential of lateritic soil resource
7.3.4	Non potential of lateritic soil resource

NOTE

1) This map must be used with table 4-MC 7.3
2) Mapping units are combined data from Surface geological material map (2.2), and Soil map (DLD,1976)



Location map

Study area

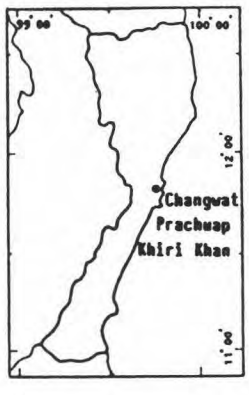


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Table 4-MC 7.4 The technicality of aggregate rocks potential mapping

MAP CODE/TOPIC 7.4 AGGREGATE ROCK POTENTIAL INFORMATION STAGE 1GI GROUP OF MAP TOPIC GEOLOGICAL RESOURCE

MAPPING METHOD Map reclassification

DATA USES : Surface geological material in consolidate ed. (2.1)

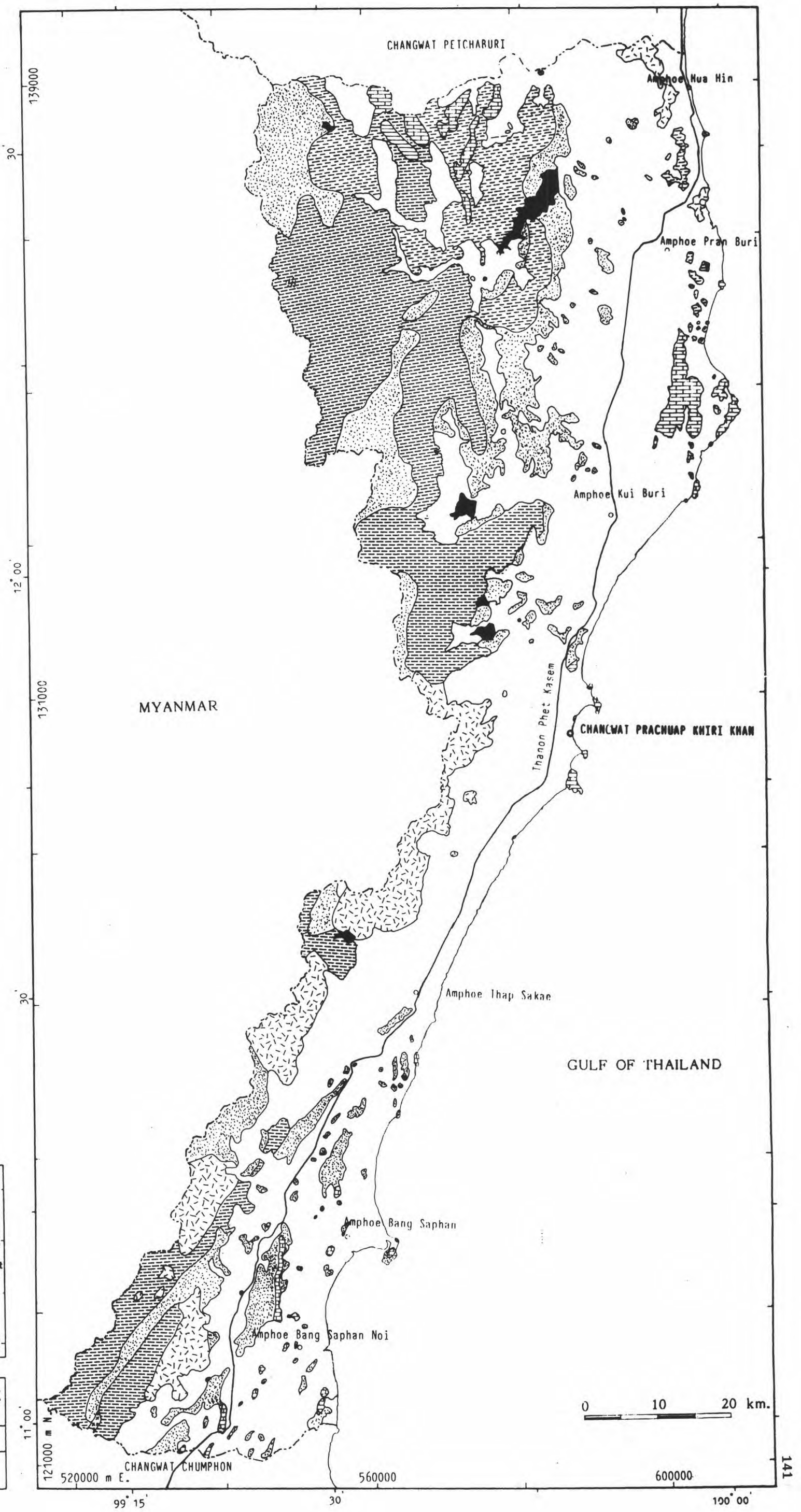
Code	Unit	Mapping Keys	Remark
7.4.1	**High potential of aggregate rocks resource**	Selected Unit : 2.1.3	Expect to rocks in carbonate group such as limestone
7.4.2	**Moderate potential of aggregate rocks resource**	Selected Unit : 2.1.4	Expect to rocks in granitoid group such as granite, gneiss
7.4.3	**Low potential of aggregate rocks resource**	Selected Unit : 2.1.1, 2.1.2	Expect to rocks in arenaceous and argillaceous group
7.4.4	**Non potential of aggregate rocks resource**	other area	

7.4 AGGREGATE ROCK POTENTIAL MAP

Code	Unit
7.4.1	High potential of aggregate rocks resource
7.4.2	Moderate potential of aggregate rocks resource
7.4.3	Low potential of aggregate rocks resource
7.4.4	Non potential of aggregate rocks resource

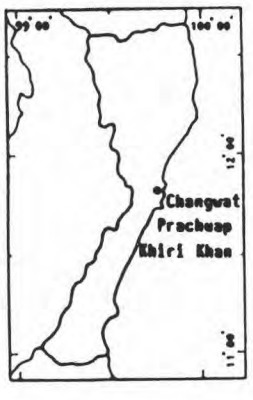
NOTE

1) This map must be used with table 4-MC 7.4
2) Mapping units are reclassified data from Surface geological material (2.1)



Location map

Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC7.5

7.6 Surface Water Resource Potential Map

Map showing potential degree particular land to contain of surface water which is especially by capability of storing water by pond, dam-reservoir, and irrigation by analysis of primary geological informations as Geological material, Drainage system and, Landform. The mapping units can be divided into 2 regions, the mountainous region and the lowland region. The mountainous region can be classed the potential units into 2 degrees as High to moderate potential and Moderate to low potential. The lowland region can be classed the potential units into 6 degree as High potential, Moderate potential, Moderate to low potential, Low potential, and Very low or Non potential.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC7.6

Table 4-MC 7.5 The technicality of building/dimension stones potential mapping

MAP CODE/TOPIC 7.5 BUILDING/DIMENSION STONES POTENTIAL INFORMATION STAGE IGI GROUP OF MAP TOPICS GEOLOGICAL RESOURCE
MAPPING METHOD Map reclassification
DATA USES : Surface geological material in consolidate edition (2.1)

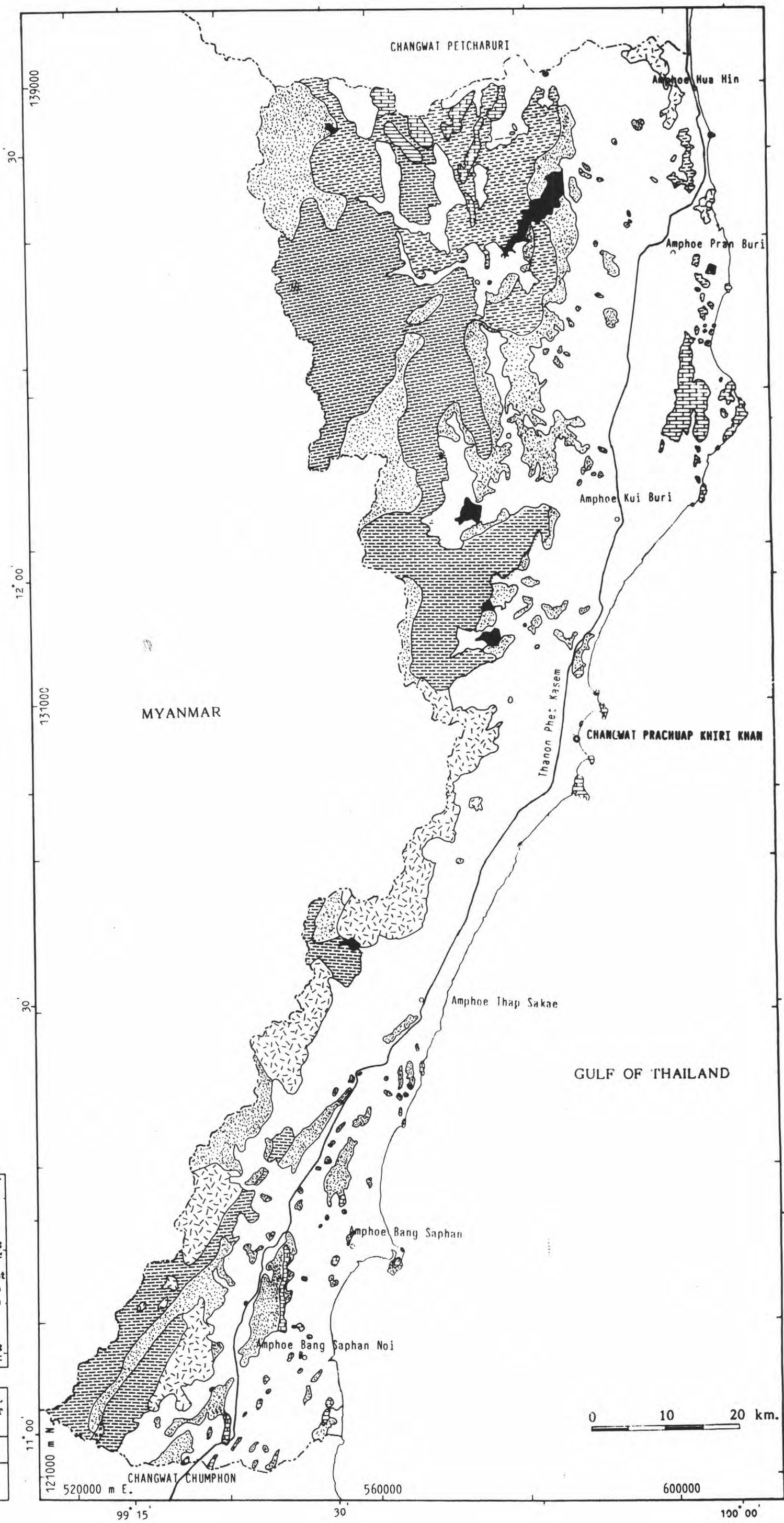
Code	Unit	Mapping Keys	Remark
7.5.1	High potential of building/dimention stone resource	Selected Unit : 2.1.4	Expect to rocks in granitoid group such as granite, gneiss
7.5.2	Moderate potential of building/dimention stone resource	Selected Unit : 2.1.3	Expect to rocks in carbonate group such as limestone
7.5.3	Low potential of building/dimention stone resource	Selected Unit : 2.1.1	Expect to rocks in arenaceous group such as sandstone
7.5.4	Very low potential of building/dimension stones resources	Selected Unit : 2.1.2	Expect to rocks in argillaceous group such as shale, phyllite
7.5.5	Non potential of building/dimention stone resource	other area	

7.5 BUILDING/DIMENSION STONES POTENTIAL MAP

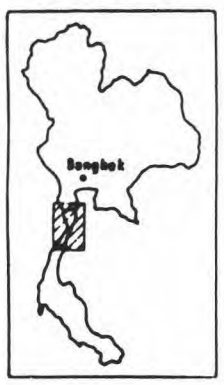
Code	Unit
7.5.1	High potential of building/dimention stone resource
7.5.2	Moderate potential of building/dimention stone resource
7.5.3	Low potential of building/dimention stone resource
7.5.4	Very low potential of building/dimension stones resources
7.5.5	Non potential of building/dimention stone resource

NOTE

1) This map must be used with table 4-MC 7.5
2) Mapping units are reclassified data from Surface geological material (2.1)



Location map



Study area

A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

Table 4-MC 7.6 The technicality of surface water resource potential mapping

MAP CODE/TOPIC 7.6 SURFACE WATER RESOURCE POTENTAIAL INFORMATION STAGE IGI GROUP OF MAP TOPICS GEOLOGICAL RESOURCE
MAPPING METHOD Seiving/overlay
DATA USES : Landform map (1.2), Surface material maps (consolidate ed. (2.1), unconsolidate ed. (2.2))

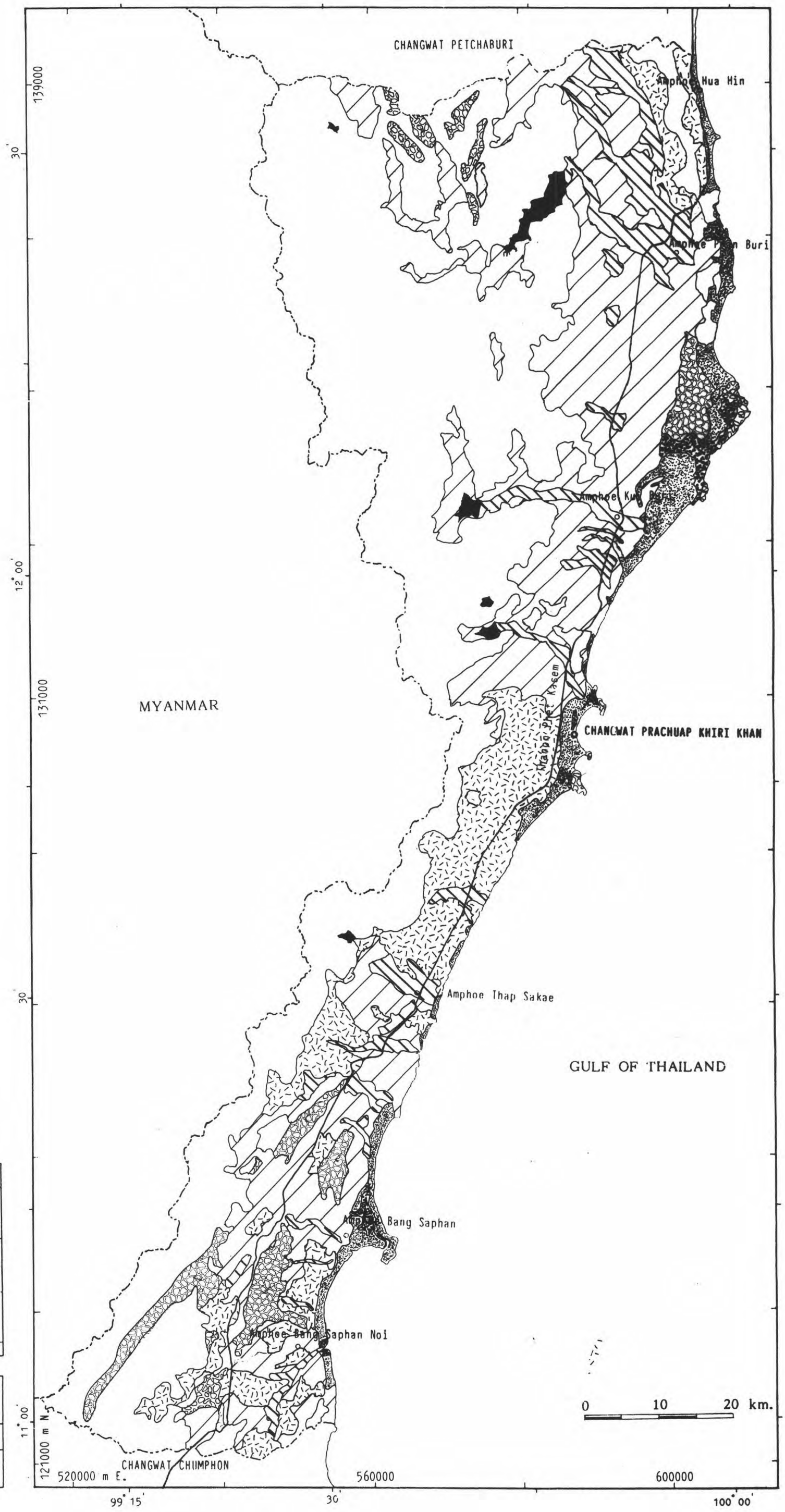
Code	Unit	Mapping Keys	Remark
	The Highland Region		
7.6.1	High to moderate potential of surface water resource	Combination of map 1.2 : unit 1.2.1 and map 2.1 : units 2.1.1.1 / 2.1.2/ 2.1.4	Highland underlain by meta-arenac, argil., and granit.
7.6.2	Moderate to low potential of surface water resource	Combination of map 1.2 : unit 1.2.1 and map 2.1 : units 2.1.1.2 /2.1.3	Highland underlanin by arenac. , and carbonate rocks.
	The Lowland Region		
7.6.3	High potential of surface water resource	Map 1.2 : unit 1.2.4	Riverplain landform
7.6.4	Moderate to high potential of surface water resource	Combination of map 1.2 : unit 1.2.3 , 1.2.5,1.2.9 with map 2.2 : all unit except 2.2.1/2.2.3	Units that are not riverplain beach ridge., tidal flat, formertidal flat landforms. Units 2.2.1/2.2.3 are sandy surface materials.
7.6.5	Moderate potential of surface water resource	Combination of map 1.2 : unit 1.2.3, 1.2.5,1.2.9 with Map 2.2 : units 2.2.1/2.2.3	
7.6.6	Low potential of surface water resource	Map 1.2 : Units 1.2.7/1.2.8	Beach ridge., formertidal flat landforms
7.6.7	Non potential	Map 1.2 : Unit 1.2.6	Tidal flat

7.6 SURFACE WATER RESOURCE POTENTAIAL MAP

Code	Unit
	<u>The Highland Region</u>
7.6.1	High to moderate potential of surface water resource
7.6.2	Moderate to low potential of surface water resource
	<u>The Lowland Region</u>
7.6.3	High potential of surface water resource
7.6.4	Moderate to high potential of surface water resource
7.6.5	Moderate potential of surface water resource
7.6.6	Low potential of surface water resource
7.6.7	Non potential

NOTE

1) This map must be used with table 4-MC 7.6
2) Mapping units are combined data from Landform map (1.2), and Surface material maps (2.1-2.2)



Location map

Study area

A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

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Dept. of Geology, Graduate School
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7.7 Groundwater Resource Potential Map,

Map showing potential degree particular land to exploitation of groundwater by analysis of primary geological informations as Aquifer and Landform. The mapping units can be classed by grouping the yield ranges average of each aquifer units into 5 degree; High potential, Moderate potential, Low potential, Very low potential, and Non potential.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC7.7

7.8 Composite Water Resource Potential Map

Map showing potential degree particular land to exploitation of water resource which be overview both groundwater and surface water by composite of Surface water resource and groundwater resource potential. The mapping united can be classed into 4 degree; High potential, Moderate potential, Low potential, Very low to non potential.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps

Table 4-MC 7.7 The technicality of groundwater resource potential mapping

MAP CODE/TOPIC 7.7 GROUNDWATER RESOURCE POTENTIAL INFORMATION STAGE IGI GROUP OF MAP TOPICS GEOLOGICAL RESOURCE
MAPPING METHOD Aquifer map reclassification, compiled with other PGI map
DATA USES : Aquifer map (4.1), Landform map (1.2)

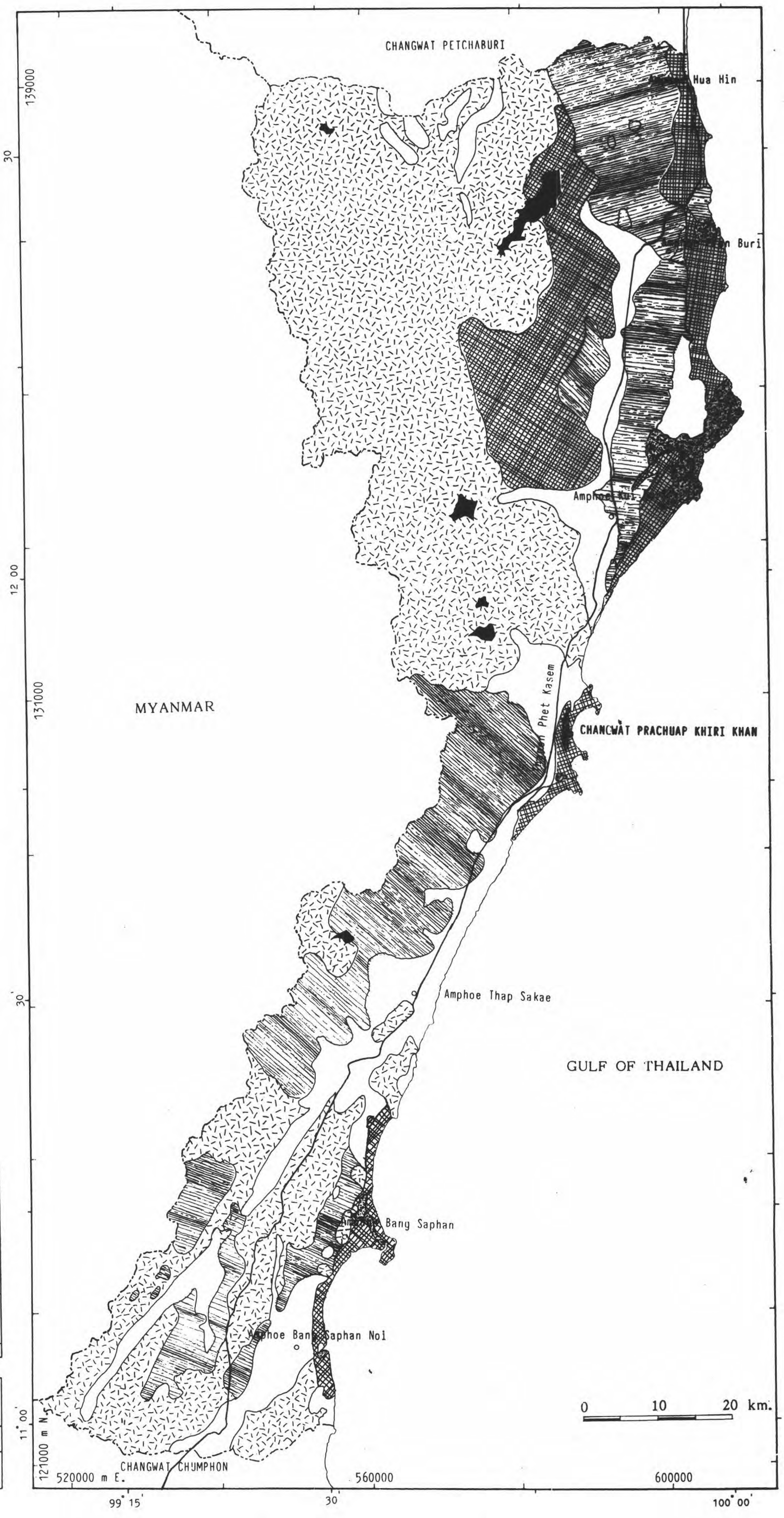
Code	Unit	Mapping Keys	Remark
7.7.1	High potential of groundwater resource ;the expected yield everage is >40 gpm..	Selected Units : 4.1.2, 4.1.4, 4.1.7 from Map 4.1	Alluvium , carbonate rk., and sandstone aquifers.
7.7.2	Moderate potential of groundwater resource ;the expected yield everage is 20 gpm..	Selected Units : 4.1.5	Argillaceous and meta argill. rk. aquifers.
7.7.3	Low potential potential of groundwater ;the expected yield everage is 10 gpm..	Selected Units : 4.1.3 from Map 4.1, included with Unit 1.2.9 and adjacent area of Map 1.2 in Thung Sam Roi Yord (risk of saltwater)	Colluvium aquifer
7.7.4	Very low potential of groundwater resource ;the expected yield everage is 5 gpm..	Selected Units : 4.1.1, 4.1.6	Beach sand , meta-sedimentary rock aquifer
7.7.5	Non potential	Selected Units : 1.2.6 from Map 1.2 (Saltwater)	Tidal flat

7.7 GROUNDWATER RESOURCE POTENTIAL MAP

Code	Unit
7.7.1	High potential of groundwater resource ;the expected yield everage is >40 gpm..
7.7.2	Moderate potential of groundwater resource ;the expected yield everage is 20 gpm..
7.7.3	Low potential potential of groundwater ;the expected yield everage is 10 gpm..
7.7.4	Very low potential of groundwater resource ;the expected yield everage is 5 gpm..
7.7.5	Non potential

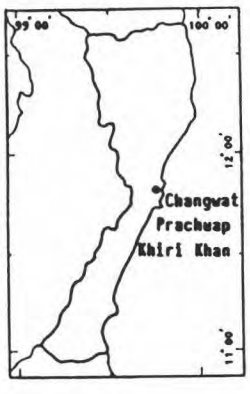
NOTE

1) This map must be used with table 4-MC 7.7
2) Mapping units are combined data from Aquifer map (4.1), and Landform map (1.2)



Location map

Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC7.8

7.9 Geological Heritage Value Map

Map showing the degree of particular land or site value for geological research and study aspect, special geological ecology aspect and in tourism aspect by analysis of primary geological informations as geological heritage site map, Landform map, and supporting data as geological material map and drainage system . The mapping can be present informations as High value site/area for geological excursion or study and research, High value site/area of specific geologic ecology, High scenic wonder value site/area of identical locality of Changwat Prachuap Khiri Khan, Investigating interest area for karst topography study and cave surveys, and general sites.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding PGI maps and/or other maps which are geological informations and other fields.

The list of geological site value and the significant features are present conclusively in table 4-MC7.9

Table 4-MC 7.8 The technicality of the composite water resource potential mapping

MAP CODE/TOPIC 7.8 COMPOSITE WATER RESOURCE POTENTIAL INFORMATION STAGE IGI GROUP OF MAP TOPICS GEOLOGICAL RESOURCE
MAPPING METHOD : Sieving/overlay IGI maps
DATA USES : Surface water resource potential (7.6), Groundwater resource potential (7.7)

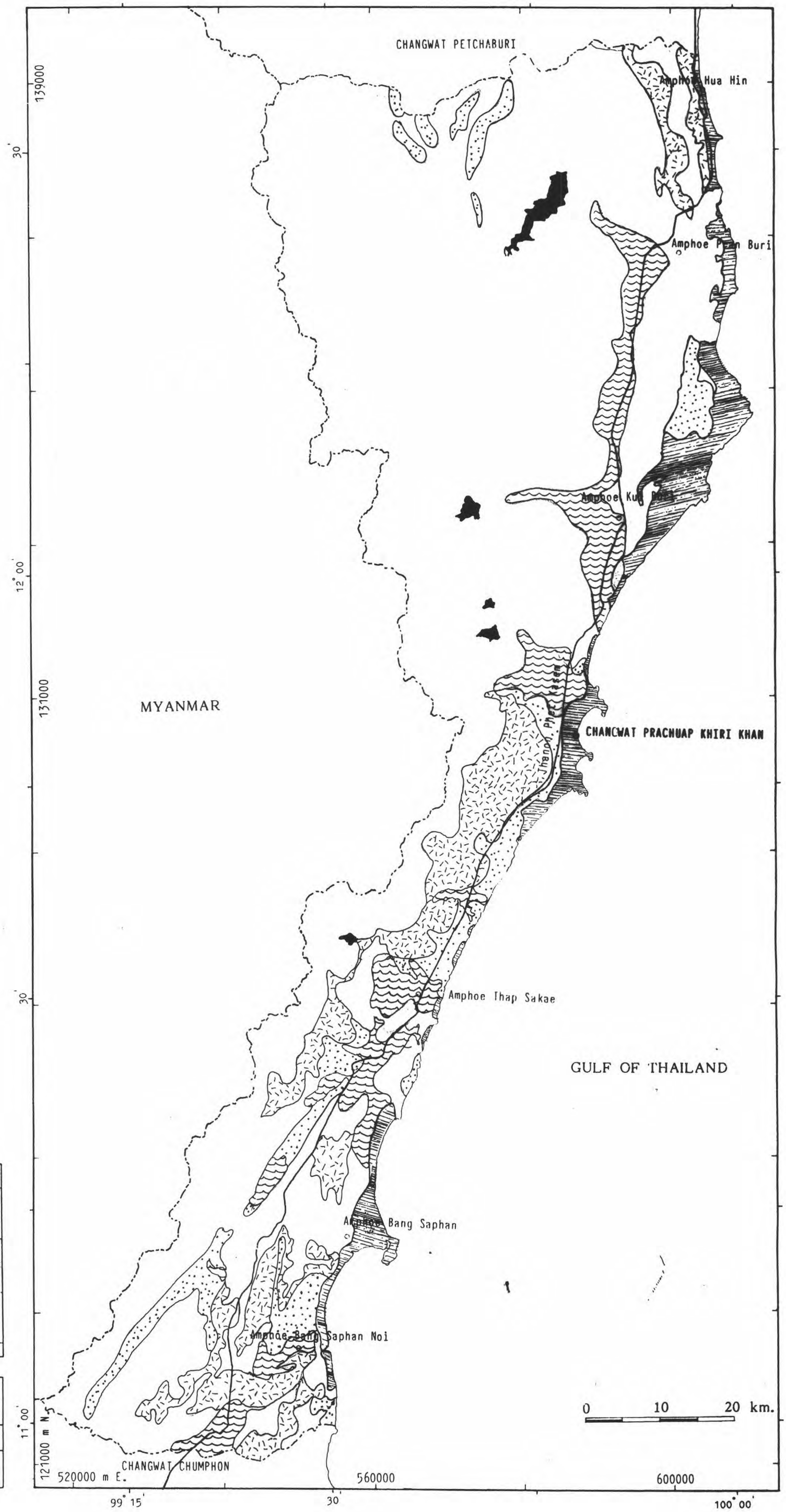
Code	Unit	Mapping Keys	Remark
7.8.1	**High potential of water resource**	Combination of map 7.6 : unit 7.6.1/ 7.6.3/ 7.6.4 with map 7.7 : unit 7.7.1	High potential both surface and groundwater resources
7.8.2	**Moderate potentail of water resource ; high potential of surface water resource but moderate potential of groundwater resource**	Combination of map 7.6 :unit 7.6.1/ 7.6.3/ 7.6.4 with map 7.7 : unit 7.7.2/7.7.3	Moderate potential of ground water, high potential of surface water resources
7.8.3	**Moderate potential of water resource : high potential of groundwater resource but moderate potential of surface water resource**	Combination of map 7.7 : unit 7.7.1 with map 7.6 : unit 7.6.2/7.6.5	Moderate potential of surface water, high potential of groundwater resources
7.8.4	**Low potential of water resource**	Combination of map 7.6 : unit 7.6.2/ 7.6.5 with map 7.7 : unit 7.7.3/7.7.4	Moderate/low potential of groundwater and surface water resource
7.8.5	**Very low to non potential of resource**	Combination of map 7.7 : 7.3.5 with map 7.6 : unit 7.7.6 Map 7.6 ; Unit 7.7.6	Low potential of groundwater and surfacewater resources

7.8 COMPOSITE WATER RESOURCE POTENTIAL MAP

Code	Unit
7.8.1	High potential of water resource
7.8.2	Moderate potentail of water resource ; high potential of surface water resource but moderate potential of groundwater resource
7.8.3	Moderate potential of water resource : high potential of groundwater resource but moderate potential of surface water resource
7.8.4	Low potential of water resource
7.8.5	Very low to non potential of resource ; (Saltwater)

NOTE

1) This map must be used with table 4-MC 7.8
2) Mapping units are combined data from
   Surface water resource potential map (7.6)
   and Groundwater resource potential map (7.7)



Location map

Study area

A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

Table 4-MC 7.9 The technicality of geological heritage value map

MAP CODE/TOPIC 7.9 GEOLOGICAL HERITAGE VALUE INFORMATION STAGE IGI GROUP OF MAP TOPICS GEOLOGICAL RESOURCE

MAPPING METHOD Directed analysis from PGI

DATA USES : Geological heritage site map (5.1)

Code	Unit	Mapping Keys	Remark
7.9.1	**High value of geological heritage site/area ; for geological study, research and excursion**	5.1.1.4 Khao Tao	Type locality of Precambrian Gneiss outcrop
		5.1.1.5 Khao Tao beach	Significant of Coastal dune
		5.1.3.3 Khao Sam Roi Yord National Park	Suitable for Sea level change, and Karst Investigation
		5.1.3.8 Thung Sam Roi Yord	Suitable for Sea level changes Investigation
		5.3.9 Khao Deang and Men cave	Suitable for Sea level change Investigation
7.9.2	**High value of geological heritage site/area ; for tourism scenic wonders**	5.1.2.1 Keaw cave 5.1.2.2 Praya Nakorn cave 5.1.2.5 Sai cave 5.1.4.6 Khao Chong Krachok 5.1.4.11 Khao Hin Toen 5.1.7.1 Pha Daeng Cliff Coast	5.1.2.1/5.1.2.5 are the most beutiful caves of the area 5.1.2.5 /5.1.2.6 are the identical localities of area 5.1.4.11 / 5.1.7.1 are very interesting tourism sites
7.9.3	**High value of geological heritage site/area ; for specific geological ecology**	5.3.8 Thung Sam Roi Yord	The one of most significant birdwatching sites of country
7.9.4	**Potential area for cave surveys and karst landform study**	Selected Unit 1.2.2 from Map 1.2.2	Karst topography landform
7.9.5	**general**	Other sites/areas	

7.9 GEOLOGICAL HERITAGE VALUE MAP

Code	Unit
7.9.1 △	High value of geological heritage site/area ; for geological study, research and excursion
7.9.2 ⬡	High value of geological heritage site/area ; for tourism scenic wonders
7.9.3 ◎	High value of geological heritage site/area ; for specific geological ecology
7.9.4 ▲	Potential area for cave surveys and karst landform study
7.9.5 △	general

NOTE

1) This map must be used with table 4-MC 7.9
2) Mapping units are combined data from
   Geological heritage site map (5.1)
   Landform map (1.2)
3) Name of geological heritage sites would be used together with map 5.1

A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN
SASIN CHALERMLARP
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8. Geotechnical property Map

8.1 Land stability Map

Map showing degree of possibility of particular land to unstable by analysis of primary geological informations as Morphology of land, Geological Material, and Landform. The mapping units can be classed into 5 degree; Stable, Generally stable, Moderately to low stable, and low to Unstable. The criteria of mapping keys are applied from Nilson et al. (1979).

The technicality of mapping in each unit are present conclusively in table 4-MC8.1

4.5 UGI-Ultimate Geological Information

GILM mapping in UGI stage are selected in the total of 3 themes of map topics. They are Suitability Zone for Agriculture Map (9.1), Suitability Zone for Land development Map (9.2), and Suitability Zone for Conservation Map (9.3).

9.1 Suitability of Agriculture Map

Map showing degree of suitability of particular land for general agriculture by evaluation of intermediate geological informations as Erosion susceptibility, Flood hazard, and Surface water resource potential. The mapping units can be classed into 4 degree; Most suitability zone, Moderate suitability zone, low suitability zone, and non suitability

Table 4-MC 8.1 The technicality of land (slope) stability map

MAP CODE/TOPIC 8.1 LAND (SLOPE) STABILITY INFORMATION STAGE IGI GROUP OF MAP TOPICS GEOTHECHNICAL PROPERTIES
MAPPING METHOD Sieving/overlay PGI maps
DATA USES : Morphological map (1.1), Surface geological material in unconsolidate ed. map (2.2), Landform map (1.2)

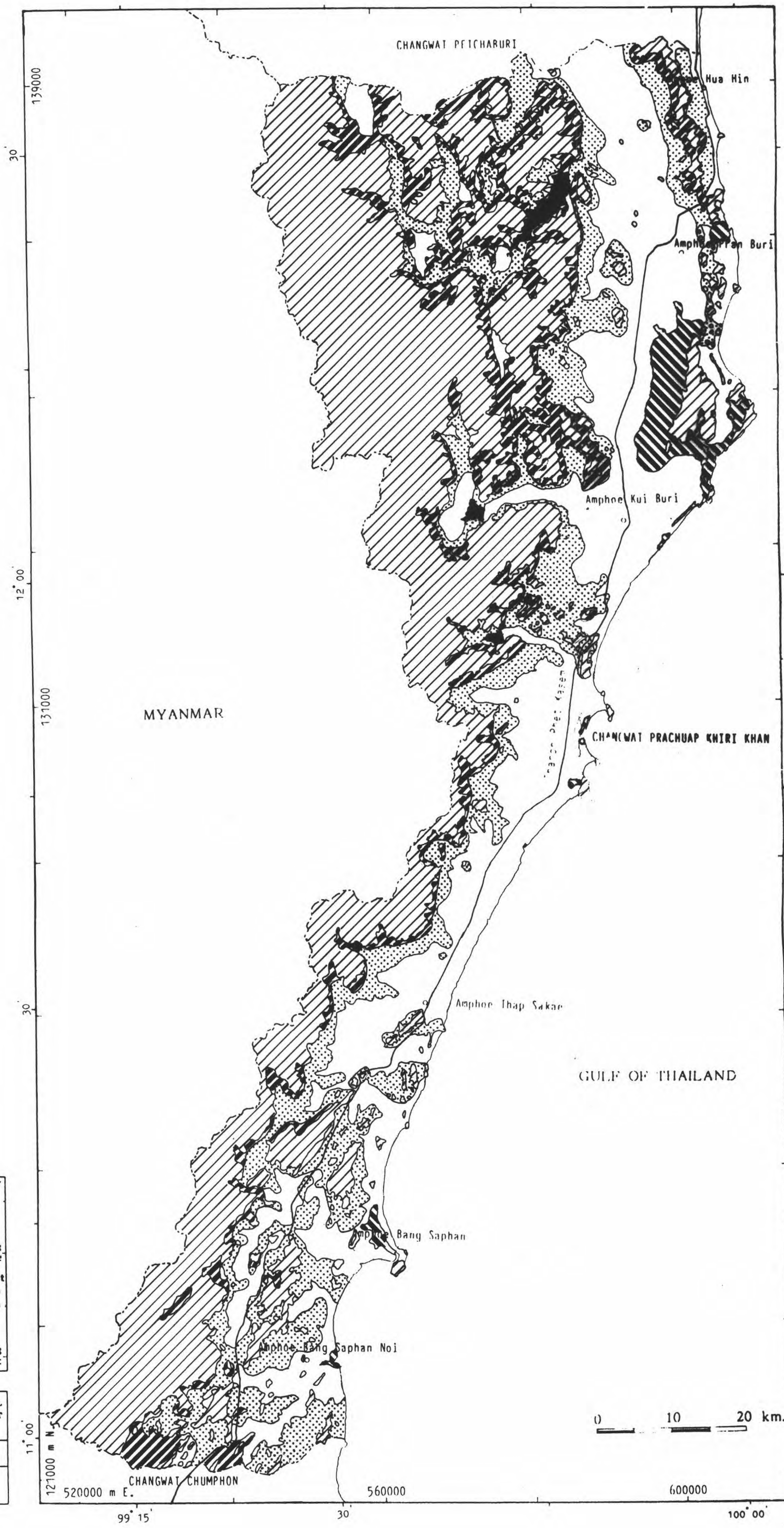
Code	Unit	Mapping Keys	Remark
8.1.1	Stable area	Map 1.1 : unit 1.1.1 which not be position on map 1.2 : unit 1.2.6 or 1.2.9	Nearly flat terrain that is not tidal flat and swamp & marsh landforms
8.1.2	General stable area	Map 1.1 : unit 1.1.2	Undulating to rolling terrain
8.1.3	Moderate stable area	Map 1.1 : unit 1.1.4	Hill and Mountain terrain
8.1.4	Moderate to low slope stability area	Combination of map 1.1 unit 1.1.3 with map 2.1 units 2.2.1 and 2.2.2	Rolling to hilly terain that underlain by colluvial-alluvial deposits.
8.1.5	Low to Unstable stable area	Map 1.2 : units 1.2.6/1.2.9	Swamp & marsh , tidal flat

8.1 LAND (SLOPE) STABILITY MAP

Code	Unit
8.1.1	Stable area
8.1.2	General stable area
8.1.3	Moderate stable area
8.1.4	Moderate to low slope stability area
8.1.5	Low to Unstable stable area

NOTE

1) This map must be used with table 4-MC 8.1
2) Mapping units are combined data from Morphological map (1.1), Surface geological material map (2.2), and Landform map (1.2)
3) Criteria of mapping keys are applied from Nilson et al.(1979)



Location map

Study area

A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

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Chulalongkorn University, 1995

zone. The mapping units are idealized from the Terrain Classification and Agricultural Land Inventory and Evaluation (see Zuidam, 1986).

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding IGI and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC9.1.

9.2 Suitability Zone for Land development Map

Map showing degree of suitability of particular land for general land development (build up area) by evaluation of intermediate geological informations as Landslide Hazard, Flood Hazard, Erosion susceptibility, Land stability, Water Resource Potential and Geological heritage Value map. The mapping units can be classed into 4 degree; Suitability, Moderate suitability, Low suitability, and Not suitability.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding IGI and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC9.2

Table 4-MC 9.1 The technicality of suitability zone for agriculture mapping

MAP CODE/TOPIC 9.1 SUITABILITY ZONE FOR AGRICULTURE INFORMATION STAGE UGI GROUP OF MAP TOPICS -
MAPPING METHOD Sieving/overlay
DATA USES : Erosion susceptibility map (6.3), Surface water resource potential (7.6), Risk of flood hazard map (6.2)

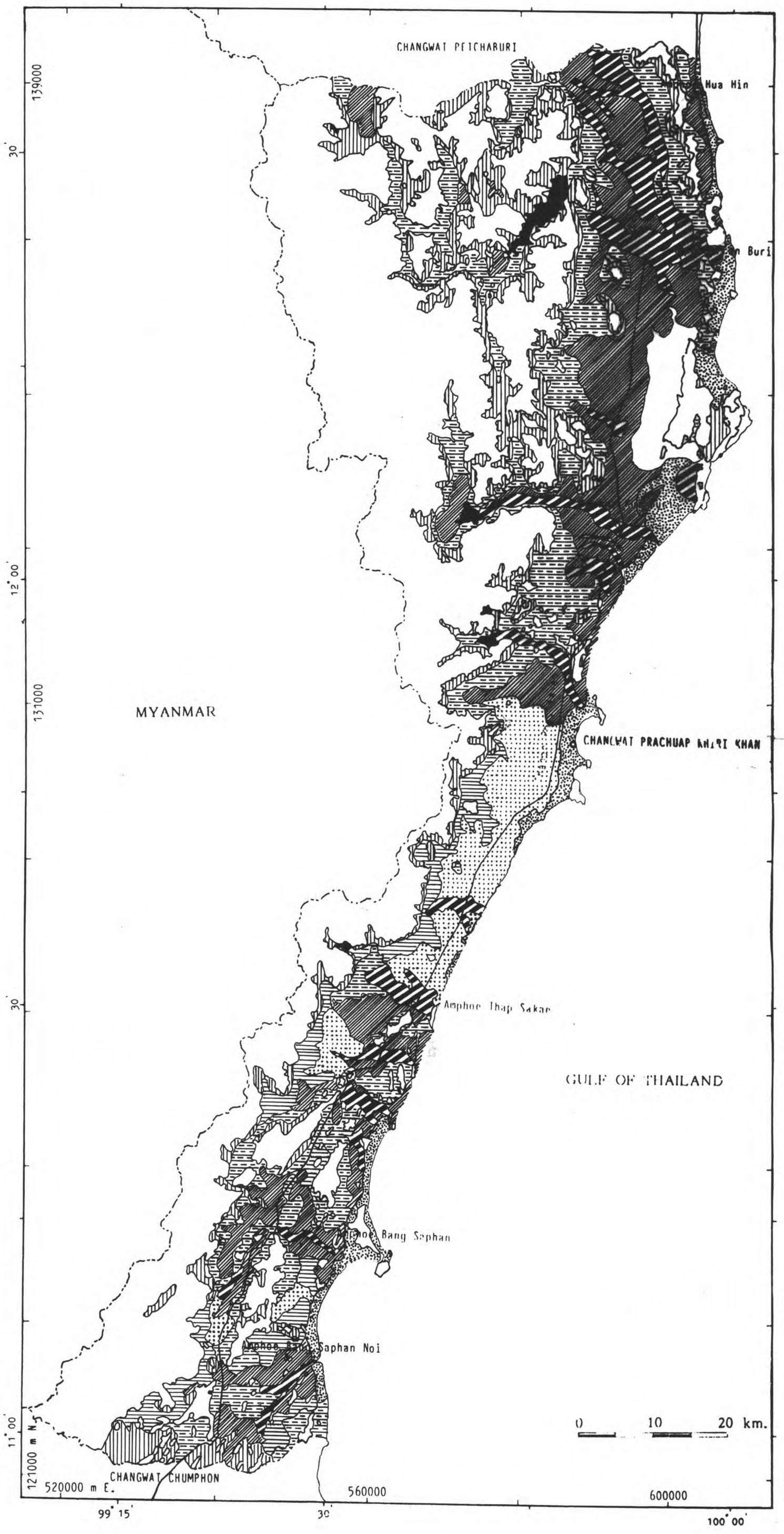
Code	Unit	Mapping Keys	Remark
9.1.1	Suitability zone for agriculture; not to slightly susceptible to erosion with high potential of surface water resource development.	Map 6.3 : units 6.3.4/6.3.5 combine with map 7.6 : unit 7.6.3	- Units 6.3.4/6.3.5 are slight to non erosion susceptibility area. - Unit 7.6.3 is high potential of surface water resource - Unit 7.6.4 is moderate to high potential. - Unit 7.6.5 is moderate potential. - Unit 7.6.6 is low potential.
9.1.2	Suitability zone for agriculture ; not to slightly susceptible to erosion with high to moderate potential of surface water resource development.	Map 6.3 : units 6.3.4/6.3.5 combine with map 7.6 : unit 7.6.4	
9.1.3	Suitability zone for agriculture ; not to slightly susceptible to erosion surface but have moderate to low potential of water resource development.	Map 6.3 : Units 6.3.4/6.3.5 combine with map 7.6 : unit 7.6.5	
9.1.4	Suitability zone for agriculture; not to slightly susceptible to erosion but have low potential of surface water resource development.	Map 6.3 : units 6.3.4/6.3.5 combine with map 7.6 : units 7.6.6	
9.1.5	Moderate Suitability for agriculture; moderately susceptible to erosion with high potential of surfacewater resource development.	Map 6.3 : unit 6.3.3 combine with map 7.6 : unit 7.6.3 or 7.6.4	- Units 6.3.3 is moderate erosion sesceptibility area - Units 7.6.3 and 7.6.4 are high to moderate potential of surface water resource - Unit 7.6.5 is moderate to low potential.
9.1.6	Moderate Suitability for agriculture; moderately susceptible to erosion with moderate to low potential of surface water resource development.	Map 6.3 : unit 6.3.3 combine with Map 7.6 : unit 7.6.5	
9.1.7	Low Suitability for agriculture ; highly susceptible to erosion.	Map 6.3 : unit 6.3.2	Unit 6.3.2 is high erosion susceptibility area
9.1.8	Not Suitability foragriculture ; very high susceptible to erosion or very high risk of flooding/ saltwater-intrusion hazard.	Map 6.3 : unit 6.3.1	Unit 6.3.1 is very high erosion susceptibility area

9.1 SUITABILITY ZONE FOR AGRICULTURE MAP

Code	Unit
9.1.1	**Suitability zone for agriculture;** not to slightly susceptible to erosion with high potential of surface water resource development.
9.1.2	**Suitability zone for agriculture ;** not to slightly susceptible to erosion with high to moderate potential of surface water resource development.
9.1.3	**Suitability zone for agriculture ;** not to slightly susceptible to erosion surface but have moderate to low potential of water resource development.
9.1.4	**Suitability zone for agriculture;** not to slightly susceptible to erosion but have low potential of surface water resource development.
9.1.5	**Moderate suitability for agriculture;** moderately susceptible to erosion with high potential of surfacewater resource development.
9.1.6	**Moderate suitability for agriculture;** moderately susceptible to erosion with moderate to low potential of surface water resource development.
9.1.7	**Low suitability zone for agriculture ;**highly susceptible to erosion
9.1.8	**Not suitability zone for agriculture;** very high susceptible to erosion or very high risk of flooding or saltwater-intrusion

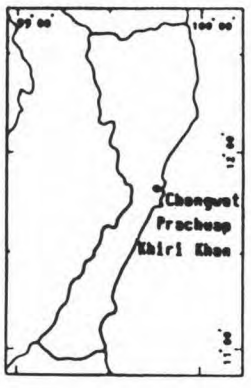
NOTE

1) This map must be used with table 4-MC 9.1
2) Mapping units are combined data from
   Erosion susceptibility map (6.3)
   Surface water resource potential map (7.6)



Location map

Study area



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

SASIN CHALERMLARP

Dept. of Geology, Graduate School
Chulalongkorn University, 1995

Table 4-MC 9.2 The technicality of suitability zone for land development mapping

MAP CODE/TOPIC 9.2 SUITABILITY ZONE FOR LAND DEVELOPMENT INFORMATION STAGE UGI GROUP OF MAP TOPICS -
MAPPING METHOD Seiving/overlay
DATA USES : Risk of landslide hazard map (6.1), Risk of flood hazard map (6.2), Erosion susceptibility map (6.3), Land (slope) stability map (8.1), Composite water resource potential map (7.8)

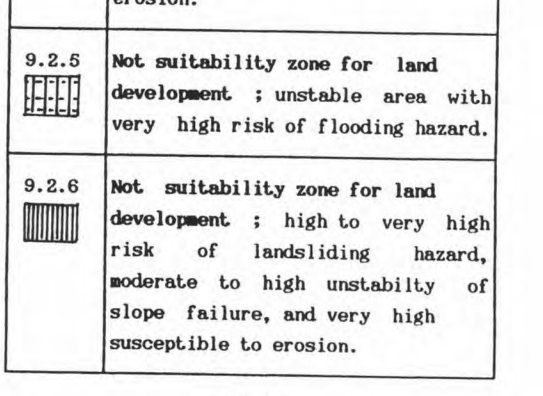
Code	Unit	Mapping Keys	Remark
9.2.1	Suitability zone for land development; low risk of geological hazard but vary in water resource potential	Map 6.1 : Units 6.1.4/6.1.5 and Map 6.2 : Units 6.2.5 - 6.2.7 combine with	Units 6.1.4, 6.1.5 are low and very low risk of landslide hazard Units 6.2.5-6.2.7 are moderate to very low risk of flood hazard Unit 7.8.1 is high potential of water resource Unit 7.8.2 and 7.8.3 are moderate potential of water resource
9.2.1.1	1st suitable (high potential of water resource)	- Map 7.8 : Unit 7.8.1	
9.2.1.2	2nd suitable (high potential of surface water but moderate for groundwater resource)	- Map 7.8 : Unit 7.8.2	
9.2.1.3	3rd suitable (high potential of groundwater but moderate for surface water resources)	- Map 7.8 : Unit 7.8.3	
9.2.2	Moderate suitability zone for land development ; low risk of hazard but have moderate to low of potential of water resource development.	Map 6.1 : Unit 6.1.4/6.1.5 and Map 6.2 : Unit 6.2.5-6.2.7 combine with	Unit 7.8.4 is low to very low potential of water resource
9.2.2.1	1st moderate suitable (moderate potential of water resource)	- Map 7.8 : Unit 7.8.4	
9.2.2.2	2nd moderate suitable (low - potential of water resource	- Map 7.8 : Unit 7.8.5	
9.2.3	Low suitability zone for land development ; moderate to high risk of flood hazard		
9.2.3.1	1st (moderate risk)	- Map 6.2 : Unit 6.2.4	Moderate risk of flood hazard
9.2.3.2	2nd (high risk)	- Map 6.2 : Unit 6.2.5	High risk of flood hazard
9.2.4	Low suitability zone for land development ; moderate to high risk of landsliding hazard, risk of unstablity of slope failure, and Highly to moderatly susceptible to erosion.	Map 6.1 : Units 6.1.2 Map 6.3 : Unit 6.3.2 Map 8.1 : Unit 8.1.4	High-moderate risk of landslide High erosion susceptibility Moderate-low slope stability
9.2.5	Not suitability zone for land development ; unstable area with very high risk of flooding hazard.	Map 6.2 : Unit 6.2.1 Map 8.1 : Unit 8.1.5	Very high risk of flood hazard Low stable to unstable area
9.2.6	Not suitability zone for land development ; high to very high risk of landsliding hazard, moderate to high unstabilty of slope failure, and very high susceptible to erosion.	Map 6.1 : Unit 6.1.1 Map 6.3 : Unit 6.3.1 Map 8.1 : Unit 8.1.3	High risk of landslide hazard Very high erosion suscept. Moderate stable area

9.2 SUITABILITY ZONE FOR LAND DEVELOPMENT MAP

Code	Unit
9.2.1	**Suitability zone for land development;** low risk of geological hazard but vary in water resource potential
9.2.1.1	1st suitable (high potential of water resource)
9.2.1.2	2nd suitable (high potential of surface water but moderate for groundwater resource)
9.2.1.3	3rd suitable (high potential of groundwater but moderate for surface water resources)
9.2.2	**Moderate suitability zone for land development ;** low risk of hazard but have moderate to low of potential of water resource development.
9.2.2.1	1st moderate suitable (moderate potential of water resource)
9.2.2.2	2nd moderate suitable (low - potential of water resource
9.2.3	**Low suitability zone for land development ;** moderate to high risk of flood hazard
9.2.3.1	1st (moderate risk)
9.2.3.2	2nd (high risk)
9.2.4	**Low suitability zone for land development ;** moderate to high risk of landsliding hazard, risk of unstablity of slope failure, and Highly to moderatly susceptible to erosion.
9.2.5	**Not suitability zone for land development ;** unstable area with very high risk of flooding hazard.
9.2.6	**Not suitability zone for land development ;** high to very high risk of landsliding hazard, moderate to high unstabilty of slope failure, and very high susceptible to erosion.

NOTE

1) This map must be used with table 4-MC 9.2
2) Mapping units are combined data from Risk of landslide hazard map (6.1), Risk of flood hazard map (6.2), Erosion susceptibility map (6.3), Land (slope) stability map (8.1),and Composite water resource potential map (7.8)



A CASE STUDY OF SYSTEMIZATION OF GEOLOGICAL INFORMATION FOR LAND MANAGEMENT IN CHANGWAT PRACHUAP KHIRI KHAN

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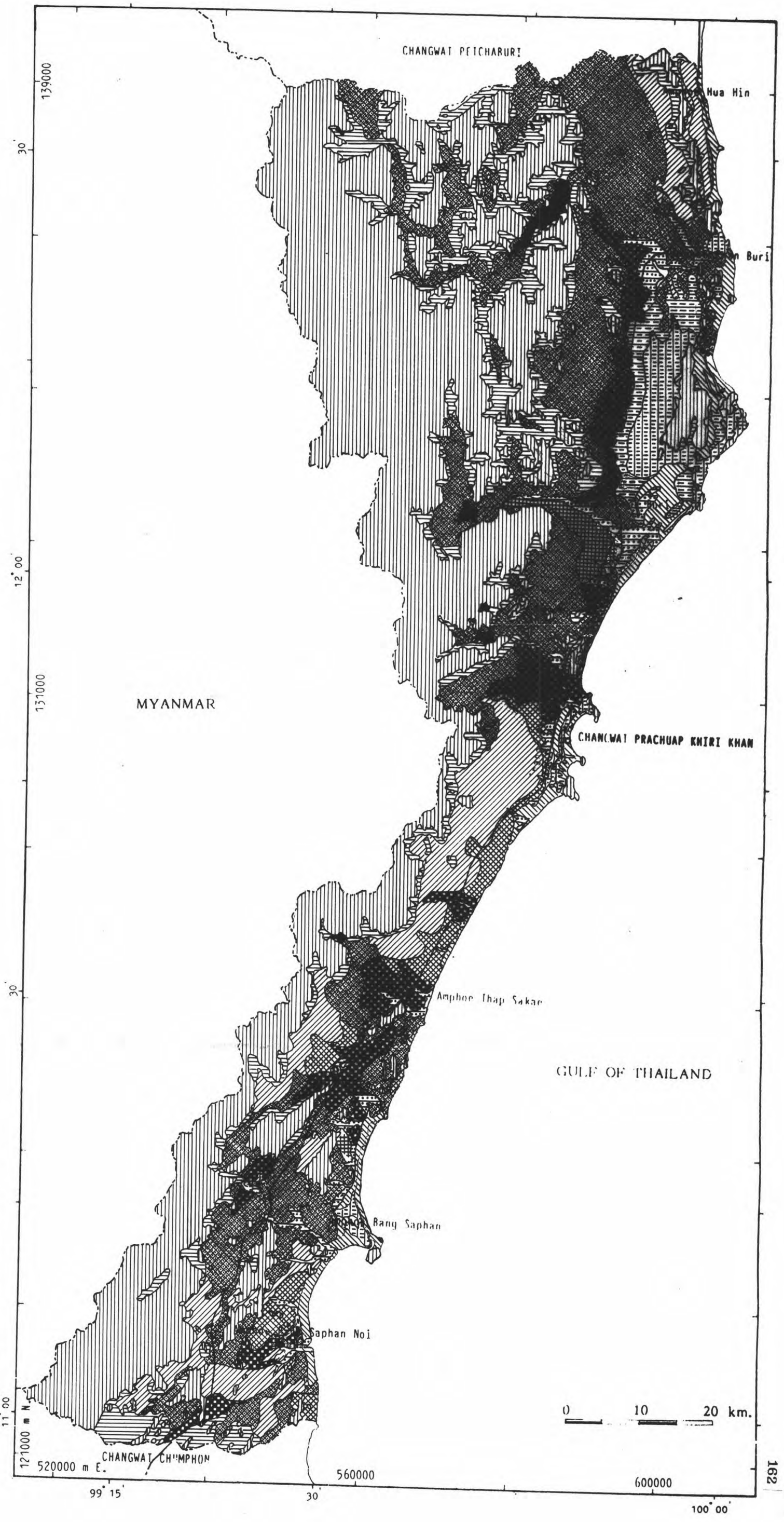


9.3 Suitability Zone for Conservation Map

Map showing degree of suitability of particular land for conservation or preservation by evaluation of intermediate geological informations as Geological heritage value, Landslide Hazard, Flood hazard, Land stability, and Erosion susceptibility, The mapping units can be classed into 3 degree; Most suitability, Moderate suitability, and general.

This map can be readjusted to increase more classes of mapping degree by add up of more factor in preceding IGI and/or other maps which are geological informations and other fields.

The technicality of mapping in each unit are present conclusively in table 4-MC9.3

Table 4-MC 9.3 The technicality of suitability zone for coanservation mapping

MAP CODE/TOPIC 9.3 SUITABILITY ZONE FOR CONSERVATION INFORMATION STAGE UGI GROUP OF MAP TOPICS -
MAPPING METHOD Direct evaluation from IGI and PGI maps
DATA USES : Geological heritage value map (7.9), Risk of landslide hazard map (6.1), Erosion susceptibility map (6.3) Drainage system map (1.3), Landform map (1.4)

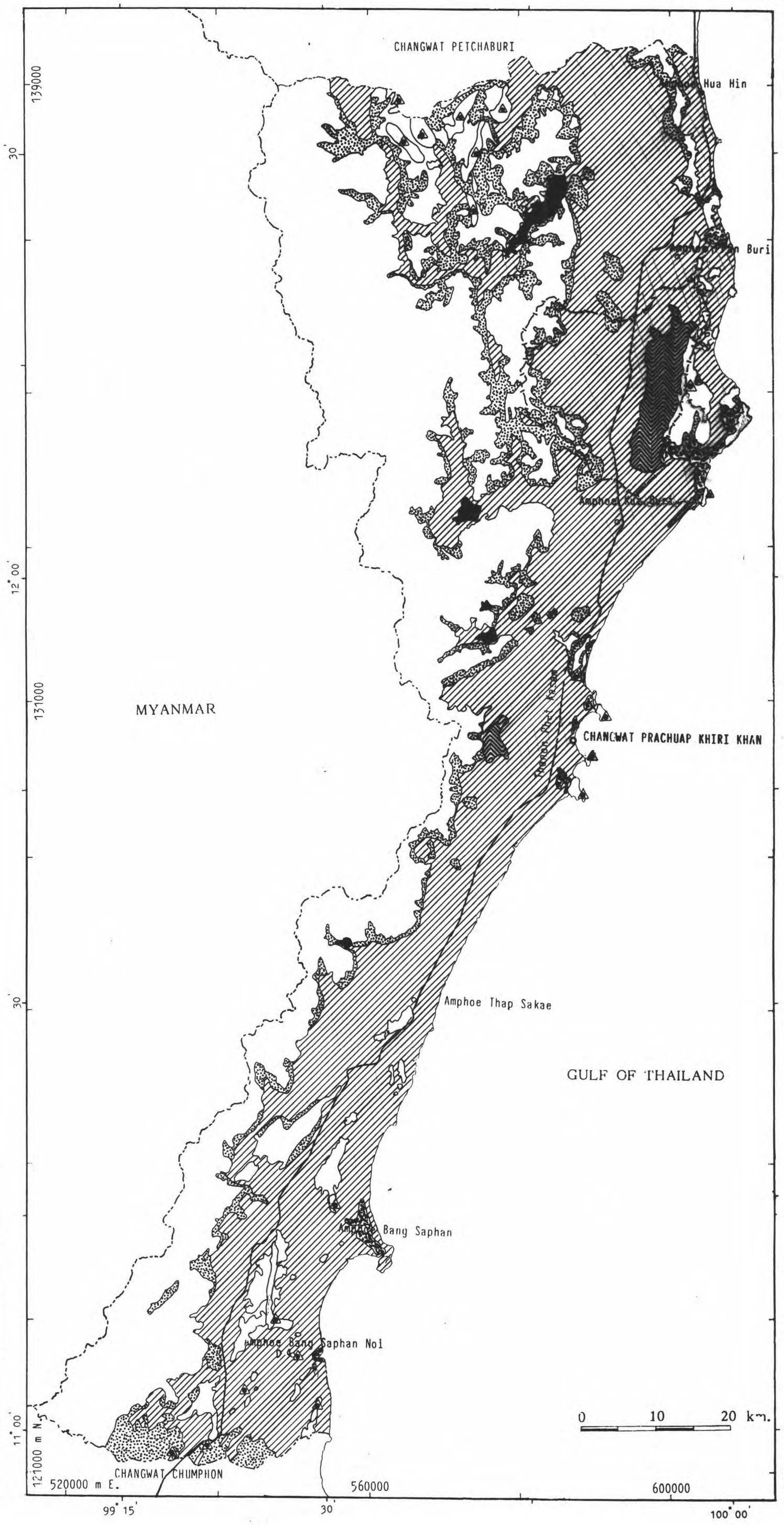
Code	Unit	Mapping Keys	Remark
9.3.1	Most suitability zone for conservation ; high value of geological heritage area.	Map 7.9 : Units 7.9.1-7.9.3	High value of geological heritage sites
9.3.2	Most sutability zone for conservation ; susceptible zone which the land development can be induced landslide hazard and severe erosion.	Map 6.1 : Units 6.1.1 Map 6.3 : Units 6.3.1	High risk of landslide hazard Very high erosion suscept.
9.3.3	Moderate suitability zone for conservation ; watershed area of Thung (swamp) Sam Roi Yord	Map 1.3 : part of unit 1.3.4 (Sam Roi Yord -Khlong Khao Daeng system)	landuses activities should be considered for environmental impact assesment
9.3.4	Moderate suitability zone for conservation ; interesting area for cave surveying and karst topography investigation	Map 7.9 : Unit 7.9.4 (Potential area for cave surveys and karst landform study)	
9.3.5	Moderate suitability zone for conservation ; susceptible area that land development can be induced landslide hazard and severe erosion	Map 6.1 : Unit 6.1.2 (high to moderate risk of landslide hazard) Map 6.3 : Unit 6.3.2 (high erosion susceptibility)	
9.3.5	Moderate suitablility zone for conservation ; susceptible geo-ecological area as tidal environment	Map 1.2 : Unit 1.2.6 (Tidal flat landform)	
9.3.6	general	The other area	

9.3 SUITABILITY ZONE FOR CONSERVATION MAP

Code	Unit
9.3.1	**Most suitability zone for conservation ;** high value of geological heritage area.
9.3.2	**Most suitability zone for conservation ;** susceptible zone which the land development can be induced landslide hazard and severe erosion.
9.3.3	**Moderate suitability zone for conservation ;** watershed area of Thung (swamp) Sam Roi Yord
9.3.4	**Moderate suitability zone for conservation ;** interesting area for cave surveying and karst topography investigation
9.3.5	**Moderate suitability zone for conservation ;** susceptible area that land development can be induced landslide hazard and severe erosion
9.3.5	**Moderate suitablility zone for conservation ;** susceptible geo-ecological area as tidal environment
9.3.6	**general**

NOTE

1) This map must be used with table 4-MC 9.3
2) Mapping units are combined data from Geological heritage value map (7.9), Risk of landslide hazard map (6.1), Erosion susceptibility map (6.3), Drainage system map (1.3), and Landform map (1.4)



Location map

Study area

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