Office of the National Economic and Social Development Board
Office of the Prime Minister

FINAL REPORT

GLOBAL TRANSPARK AT U TAPHAO AIRPORT

VOLUME III : INITIAL ENVIRONMENTAL EXAMINATION

Global Transpark Consultants

January 1998

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PREFACE

This study provides a plan by which the GTP at U Taphao can be developed and implemented. The study was conducted by the Global Transpark Consultants study team under contract to the Office of the National Economic and Social Development Board (NESDB).

A brief summary of the entire study and its findings is presented in a separately bound Executive Summary. The detail study results are presented in a four-volume master report. The four separately bound master report volumes are:

1. **Business Plan** - GTP business elements, including the market for GTP services, how to organize for GTP implementation and operation, what Government needs to do to implement, how the GTP should be organized, and whether or not the GTP makes sense from the financial and economic perspectives.

2. **Implementation Plan** - Focuses on the physical layout plan, the engineering, and the site's physical improvements. Includes appendices with backup information.

3. **Initial Environmental Examination** - An examination of existing environmental conditions at U Taphao as well as the probable environmental effects of the GTP.

4. **Business Plan Appendices** - Separately bound backup information related to the Business Plan - Volume 1.

The report volume that you are now reading is "Initial Environmental Examination."

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ACKNOWLEDGEMENTS

The Consultants wish to thank the many officials of the Royal Thai Government and its agencies for the help and support given generously during the course of this project. In particular, they are grateful to **Mr. Wirat Wattanasiritham**, Secretary-General, National Economic and Social Development Board; **Dr. Phisit Pakkasem**, Chairman of the Thailand's Global Transpark Subcommittee; **Vice Admiral Taweechai Liangbhipool** RTN, Deputy Commander-in-Chief, Royal Thai Fleet; **Rear Admiral Vatanapong Verasa** RTN, Commander, Naval Air Division, Royal Thai Fleet; **Capt. Saknarin Charoensuk** RTN, Deputy Commander, Naval Air Station, Naval Air Division; **Mr. Preecha Chavalittumrong**, Deputy Director-General of the Customs Department; and **Mr. Somchet Taeracoop**, Project Director, for their valuable guidance.

The Consultants also wish to thank all of the members of the Global Transpark Subcommittee, individually and collectively, for their oversight to the project.

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The Consultants are grateful to the private sector for their willing co-operation. Lastly, they wish to thank the staff of Office of the Eastern Seaboard Development Committee/Office of the National Economic and Social Development Board, especially Dr. Suwat Wanisubut and Ms. Sunisa Boonyobhas for their valuable contributions.

GLOSSARY

CGI . . . . . Combustible Gas Indicator
dB . . . . . Decibels
dBA . . . . . Decibels, A-Weighted
DNL . . . . . Day-Night Sound Level
EIA . . . . . Environmental Impact Assessment
ESB . . . . . Eastern Sea Board
FAA . . . . . Federal Aviation Administration
GDP . . . . . Gross Domestic Product
GIS . . . . . Geographic Information System
GPP . . . . . Gross Provincial Product
GTC . . . . . Global Transpark Consultants
GTP . . . . . Global Transpark
INM . . . . . Integrated Noise Model
LEL . . . . . Lower Explosion Limit
Leq . . . . . Equivalent Sound Level
Lmax . . . . . Maximum Sound Level
NHA . . . . . National Housing Authority
UOD . . . . . Unexploded Ordnance Demolition
USEPA . . . . . The United States Environmental Protection Agency
UXO . . . . . Unexploded Ordnance
VMT . . . . . Vehicle Miles of Travel

NOTE:

It should be noted that this report is based on prices that prevailed in July 1997. At that time there were large fluctuations in the value of the Baht. For Study purposes tthe following exchange rate was used:

1.00 US$=30 Baht

The area of ground measurement used in this report is the Rai - this is 40m by 40m and therefore:

1.00 Acre=2.52 Rai

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REPORT SUMMARY

Project Overview

This *Initial Environmental Examination* (IEE) is one of three reports prepared by the Global Transpark Consultants (GTC). The IEE describes the existing conditions at U Taphao and assesses the potential environmental impacts of proposed improvements and expansion of the existing facilities.

Existing Environmental Conditions: Physical Resources

U Taphao Naval Air Station is located on the southeast coast in Chon Buri and Rayong Provinces. The site is relatively level, although several hills and ridges occur just to the north. One of these, Khao Krok Tabaek, is only 750 meters northeast of the site boundary. Several small drainages, including a concrete-lined ditch, flow through the project site and empty into the Gulf of Thailand. A larger drainage, Khlong Bang Phai, flows through the western part of the base but is not within the area proposed for development.

Water quality samples were taken in upstream and downstream locations along two small drainageways within the project site. Samples were also taken from a nearby reservoir and the Gulf of Thailand. Except for low dissolved oxygen readings in the stream samples, existing water quality appears to be acceptable and within published drinking water standards.

There are no ambient air quality monitoring stations at U Taphao, so no information is available on existing air quality. It can be assumed that some carbon monoxide and nitrogen dioxide emissions are generated by airpor- related vehicle traffic. Frequent small-scale dry season brush fires on undeveloped parts of the base and in surrounding agricultural areas likely contribute to some degradation of regional air quality.

Baseline noise measurements were taken at nine locations on and near U Taphao. Most readings were in the 52 to 58 decibel range, which is considered a moderate to light level of noise.

Existing Environmental Conditions: Ecological Resources

Undeveloped portions of U Taphao presently consist mostly of shrubland or grassland, with smaller areas of coconut and mango plantation, wet meadow and beach. Very small areas of mangrove swamp are present where streams enter the Gulf of Thailand. Seasonal wetlands are relatively common on the site. Common species of birds, reptiles and amphibians utilize these various habitats. No rare or endangered species were observed. The nearest known coral reefs are around offshore islands near Sattahip. Common varieties of small fish are present in the estuaries at U Taphao.

Human and Economic Development

Major land uses around U Taphao include: residential housing, light commercial and retail, agriculture, including coconut and mango plantations and field crops, and idle land generally overgrown with a mix of grassland and scrub. Heavy industries such as chemicals, petroleum, paper, plastics, steel and manufacturing are concentrated near the port facility at Map Ta Phut.

Quality of Life Values

The Eastern Seaboard region has experienced rapid growth over the past 10 years, with annual Gross Provincial Product growth rates of 9.03 to 49.80 percent.

The three major sectors of the labor force within the region around U Taphao are agricultural, 36.2 percent; industry, 20.2 percent; and services, 15.[illegible]percent. Trading and construction comprise 13.6 percent and 10.0 percent, respectively. Within the region, Chon Buri Province has the highest industrial investment, and Rayong Province ranks third.

Schools and medical facilities are available within the immediate vicinity of U Taphao. The Eastern Seaboard region has become an increasingly popular tourist destination in recent years.

Probable Environmental Effects

Noise: The projected increase in flights is unlikely to significantly increase local noise levels.

Air Quality: Construction and operation of an expanded airport is expected to have minimal impact on local or regional air quality.

Water Quality: Assuming adequate treatment of water used on site and existence of a vegetated buffer along drainageways, there should be little airport-related impact on water quality. The most sensitive areas are within a one-kilometer coastal security buffer and will not be directly affected by airport expansion.

Fish and Wildlife Habitat: Airport expansion will impact mostly scrub and grassland habitats, both of which are common in the region. Unusual habitats, such as mangrove swamp and pes-caprae formation, are within the one-kilometer coastal security buffer and will not be affected. These areas will continue to provide valuable wildlife habitat. The TAMS proposal would not affect wildlife habitat on nearby Khao Krok Tabaek, which is a Forest Conservation Area; the Louis Berger alternative would require removal of part of this hill.

Drainage: Some existing drainageways will be relocated as part of airport expansion. Newly constructed drainages will be designed to accommodate any projected increase in water runoff.

Wetlands: Some areas of low to moderate quality wetland would be filled as part of airport expansion. Mitigation, in the form of wetland restoration or creation either on or off site, is feasible if desired.

Solid Waste: Any waste materials generated by expanded airport operations would be disposed of at an off-site landfill. No on-site disposal is expected.

Hazardous Materials: Any hazardous materials such as waste oils or asbestos will be disposed of as is currently done by commercial tenants. Materials will be stored in drums and labeled before being transported off-site.

Temporary Construction Impacts: Construction-related equipment noise will be well away from sensitive areas and is unlikely to adversely affect either local residents or wildlife. Exposed soil during construction may increase the amount of dry season windborn dust; however, a concurrent reduction in flammable scrub and grassland vegetation will reduce the risk of fire and the release of associated particulates. During the rainy season, some standard erosion control measures may be needed to reduce the risk of siltation in local streams and in the Gulf of Thailand.

CHAPTER 1

PROJECT DESCRIPTION

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1.0 Overview

The *Initial Environmental Examination* is one of three reports prepared by the Global Transpark Consultants (GTC), a consortium of four firms dedicated to determining the viability of and developing a plan to make a Global Transpark at U Taphao Airport a reality. There is a genuine interest on the part of express air cargo carriers, conventional air cargo carriers and industrial/commercial interests in using a facility such as a Global Transpark (GTP). The GTP at U Taphao will be the cargo processing center of an industrial/commercial center which will encompass the entire Eastern Seaboard Region of Thailand. The intermodal connections will involve updated roadway and air transportation planned to meet the demand of the region.

The three reports are: 1) *Business Plan;* 2) *Implementation Plan;* and 3) *Initial Environmental Examination.*

After review of applicable rules and regulations of Thailand, it was determined that an Initial Environmental Examination was the appropriate level of analysis for this stage of the GTP.

1.1 Project Description

Based on interviews with air cargo carriers, industries using air freight, and the Royal Thai Navy, GTC determined that initial improvements to the Global Transpark (GTP) at U Taphao Airport should include:

- Utilities and Infrastructure
- GTP Authority Headquarters
- Airfield Improvements
  - New Taxiways
  - Navigation Aids
- Cargo Warehouse and Apron
- Transit Aircraft Parking Apron
- Aircraft Rescue and Fire Fighting Facility
- Structural Fire Fighting Facility
- Airport Maintenance Facility
- Staff Residential Facilities

The initial improvements should be kept to a minimum and funded by the Government of Thailand to make the GTP more attractive to potential investors.

The Royal Navy has set aside the majority of the land on the east side of the existing runway for development of the GTP. GTC has recommended a layout that includes approximately 3,500 Rai divided into five functional areas: cargo handling; logistics, distribution, and warehousing; light assembly; long-term airport activities; and other airport activities. This layout is shown in Exhibit 1.3.

1.2 Aviation Activity

Since the GTP is a new concept in Thailand, projections of activity at the facility are based on assumed development scenarios rather than past history. The four levels of activity anticipated to occur at GTP are:

Time	Level of Activity	Type of Activity
1-2 Years	Division of Existing Don Muang Cargo Operations	Outbound express and local air cargo
3 Years	Direct Express	Established express and time definite cargo operations serving Thailand, seasonal transport of perishable goods
4-5 Years	Initial Global Transpark	Beginning of a Global Transpark - Express Distribution Center, logistics warehousing, beginning Southeast Asia service
6-20 Years	Full Global Transpark	Full Global Transpark - regional hub for Southeast Asia, air freight dependent industry located on or near the Transpark

Exhibits 1.1, 1.2, 1.3 and 1.4 show site location the U Taphao Naval Air Station (existing condition): GTP Development Plan, 1997 Layout; and GTP Development Plan, Louis Berger 1991 Layout[1], respectively.

[1]Louis Berger International, Inc., Asian Engineering Consultants Corp., Ltd., and Index International Group Co., Ltd. March 1991. Feasibility and Master Plan, Rayong-U Taphao International Airport.

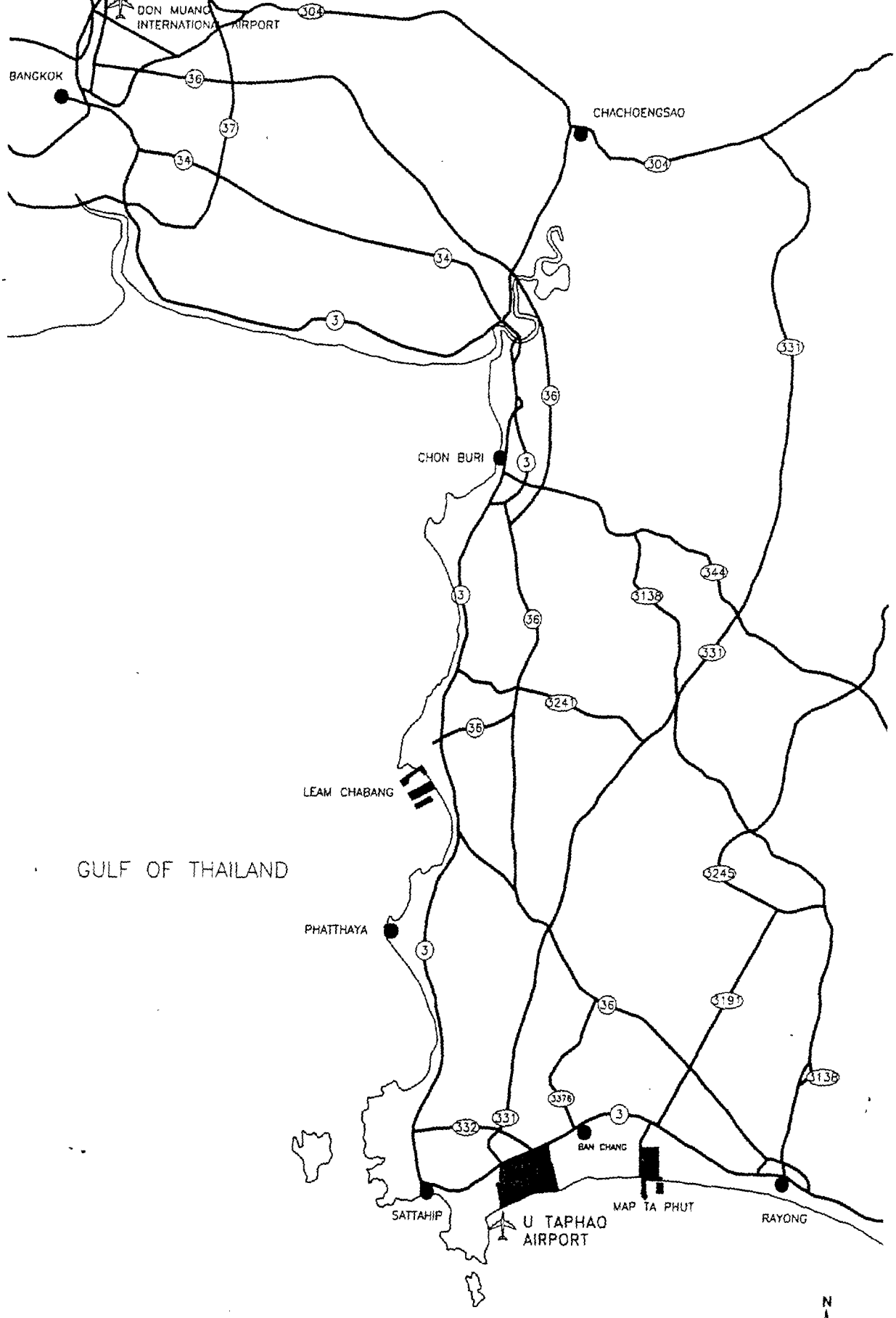

EXHIBIT 1.1 U TAPHAO SITE

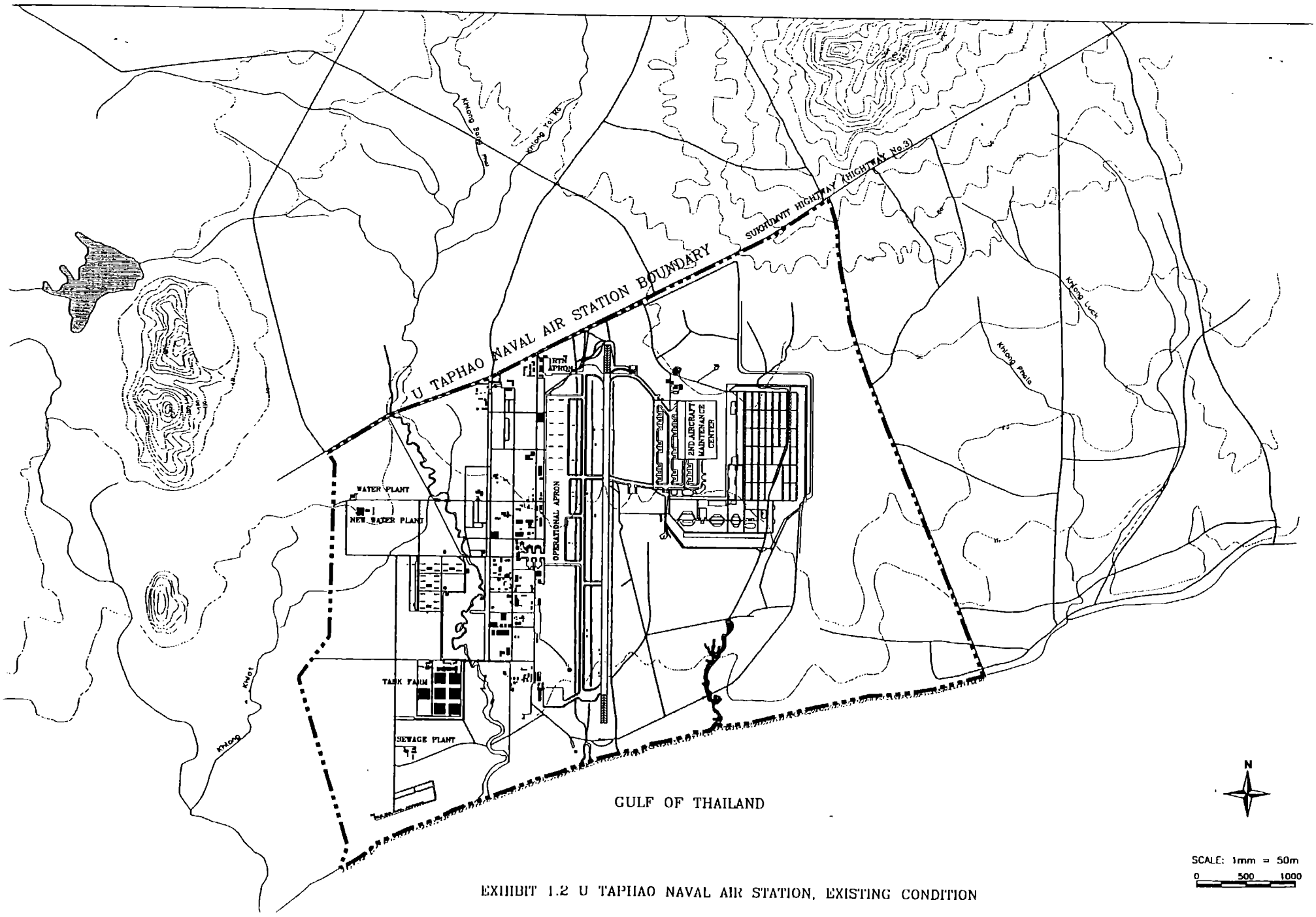

EXHIBIT 1.2 U TAPHAO NAVAL AIR STATION, EXISTING CONDITION

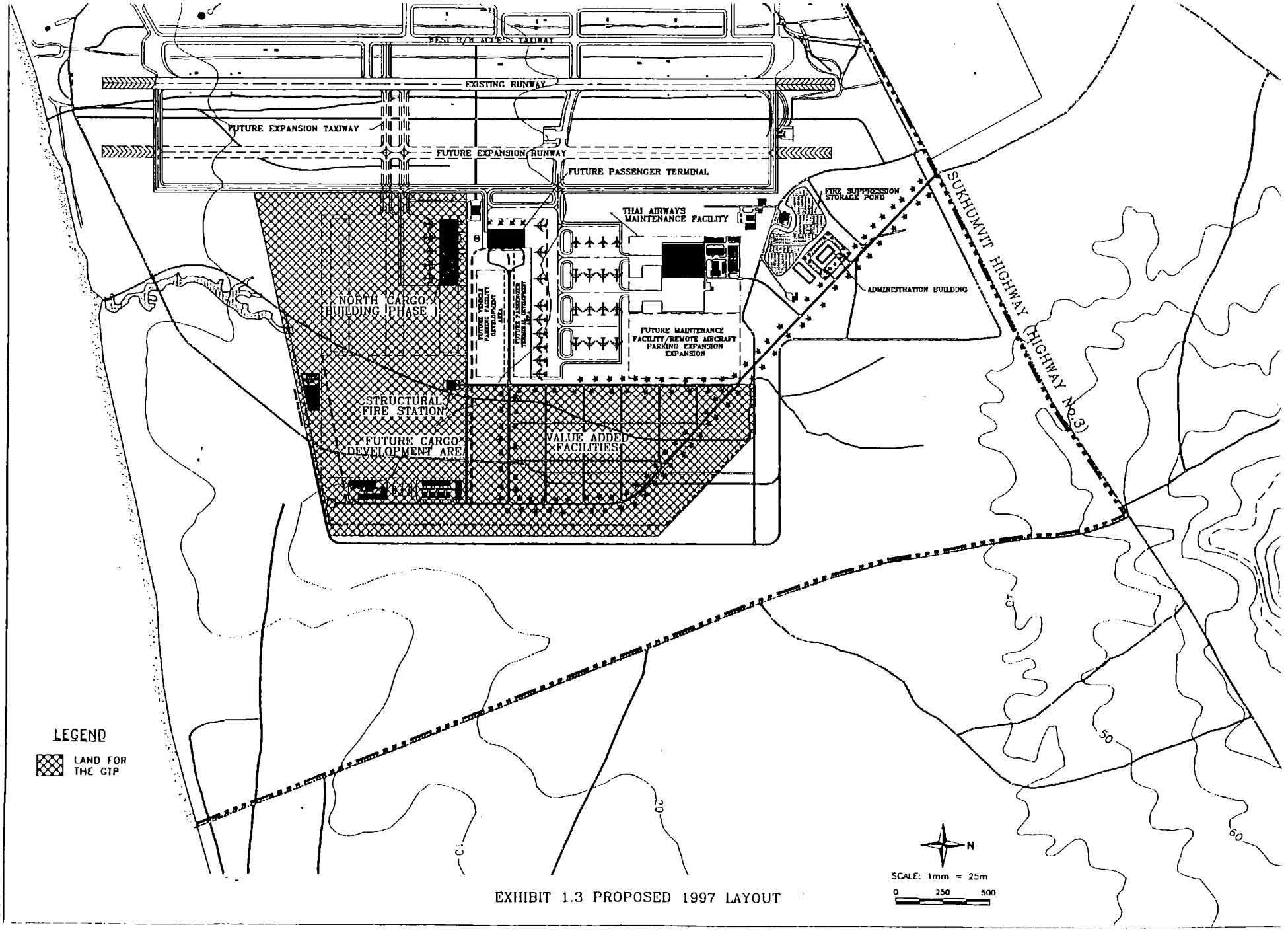

EXHIBIT 1.3 PROPOSED 1997 LAYOUT

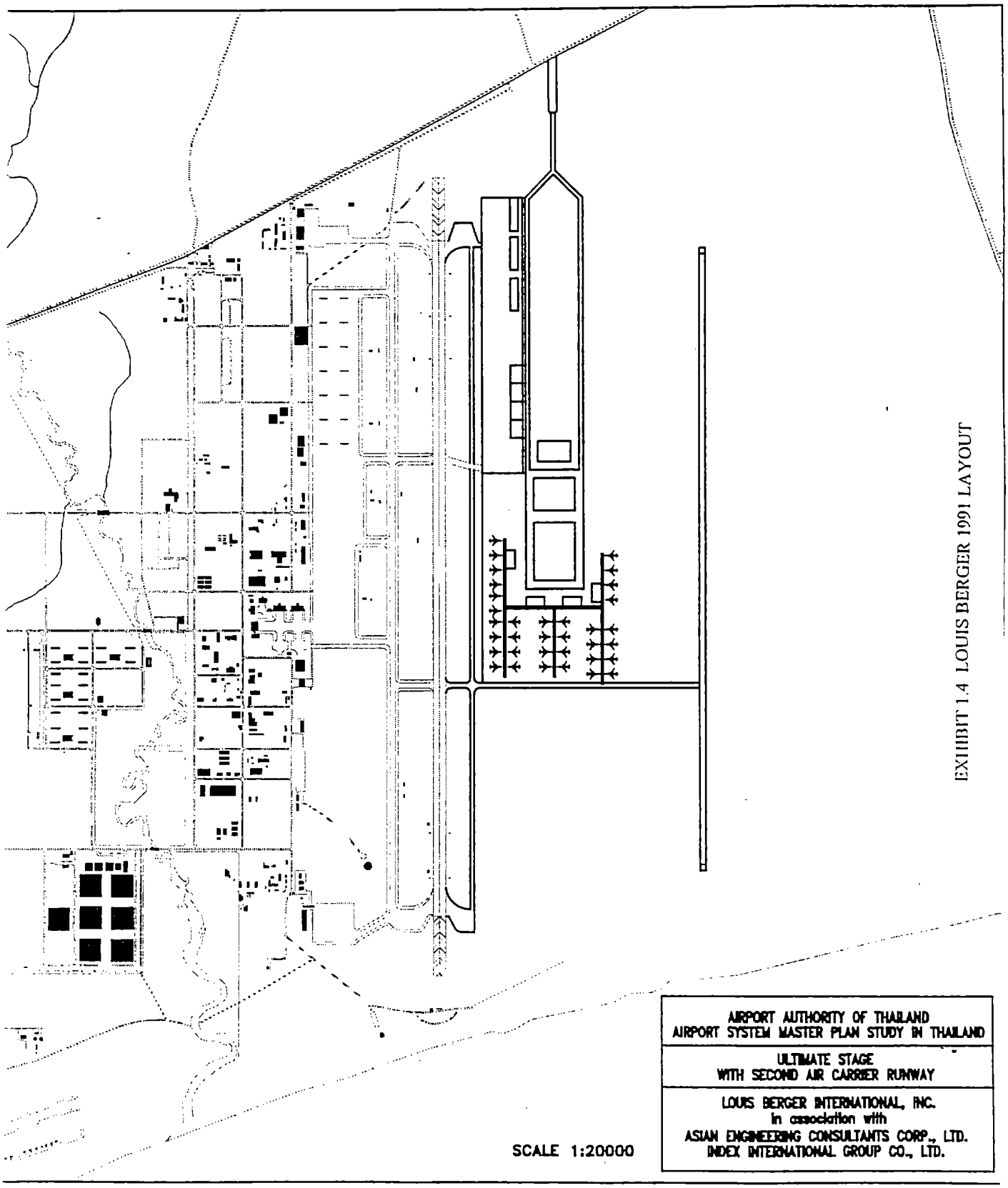

EXHIBIT 1.4 LOUIS BERGER 1991 LAYOUT

CHAPTER 2

EXISTING ENVIRONMENTAL CONDITIONS

CHAPTER 2

EXISTING ENVIRONMENTAL CONDITIONS

2.0 Introduction

The U Taphao Naval Air Station and vicinity was visited from 24 January through 31 January, 1997 to review and characterize the existing conditions at the site. Participants included Mark Thompson, Kenneth Mierzwa and Chris Purkiss of TAMS Consultants, Inc., and Athaporn Yordkaew of ACT Consultants Co., Ltd. In addition, reference materials and publications were obtained from various sources at the Air Station and in Bangkok, including appropriate government agencies and libraries. The results of the literature review, site visit and subsequent data analysis are presented below.

2.1 Physical Resources

2.1.1 Topography

Arbhabhirama et al. (1987) described the portion of the southeast coast near U Taphao as "Quaternary terraces, mainly of marine origin...numerous separate hills and ridges are found, the rock formations mainly having a north, west-southeast orientation...stream alluvial plains are insignificant."

The U Taphao site is relatively level, rising gradually from sea level to 60 meters at the northeast corner. Khao Krok Tabaek, a hill located approximately 750 meters northeast of the site boundary, reaches a maximum elevation of 274 meters. West of the site, a chain of hills extends from Sattahip to the north, but the nearest of these is more than three kilometers west of the existing runway centerline. Site topography is shown in Exhibit 2.1.

2.1.2 Climate/Meteorology

U Taphao is within a region characterized by a monsoon climate. Winds are typically from the north, northeast, or east from November through February, from the east, southeast, or south from March to May, and from the southwest from May through September. Most rainfall occurs from May to October. Annual mean temperature is about 28 degrees Celsius. April is the warmest month and December is the coolest. Mean relative humidity varies from 66 percent in December to 80 percent in September. Table 2.1 shows climatic data at Sattahip for the period of records 1951-1970.

2.1.3 Geology and Soil Condition

Scholten and Siriphant (1973) described the regional geology: "rocks folded and locally metamorphosed, and including a wide variety of clastic rocks and limestones that, in many places, are intruded by igneous rocks." They go on to describe the high terraces of the southeast coast, including the area just north of U Taphao, which "have an undulating to rolling relief with slopes ranging from 2 to 16 percent and characterized by moderately well to somewhat excessively well drained soils." (Along the immediate coastal area, Scholten and Siriphant (1973) map beach and dune formations active and former tidal flats of recent marine and brackish water deposits.)

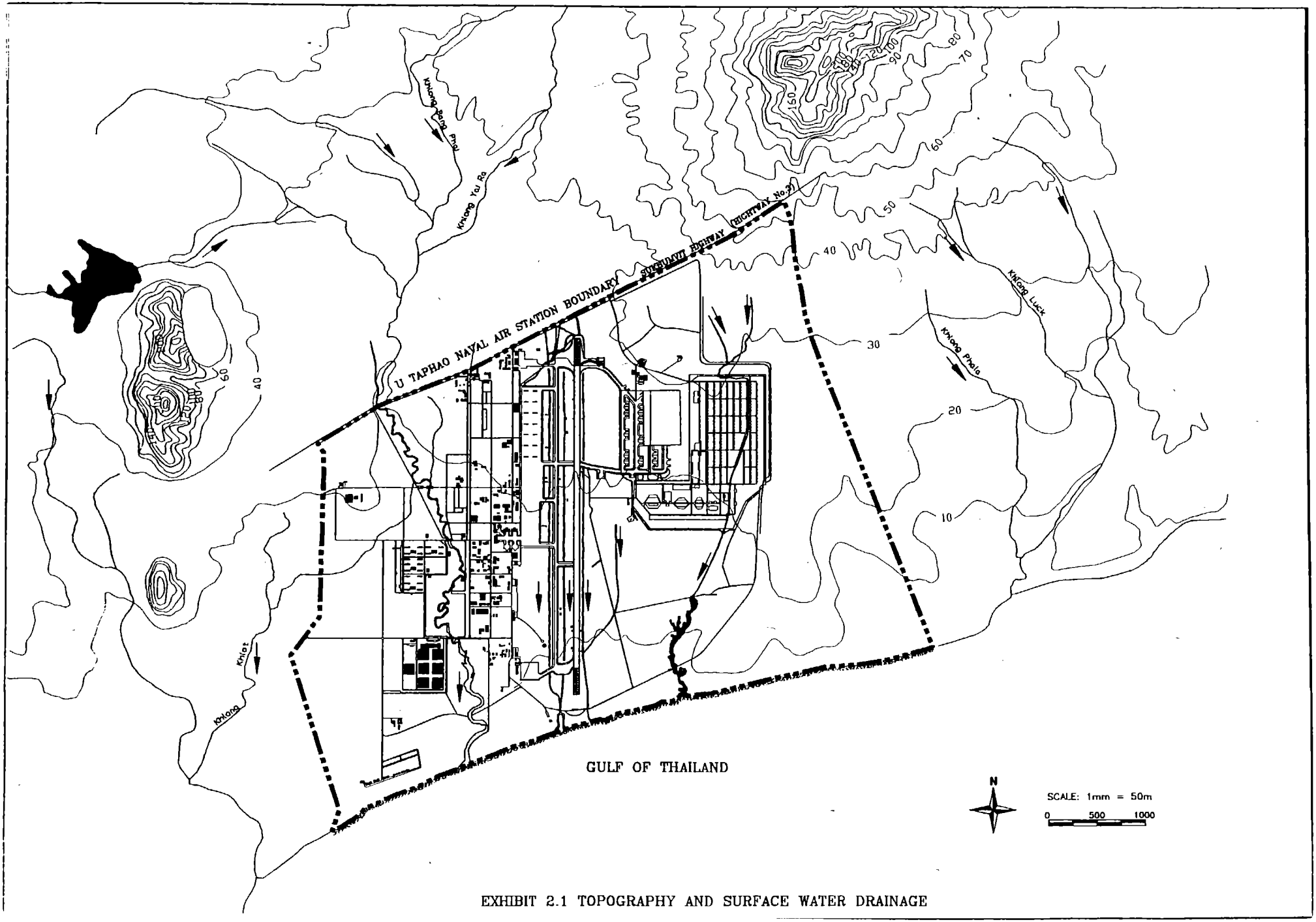

EXHIBIT 2.1 TOPOGRAPHY AND SURFACE WATER DRAINAGE

Table 2.1
Climatic Data of Sattahip* *(Period of Records 1951-1970)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Rainfall (mm.)	28.9	67.0	64.7	78.5	195.1	74.6	102.6	92.7	215.2	290.9	96.3	19.2
Average Rainy Days	2.7	5.2	4.7	7.7	14.0	11.0	14.3	13.9	16.2	17.9	8.5	1.9
Greatest Fall in 24 hrs. (mm.)	49.4	117.6	116.1	100.6	120.0	56.0	155.0	89.7	107.7	302.7	319.6	87.0
Average Temperature (°C)	28.1	28.9	30.2	30.9	30.0	29.7	29.2	29.2	28.7	28.1	27.7	27.4
Maximum Temperature (°C)	39.0	39.4	39.5	40.5	40.5	37.2	37.8	37.2	37.4	36.2	37.4	38.3
Minimum Temperature (°C)	12.3	18.3	18.7	21.0	21.7	20.9	19.0	21.5	19.0	19.5	16.1	18.8
Average Relative Humidity (%)	**69.4**	**74.6**	**75.9**	**75.8**	**78.3**	**76.2**	**77.6**	**77.6**	**80.3**	**83.0**	**76.6**	**70.9**
Minimum Relative Humidity (%)	**25.0**	**17.0**	**32.0**	**33.0**	**45.0**	**43.0**	**47.0**	**48.0**	**45.0**	**38.0**	**33.0**	**30.0**
Prevailing Wind Direction	N	S	S	S	S	SW	SW	SW	SW	N	N	N
Average Velocity (knots)	5.9	7.8	7.6	7.4	7.9	10.0	9.5	9.0	7.7	5.8	6.8	7.0
Greatest Wind - Direction -Velocity (knots)	N 35.0	NE 36.0	SE 48.0	E,SE 46.0	NW 57.0	WSW 58.0	W 52.0	W 52.0	WNW 49.0	W 59.0	NNW 73.0	SSE 38.0

* From: Meteorological Department, Office of The Prime Minister, Bangkok

The airport is located on Quaternary terrace deposits consisting of laterite, gravel, sand, silt and clay. Small areas of alluvium and beach sand are present. Hills north of "Sukhumvit Route 3," including Khao Krok Tabaek, are composed of granite with some pegmatite. Metamorphosed sedimentary rocks are present a short distance west and northwest of the site.

Soils in the project area are predominantly Pakchong loams, formed by weathering and erosion of the country rock (Pendleton and Montrakun, 1960). Small areas of Pattani Coastal Soils, a lowland coastal alluvium of alternating beach ridges, are mapped along the shoreline (Pendleton and Montrakun, 1960). Regional geology is shown in Exhibit 2.2.

2.1.4 Surface Water Drainage

Khlong Bang Phai flows through the western part of the U Taphao site. This stream originates north of the site and carries a substantial amount of water, even in the dry season. The channel is mostly natural, although erosion is severe in places; and at least one check dam has been installed.

A smaller, concrete-lined ditch originates in the northeastern corner of the site and flows south, flowing through a natural meandering channel for the final kilometer before entering the Gulf of Thailand. This also maintains a slight flow in the dry season. Little or no erosion was noted along this drainage, probably because of lower flow rates and concrete channel protection.

Several smaller, unnamed, ephemeral drainages are also present, including a series of drainage ditches associated with the runway and taxiway system. In general, streams and other drainageways flow from north to south, emptying into the Gulf of Thailand.

2.1.5 Surface Water Quality

Methods

Inquiries were made at the Ministry of Science, Technology and Environment regarding water quality and quantity near U Taphao. During the field visit, samples were obtained from six locations. Portable field instruments were used to obtain in-situ measurements of the surface waters for dissolved oxygen, pH, salinity, conductivity and temperature.

Sample Sites

Upstream and downstream samples were collected from each of the two major drainage ways flowing through the eastern part of the project site (SW-1, SW-2, and SW-3; Exhibit 2.3). Samples were also collected from the Gulf of Thailand and from the Phlu Ta Luang reservoir northwest of U Taphao (GT-1 and RES-1).

Sample site SW-1 is within the upper portions of the eastern concrete-lined channel in the northeastern part of the airport facility. At the time of the sample, shallow water covered the bottom of the channel to a depth of several centimeters. Some silt and aquatic vegetation had accumulated in the channel bottom. Bordering uplands consisted of scrub, with shrubs and small trees overhanging and partially shading the channel.

Sample site SW-2 is within the lower reaches of the same channel, just above the perimeter road bridge and within sight of the Gulf of Thailand. The channel at this location is natural, with considerable bordering vegetation consisting mostly of small

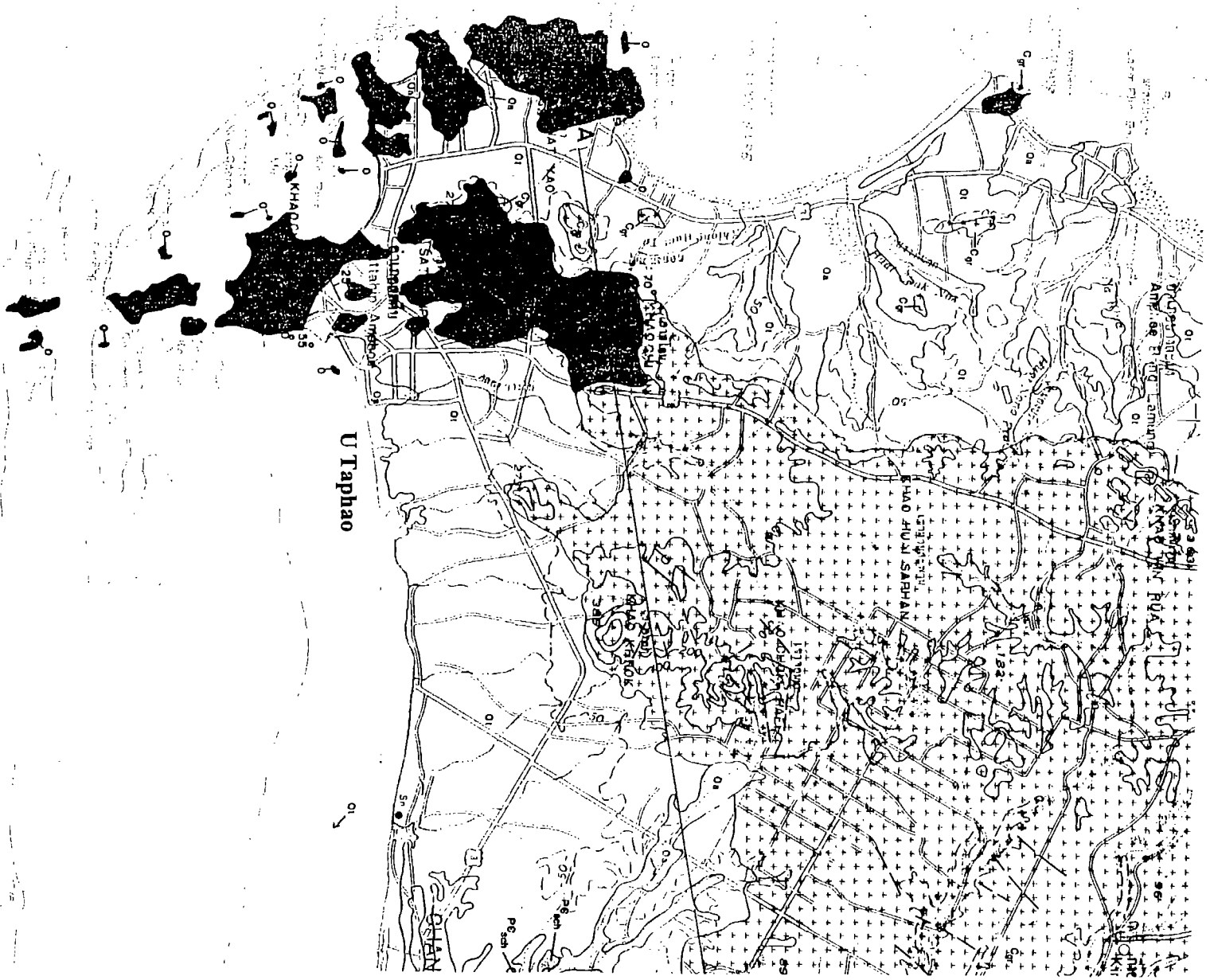

EXHIBIT 2.2 REGIONAL GEOLOGY

EX-WATER

trees, and is partly in shade. The channel is about 10-meters-wide and more than 1-meter-deep at this location, with nearly imperceptible flow.

Sample site SW-3 is near the outlet of a channel draining the existing runway area. This location is also just above the perimeter road bridge and near the Gulf of Thailand, but is buffered from saltwater influence by a low concrete ledge associated with the bridge structure, which acts as an outfall dam. This channel is only a few meters wide and was perhaps a meter in depth at the time of sampling. It is bordered by dense thickets of shrubs and young trees, including mangrove saplings, and is mostly shaded. Fish were common and easily seen.

Sample site SW-4 is upstream of SW-3, and is a drainage ditch between the runway and axiway. (At the time of sampling it held only a small amount of water, and was overgrown with dense herbaceous vegetation.

Sample site RES-1 is near the outfall of the Phlu Ta Luang reservoir northwest of the airport, created by construction of a dam on the upper reaches of Khlong Bang Phai. The adjacent bank is silt armored with rip rap. The sample was taken near the shoreline in water less than 1-meter deep.

Sample site GT-1 is in the Gulf of Thailand just off the southwestern corner of the airport. It is west of, and up current of, the Khlong Bang Phai outlet, to avoid influence by that silt-laden stream. The sample was collected about 10 meters offshore in water less than 1-meter deep.

Analysis

Analysis of the samples was completed in Bangkok. Results are presented in Table 2.2. Data for the freshwater samples were compared to the Thailand Drinking Water Quality Standards (Department of Science, Ministry of Industry, 1983). These standards are included in Table 2.2.

It should be noted that in some cases, such as for magnesium, the data were reported in units other than those on which the standard appears to be based. In such cases the data have been converted to consistent units as shown in the table.

The Gulf of Thailand water sample data have been compared to published data on the composition of seawater. Appropriate conversions (from elements to ions, or vice versa) have been made as noted on the table.

Stream/Reservoir Water Quality Results

Laboratory data do not show the presence of any analyte tested at concentrations exceeding the cited drinking water standards. Sample data for "magnesium as $CaCO_3$" were converted to "magnesium as Mg" by multiplying by 0.243. Field pH data, determined with pH paper, do show pH values less than the minimum standard of 6.5 for all five freshwater samples, including RES-1. The accuracy of those measurements may be suspect, since they are lower than pH results reported from laboratory samples. Field conductivity measurements matched laboratory measurements well.

Table 2.2
Water Quality Sample Results *(January 1997)*

	SURFACE WATER SAMPLES AND STANDARDS						SEA WATER	
	SW-1	SW-2	SW-3	SW-4	RES-1	Thai DW Std	GT-1	Sea Water
pH (standard units)	6.51	6.91	6.9	6.78	7.59	6.5-8.5	7.97	N/A
Conductivity (umho/cm)	153	1037	771	300	183	N/S	47000	N/A
Ammonia-N (as N)	<0.05	<0.05	<0.05	<0.05	<0.05	N/S	<0.05	N/A
Organic N (as N)	<0.05	<0.05	<0.05	<0.05	<0.05	N/S	<0.05	N/A
Nitrite (as N)	0.002	0.008	0.009	0.005	0.007	N/S	0.004	N/A
Nitrate (as N)	0.014	0.04	0.??	0.046	0.003	45	0.006	N/A
Phosphate, total (as P)	0.39	0.01	0.01	0.02	0.01	N/S	0.01	N/A
Alkalinity - CO_3 (as $CaCO_3$)	0	0	0	0	0	N/S	0	N/A
Alkalinity - HCO_3 (as $CaCO_3$)	37.2	53.3	69.3	55.3	63.3	N/S	110	N/A
Chloride (as Cl)	21.5	230	168	40	10	250	16000	18980
Sulfate (as SO_4)	11.2	105	42	15.5	13	200	2350	2652*
Calcium (as $CaCO_3$)	30	80	52	36	38	N/S	750	1000**
Magnesium (as $CaCO_3$)	8.0	62.0	20.0	10.0	27.0	N/S	5150	N/A
Magnesium - conv. to "as Mg"	1.9	15.1	4.9	2.4	6.6	50	1251	1272
Sodium (as Na)	16.7	170	115	35.7	9	N/S	9784	10561
Hydrogen Sulfide (as S)	<0.01	0.06	0.09	<0.01	0.1	1	0.1	N/A
FIELD DATA:								
Temperature (deg C)26.5262727.530N/S29								
Salinity (o/oo or ppt)	**0**	**0.5**	**0.5**	**0.2**	**0.01**	**N/S**	**39**	
Dissolved Oxygen (mg/L)	4.75	2.8	1.8	3.0	8.5	20	7.4	
D.O. - % saturation	59.2%	34.6%	22.6%	38.1%	112.7%	N/S		
Conductivity (umho/cm)	180	1000	1000	320	200	N/S	50000	
pH (by pH paper) (Std Units)	5	6	5.5	5	6	6.5-8.5	7	

All laboratory data in mg/L (parts per million) except as noted for conductivity and pH. Field data unites as noted.
N/S = No Standard found
N/A = Not Available
Sea Water composition data from "Lange's Handbook of Chemistry", 1946.
* Converted from "S" to "SO_4"
** Converted from "Ca" to "$CaCO_3$).

The RES-1 sample is the most upstream of the five freshwater samples. Analyte concentrations detected in RES-1 are similar to those in the two more northerly, or upstream, samples collected within the airport (SW-4 and SW-1). SW-3 is downstream of SW-4, and concentrations of all analytes are somewhat higher, although still well below applicable criteria. Sample SW-2 was collected downstream of SW-1, and SW-2 may also have been tidally influenced. Although results for conductivity, chloride, sulfate and magnesium are all higher for this sample, as would be expected with the influence of seawater, concentrations of all analytes are within applicable limits and do not suggest a substantial seawater influence at the time of sampling.

With the exception of the dissolved oxygen (DO) concentrations in RES-1, DO levels are on the low side in the surface water samples. The observed DO levels may not support a diverse aquatic animal community.

Gulf of Thailand Water Quality Results

The data from sample GT-1 are consistent for all measured parameters with expected concentrations in seawater and water quality appears to be acceptable. The following data conversions were made:

- Sample data for "magnesium as $CaCO_3$" were converted to "magnesium as Mg" by multiplying by 0.243;
- Sea water data for sulfur (S as S) were converted to sulfur as sulfate by multiplying the S concentration by 3.0; and
- Sea water data for calcium were converted to "calcium as calcium carbonate" by multiplying by 2.5.

Seawater quality at other locations along the eastern seaboard has been described as poor to fair (Sema Group Belgium - Team Consulting Engineers, 1997). The most serious problems are around ports and certain river or channel mouths. For example, at the mouth of the Rayong River during 1995, dissolved oxygen averaged 7.8 mg/l, dissolved hydrocarbons were measured at 2.58 mg/l, coliform bacteria counts were below standards, and mercury concentrations were high (Sema Group Belgium - Team Consulting Engineers, 1997).

Overall Surface Water Quality Assessment

Based on the limited data, water quality in all measured samples appears acceptable. It should be noted that only a limited number of parameters were measured. With the exception of nitrate and phosphate (possible indicators of agricultural runoff), toxic chemicals (including metals, pesticides, petroleum products) or other indicators of human influence were not measured. It should also be noted that comparative standards and criteria were not available for all measured parameters.

2.1.6 Oceanography

Tidal information for an area just southwest of U Taphao is presented in Table 2.3

Table 2.3
Tidal information for Ko Saket, Sattahip (meters)

Highest Tidal Action	+ 3.5
Mean Higher High Water (MHHW)	+3.0
Mean High Water (MHW)	+2.8
Mean Sea Level (MSL)	+2.2
Mean Low Water (MLW)	+1.6
Mean Lower Low Water (MLLW)	+1.4
Lowest Tidal Action	+0.5

Source: Nippon Kloei Co., Ltd. et al. 1985

2.1.7 Air Quality

2.1.7.a Introduction

Airport-related pollutant emissions are generated during construction activities and during airport operations by a combination of mobile and stationary sources. Typically, the majority of pollutant emissions in a region are generated by industry and motorized road vehicles, with aircraft operations being minor contributors.

This section presents Thailand's National Ambient Air Quality Standards and a discussion of the types of emissions that are generally associated with airport related activities (Table 2.4).

2.1.7.b National Ambient Air Quality Standards

National Ambient Air Quality Standards have been established in Thailand to protect human health. Standards (Table 2.4) were established for six pollutants: carbon monoxide, nitrogen dioxide, sulphur dioxide, suspended particulate matter, photo chemical oxidant or ozone, and lead. These pollutants are discussed below:

- Carbon monoxide (CO) is a colorless, odorless gas. The major source of CO in an urban area is the incomplete combustion of fuels used to power vehicles, heat buildings and process raw materials and from the burning of refuse. Carbon monoxide is a site-specific pollutant; major concentrations are found near the source, such as heavily congested intersections. Carbon monoxide is the most commonly occurring air pollutant. (The health effect associated with CO-contaminated air is reduced transport of oxygen by the blood stream, a consequence of CO displacing oxygen in hemoglobin.) Exposures to very high levels of CO are lethal and exposures to high levels for a short duration can cause headaches, drowsiness or loss of equilibrium.

Table 2.4
National Ambient Air Quality Standards

Pollutant	Averaging Period	Standards and Measurement	
		Standard	Methods
Carbon Monoxide	8-hour 1-hour	20 mg/m^3 50 mg/m^3	Non-Dispersive Infrared Detection
Photo Chemical Oxidant (Ozone)	1-hour	0.20 mg/m^3	Chemiluminescence
Nitrogen Dioxide	1-hour	0.32 mg/m^3	Gas Phase Chemiluminescence
Lead	24-hour	0.01 mg/m^3	Wet Ashing
Suspended Particulate Matter	1-year 24-hour	0.10* mg/m^3 0.30 mg/m^3	Gravimetric
Sulfur Dioxide	1-year 24-hour	0.10* mg/m^3 0.30 mg/m^3	Pararosaniline

Notes:
1. * = Geometric mean value.

2. Sources:
(1) Standard: Notification of Office of the National Environment Board, No. 2, dated November 6, B.E. 2524, published in the Royal Government Gazette, Vol. 98, Part 197, dated December 1, B.E. 2524 (1981) P. 4322-4323.

(2) Methods of Measurement: Notification of the Ministry of Science, Technology and Energy, issued under Improvement and Conservation of National Environmental Quality Act B.E. 2518, B.E. 2521, published in the Royal Government Gazette, Vol. 98, Part 197, dated December 1, B.E. 2524 (1981) P. 4299-4306.

- Sulfur dioxide (SO_2) is emitted into the atmosphere from the combustion of sulfur-bearing fuels for space heating and motor vehicles. The use of low sulfur fuels for space heating has reduced the amount of sulfur dioxide emitted from these sources. The combustion of gasoline and diesel fuels in motor vehicles accounts for a very small percent of the total sulfur dioxides emitted. Respiratory illness and damage to the respiratory tract are the health effects associated with inhalation of sulfur dioxide emissions.

- Nitrogen dioxide (NO_x) is a yellowish-brown, highly reactive gas, which is present in an urban environment. Major sources of nitric oxide and nitrogen oxide emissions are from fuel combustion in boilers associated with electric utilities and industrial facilities. Nitric oxides oxidize in the atmosphere to form nitrogen dioxide. Nitrogen oxides cause irritation to the lungs, bronchitis and pneumonia, and lowered resistance to respiratory infections.

- Photochemical Oxidant or Ozone (O_3) is a photochemical oxidant and a major constituent of smog. Hydrocarbons and nitrogen oxides are precursor pollutants to the formation of ozone. Hydrocarbons and nitrogen oxides react in the presence of sunlight to form a photochemical oxidant. This reaction is time dependent and usually takes place far downwind from the site where the contaminants were originally emitted. Thus hydrocarbons and nitrogen oxides are reactive contaminants, whose impact generally occurs well beyond the areas immediate to the source. High concentrations of ozone are a major health and environmental concern. For example, ozone is a principal cause of lung and eye irritation in an urban environment.

- Suspended particulate matter in an urban environment typically occurs as a result of incomplete fuel combustion. Particulate matter includes dust, dirt, soot, smoke and liquid droplets directly emitted into the air by sources such as factories, power plants, cars, construction activity and fires. Diesel fuel compared to gasoline contributes more particulates to the atmosphere. An inhalable particulate is defined as a particulate that is less than 10 micron (PM10) in diameter. The major health effect caused by the inhalation of PM10 is damaging to the respiratory organs.

- Lead (Pb) is a bluish-gray metal, usually found in small quantities in the earth's crust. The most significant contributors of lead emissions to the atmosphere are gasoline additives, iron and steel production, and alkyl lead manufacturing. Other sources of lead include combustion of solid waste, windblown dust from weathering of lead-based paint and cigarette smoke. The use of lead-free gasoline has considerably reduced the lead levels in the urban environment. Exposure to lead is dangerous for the fetus and results in pre-term birth. Other health effects associated with lead exposure are decreased intelligence quotient (IQ) for infants and small children, increased blood pressure in middle-aged men, and brain and kidney damage in adults and children.

2.1.7.c Airport Related Sources of Air Pollution

Sources of air pollution are typically characterized into two broad categories of emission sources:

- Mobile sources such as aircraft, automobiles, trucks, buses and taxis, construction equipment; and

- Stationary sources such as boilers, incinerators, industrial processes and area sources.

Airport-related emissions are further broken down as follows:

- Airport sources - on-site mobile and stationary source emissions from aircraft, motor vehicles, power plants, fuel storage, etc.;

- Mobile sources - emissions from increased vehicle miles of travel (VMT) of off-site motor vehicles; and

- Stationary sources (non-airport) - emissions from the burning of fossil fuels, incineration, chemical processes, and bulk storage of chemicals (e.g., petroleum hydrocarbons) from such indirect non-airport sources as residential and commercial development and industrial facilities.

There are no ambient air quality monitoring stations at U Taphao, therefore conclusions regarding existing air quality levels cannot be made. Qualitative inferences can be made from past analyses at other airports. It can be assumed that the aircraft and related on and off airport motor vehicle traffic generate primarily CO and No_x emissions. Stationary on-site sources are minor contributors. The majority of the on-site airport CO emissions should be from motorized road vehicles rather than from aircraft. The aircraft and on-site vehicle operations should be minor contributors of CO and NO_x emissions in a regional context. During the dry season site visit, smoke from numerous small brush fires generated a visible haze and certainly contributed to degradation of regional air quality.

2.1.8 Noise

2.1.8.a Introduction

Sound is defined by Webster's New World Dictionary as *"vibrations of air, water, etc., that stimulate the sensation of hearing."* Noise is defined as being *"any loud, discordant or disagreeable sound or sounds."* A major part of any airport environmental report includes the study of noise generation, mainly through modeling and measurements.

This section presents background information on noise and the results of a study to identify and quantify the noise issues related to the proposed development of the Global Transpark. Noise measurements were made for existing noises at the existing airport and at representative noise sensitive receptors near the airport. Noise sample locations are shown in Exhibit 2.4. Aircraft noise models have been developed for 5 cases: forecasted conditions for opening day, year 5 and year 12.

2.1.8.b Background

Sound Generation

All sounds come from a sound source -- a musical instrument, a voice speaking, an airplane passing overhead. It takes energy to produce sound; the sound energy produced by any sound source is transmitted through the air in sound waves. Sound waves are tiny oscillations of pressure just above and just below atmospheric pressure. These oscillations or sound pressures impinge on the ear, resulting in the detection of sound. But sound pressures are not intrinsic to the source -- they are greatly affected by the environment in which the sound source is located. A symphony orchestra playing outside will sound very different from the same orchestra playing the same music in a symphony hall.

The human ear has an amazing dynamic range. At the low end of the range, you can hear very faint sounds of less than 10 decibels (dB) sound pressure level, yet you can also hear and identify sounds of more than 100 dB sound pressure level. For example, sitting inside your house on a summer evening, you can hear a cricket chirping in your garden and, minutes later, a commercial airliner flying overhead. The plane's sound power is many times greater than the cricket's – but you hear and distinguish them both.

In part, because of this range, it takes a lot of noise reduction to make a perceptible difference in sound. When a sound is decreased by about 10 dB in level, people

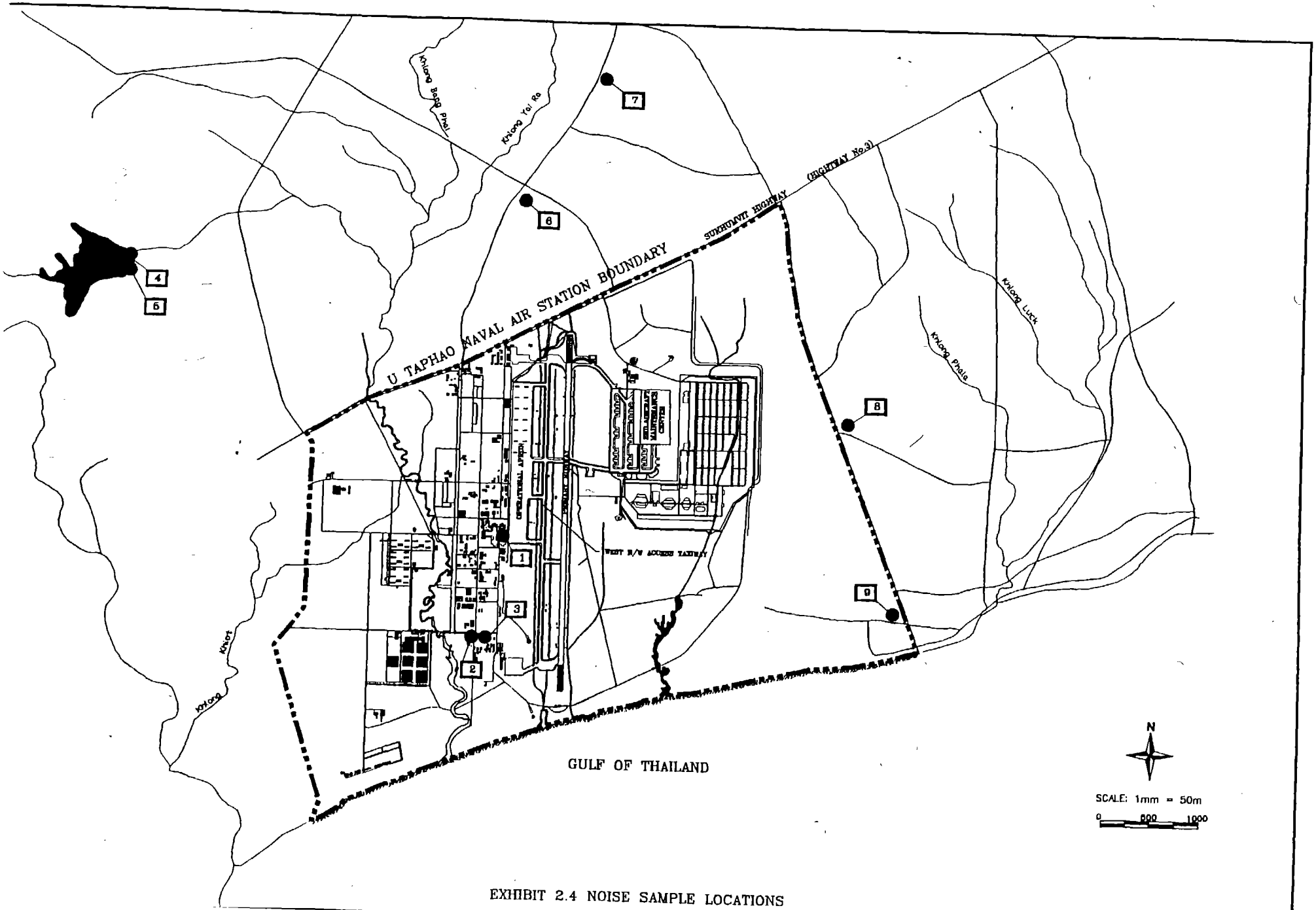

EXHIBIT 2.4 NOISE SAMPLE LOCATIONS

judge it to be about half as loud as before. Yet to achieve that change, 90 percent of the sound energy must be removed.

Sound Propagation

As sound propagates outward from its source, its magnitude decreases for a variety of reasons. Chief among these are:

- wave spreading;
- atmospheric absorption;
- ground absorption;
- physical barriers; and
- atmospheric turbulence.

The first of these is commonly known as the *"inverse square law."* In effect, this results in a 6 dB decrease in sound level with each doubling of distance from a *"point source."* For example, the sound level at 365 meters (1,200 feet) is 6 dB lower than at 183 meters (600 feet) from a source of noise due to *"inverse square"* or *"spreading"* loss.

Atmospheric and ground attenuation are often referred to as *"excess attenuations"* (in excess of spreading attenuation). Their values can exceed several dB per thousand feet at distances of more than a few thousand feet from a source.

The attenuation of physical barriers depends on the extent by which they effectively intersect the line-of-sight between a sound source and a receiver. The maximum practical limit for walls or berms is usually not more than 10 dB because of wave bending or reflection effects. An enclosure, such as a building, is a special case of a barrier. As with a wall, the limiting attenuation depends on the sound transmitting characteristics of the structure.

The effects of atmospheric turbulence are highly variable and are predictable only with detailed and complex data on the structure of the atmosphere. These effects can increase or decrease the noise over large distances (more than a mile). Except in special instances, their long-term effects are usually assumed to be zero.

Quantification of Noise

Noise is measured in logarithmic units of sound known as decibels (dB). Environmental noise exposure is measured and expressed in A-weighted sound levels sometimes expressed in units of dBA. Sound levels are weighted in this way to approximate the frequency response of the human ear. A-weighted sound levels, of several types, are used throughout this section.

Because decibels are logarithmic quantities, they cannot be added and subtracted like linear units. To add or subtract decibels, they must first be converted to linear units, then added, or subtracted and the result converted again to decibels. This is a confusing situation for most people, but it is fundamental to understanding the way sound levels combine.

Table 2.5 shows the simplified relationship between decibels and their linear counterparts. This simplified table helps to explain how, for example, two quantities of equal decibel value, when added together, have a total decibel value approximately 3 dB above their individual values. In essence, twice as much sound energy is 3 dB more sound level. Likewise, four times as much sound energy is 6 dBs more sound level. For example, adding two sounds with equal sound levels of 40 dB each, results in 20,000 energy units (2 x 10,000), or, from Table 2.5: 3 dB + 40 dB). This is twice as much as the energy of each, or 3 dB higher, 43 dB, not 80 dB. Table 2.5 also demonstrates the previously mentioned relationship between noise reduction and energy removal.

Table 2.5
Linear and Logarithmic (Decibel) Relationships

Linear Value	Decibel Value
0	N/A
1	0
2	3
4	6
10	10
100	20
1.000	30
10.000	40

Noise Descriptors

Acoustic noise is sound that can create unwanted effects upon people, animals or structures. Noise descriptors are ways of measuring and describing noise. Noise descriptors include factors that account for sound magnitude, frequency or pitch, and duration. Magnitude is expressed in terms of Sound Pressure Level and is expressed in decibels. Decibels (dB) are logarithmic units of measure, as described previously. A-weighted sound levels (dBA) are Sound Pressure Levels filtered, or weighted, to approximate the frequency response of the human ear.

A-weighted sound levels also correlate well with human assessment of the loudness and noisiness of sound, and therefore, it has become the virtual standard descriptor for expressing and measuring environmental and industrial noises.

The standard descriptors for single-event noises like aircraft flyovers and automobile drive-bys are Maximum Sound Level (Lmax), and Sound Exposure Level (SEL). SEL is a measure of combined duration and magnitude for a single event measured in A-weighted sound level. It is used in computing the contribution of single-events to the Equivalent Sound Level (Leq) and the Day-Night Sound Level (DNL) described below.

The standard descriptor for the effects of noises over a specified period of time is the Equivalent Sound Level, known as Leq. Leq is the level of a steady sound that has the same sound energy as an amplitude-varying sound of the same duration. Because the time interval is fixed and specified, Leq is a measure of the total sound energy during the specified interval as well as the energy average during that time. So, for example, for the same period of time, an increase of 3 dB for Leq means that the total sound energy has doubled.

If the time interval is based on the interval of the event, it is a measure only of the average sound energy of the event. This is to say, that if the time interval increases,

the Leq does not increase because the average value during the event has not changed. For fixed intervals (1-hour, 24-hours, etc.) then, increasing the number of noise events, or their magnitude, increases Leq. For a 24-hour interval, special weightings for night time noises are often applied as described in the next paragraph. In this study only Leq values based on fixed time intervals were used.

The United States Environmental Protection Agency (USEPA), in conjunction with the United States Department of Transportation and the Federal Aviation Administration, (FAA) developed the Day-Night Sound Level (DNL) as a single number measure of community noise exposure over a 24-hour period. DNL is a method for predicting the effects on an average population of the long-term exposure to environmental noises. It is an enhancement of the Leq that uses a 10 dB adjustment applied to nighttime (10 p.m. to 7 a.m.) noises. The 10 dB nighttime noise penalty is intended to account for increased sensitivity to noise during the night hours. DNL uses the same energy equivalent idea as Leq with the interval specified as 24-hours, and 10 dBA added to nighttime noises.

For assessing long-term noise exposure with DNL, an annual average day is the usual measure. This is calculated from total annual noise activities divided by 365 days. For example, if total annual aircraft operations happened to be 365,000 then the annual average day operations would be 365,000/365, or 1,000 operations per day.

Note that any increase in annual noise activities produces an increase in DNL. For example, if operations double, then DNL would increase by 3 dB because of the doubling of noise energy associated with a doubling of activity. However, this is only true if the fleet mix and relative numbers of day-night operations remain unchanged. Also note that when adding two values of DNL (as with other decibel quantities) the total decibel value is obtained by adding the linear energy values first and then calculating the resulting decibel value.

Noise criteria and noise descriptors have resulted from studies on human perception of noise. This is a complex subject that has been the subject of scientific research over the last 50 years. These researches were compiled and evaluated in 1973 and 1974 by the USEPA in two reports that stated the consensus of scientific opinion on the subject of acoustic noise. These reports were:

1. *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with An Adequate Margin of Safety,* USEPA Report N. 550/9-74-004, (often called *"Levels Document"*), March, 1974.

2. *Public Health and Welfare Criteria for Noise*, USEPA Report (unnumbered) July 27, 1974.

In Part 150, the FAA has established a DNL value of 65 dB as its criterion level. The Federal agency considers all uses below this level to be *noise compatible.* The FAA also defines noise compatible land uses as those areas where noise effects such as speech interference, sleep disturbance, annoyance and hearing damage are generally acceptable either by actual use or by special noise insulation in building constructions.

The DNL 65 dB criterion for receivers includes a consideration of outdoor activities with residential use and the need for communication and sleep. In commercial and manufacturing areas, where there are generally no outdoor noise-sensitive activities, the criterion level increases to DNL 70 and 75 dB.

Human Response To Noise

The known general health and welfare effects of noise on people include hearing damage, sleep disturbance, speech interference and annoyance. These effects are all part of the establishment of the regulatory criteria discussed. This section discusses each of these to provide a clearer understanding of the effects of noise on people.

Hearing damage and annoyance effects are both cumulative and are correlated to the cumulative noise descriptors of Equivalent Sound Level (Leq) and Day-Night Sound Level (DNL), respectively. Sleep disturbance and speech interference occur at particular levels of noise and are correlated to maximum A-weighted sound level and duration. That is, they occur at particular levels and continue depending on duration of the noise. Of course, persons who have been awakened may, or may not, be able to return to sleep after awakening, regardless of noise conditions. But, it is assumed that they cannot return to sleep if the disturbing noise continues. Thus, duration is an element of sleep disturbance. Criteria for these are discussed herein.

Speech Interference

Data on distance between a speaker and listener for specified, speech interference, voice levels and ambient noise levels are also available. Communication -- in *normal voice*--is adequate up to 1.2 meters at 60 dBA. Voice communication is still possible over this distance with a louder, *communicating voice,* at 70 dBA. These values would apply directly to outdoor situations.

For indoor situations, these values would be 10-15 dBA higher (70-85 dBA) with windows open, and higher with windows closed, because of the noise reduction provided by building structures. The amount of actual speech interference for a particular noise also depends, obviously on the amount of time the interfering noise exceeds these levels.

Sleep Disturbance

Sleep disturbance generally increases with increased noise levels. A threshold value can be established below which little or no sleep disturbance is expected to occur. Research data (USEPA, 1974a; 1974b) indicates that this threshold is an indoor maximum noise level of 55 dBA as a practical limit level. Below this value, noises within buildings exceed those created by outdoor activity. An indoor maximum noise level of 55 dBA would be created with windows open, in the summer, for an outdoor maximum noise level of 65-70 dBA.

Research studies (USEPA, 1974a, 1974b) have shown that about 5 percent of the population would be expected to be awakened when the indoor noise level reaches 65 dBA, which is 75-80 dBA outdoors with windows open (about 50 percent of the time for analysis purposes.) For this example, this would mean with windows open there is a probability of 2.5 percent (smaller with windows closed) of being awakened by outdoor maximum noise levels of 75-80 dBA.

Annoyance

Community annoyance with noise is the most easily measured of the various noise effects. It has been measured by door-to-door surveys and by the direct actions people have taken in response to noise, including legal actions and organized complaints.

Syntheses of studies of community reactions to noise show that Day-Night Sound Level (DNL) criterion values of 60-65 dB outdoors accounts for 85-90 percent of persons highly annoyed by aircraft noise (there are few persons highly annoyed below these values). In addition, the Day-Night Level method is the most highly correlated with community annoyance to aircraft noise, all other methods being less reliable.

Table 2.6 shows the approximate relationship between the difference in background ambient noise and aircraft noise levels and the perceived loudness of the aircraft noise.

Table 2.6
Subjective Responses to Various Differences Between Ambient and Predicted Aircraft Noise Levels

Amount the Aircraft Noise Level Exceeds Background Ambient Noise Level (dB)	Approximate Subjective Loudness of the Aircraft Noise
5	Noticeable
10	Loud
20	Very Loud
20+	Extremely Loud

Source: *Concepts in Architectural Acoustics,* Egan, 1972 and the Parry Company.

If the background ambient noise level is exceeded, and if the maximum aircraft noise level exceeds 70 dBA, various effects on human activities can be anticipated. Primarily, these effects consist of interference with speech communication and possible disturbance with sleep. Also, most people report that noise levels exceeding 70 dBA are variously annoying in addition to the two previously mentioned specific effects. Thus, in considering variable noises, both the actual maximum intensity and the amount by which the existing background ambient level are exceeded must be considered.

Hearing Damage

The U.S. government has established a limit level of Leq 90 dB for an 8-hour day. The limit increases by 5 dB for each halving of exposure time. For example, the limit for 95 dB exposure is 4 hours.

Audibility

Audibility is the ability to hear acoustic noises. A 3 dBA increase in sound level can be used as an *"audibility"* criterion. This means that if a noise introduces an increase of 3 dBA in the existing noise level, the introduced noise will probably be heard. As a general rule, this will occur when the noise becomes equal to, or higher than, the ambient (existing) level. In other words, a relatively small increase in noise levels can be heard before it becomes an impact due to activity interference.

People are exposed to acoustical noises of many kinds in normal daily living. Table 2.7 is a simplified summary of some of these noises, their noise levels and an approximate subjective impression these levels might have upon people.

Table 2.7
Level and Perception of Common Noises

Example	Decibels (dBA)	Subjective Evaluation
Rock and Roll Band	120	Deafening
Motorcycle (10 ft)	110	Deafening
Auto Horn (10 ft)	100	Very Loud
Noisy Urban Street	90	Very Loud
Noise Factory	85	Very Loud
School Cafeteria	80	Loud
Computer Print Room	70	Loud
Nearby Freeway	60	Moderate
Average Large Office	50	Moderate
Soft Radio Music	40	Faint
Stereo In Residence	30	Faint
Average Whispering	20	Very Faint
Threshold of Hearing	0	Not Audible

Source: *Concepts in Architectural Acoustics*, M. David Egan, McGraw-Hill, 1972.

Where no dominant source of noise is present, the ambient or background noise increases and decreases with general human activity. The primary source of this type of noise is vehicular traffic (eq., automobile, train, truck and bus). Its intensity depends on the population density; where there are more people there are more vehicles, which results in higher ambient noise levels. The National Research Council quantified this relationship in 1977 and is summarized in Table 2.8.

Table 2.8
Typical Value of Yearly Day-Night Sound Level (DNL)
(for various residential neighborhoods where there is no well-defined source of noise other than transportation noise)

Population Description	People Per Square Mile	DNL(dB)	Percent People Highly Annoyed
Rural (Undeveloped)	20	35	0
Rural (Partially Developed)	60	40	0
Quiet Suburban	200	45	0
Normal Suburban	600	50	1
Urban	2,000	55	4
Noisy Urban	6,000	60	8
Very Noisy Urban	20,000	65	15

Source: *Guidelines for Preparing Environmental Impact Statements on Noise*, National Academy of Sciences, 1977.

It should be noted that the ambient background DNL increases with population density (more people per square mile). This progressive increase is attributed to the ubiquitous automobile. Also, the percentage of persons highly annoyed becomes measurable at DNL levels above 50 dB.

The percent of a population highly annoyed by noise in an urban setting continues to escalate with increasing DNL values, such as occur in areas with specific kinds of noise sources. Table 2.9 shows those values.

Noise Evaluation Criteria Summary

There are many criteria for evaluating the effects of noise because there are many effects. These criteria have evolved over the last 50 years during intense research into sound and noise. Also, there is a wide variation in the effects of noise on individual people so that adopted criteria are based on statistical relationships. Since research continues on this subject, new or revised criteria or evaluation methods may be developed in the future. However, the Day-Night Sound Level criterion of 65 dB

is generally accepted based on evaluations and general agreements of health and planning agencies.

Table 2.9
Effect of Noise on People in an Urban Residential Environment

Day-Night Sound Level In Decibels	Hearing Loss Qualitative Description	Percent Of Population Highly Annoyed	Average Community Reaction	General Community Attitude Towards Area
75 and above	May Begin To Occur	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	22%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	12%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	7%	Moderate to Light	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	3%	Moderate to Light	Noise considered no more important than various other environmental factors

Source: Federal Interagency Committee on Urban Noise, 1980; Federal Interagency Committee on Noise August, 1992 (Update)

2.1.8.c Baseline Noise Conditions at U Taphao Global Transpark

Initial baseline noise measurements were made at the U Taphao Airport and vicinity during the field inventory phase of the project in January 1997. The noise measurements had an average level of 56.1 dB. The measurement locations included noise-sensitive receptors such as residences, churches, schools and parks located in and around the airport. Exhibit 2.4 identifies potential noise sensitive receptors and nine noise measurement sites in the vicinity of the GTP. Levels ranged from DNL 48 to 65 dB. Most of the values were in the 52-58 dB range. Noise monitors used for all measurements during the study were American Standards Institute Type I with calibrators traceable to U.S. Bureau of Standards. Table 2.10. shows ambient noise levels at selected measurement locations.

Table 2.10
Ambient Measured Noise Levels at Selected Locations

Noise Station	Leq Max	DNL
1	64.7	53.1
2	71.5	59.9
3	72.4	57.7
4	72.4	52.4
5	72.3	52.5
6	77.1	65.0
7	74.5	60.3
8	68.8	55.6
9	63.7	48.0

2.2 Ecological Resources

2.2.1 Terrestrial Ecology

Much of southeastern Thailand was once covered by dry evergreen forest (Rundel and Boonpragob, 1995). Although once common in Rayong Province, all original evergreen forests in the immediate vicinity of U Taphao appear to have been cut within the last century. This habitat type is no longer present within or near the project area, although it does occur in National Parks elsewhere in Rayong and Chon Buri Provinces. Coastal areas probably supported a variety of more open plant communities.

The nearest large protected lands are Ko Samet National Park, an offshore island and marine sanctuary located approximately 30 kilometers east of U Taphao; Khao Chamao National Park, 80 km northeast of U Taphao; and Khao Khieo Wildlife Sanctuary, 50 km to the north. A relatively small area of scrub habitat on Khao Krok Tabaek, a hill located 750 meters northeast of the U Taphao airport, has been designated as a forest conservation area. This site has only a few large trees remaining, and appears to have suffered from disturbance within the last several decades.

Methods

The following account emphasizes habitat assessment. Major habitat types were identified from the literature and then adapted to site specific conditions. Habitat types were classified in a manner which allows compatibility with hierarchical vegetation classifications such as Federal Geographic Data Committee (1996) or UNESCO (1973).

Studies of vegetation have been published for three nearby areas in Chon Buri Province (Maxwell, 1974; 1980; 1994). Lists of animal species have been published for two locations in Chon Buri Province, Khao Khieo Game Sanctuary (Storer, 1979) and the Bang Phra region (Pantuwana et al., 1969). These study sites include areas of habitat similar to U Taphao, and many of the same species are likely present.

The U Taphao site was first visited on 24 January, and again from 28 January through 31 January, 1997, to characterize the habitat types present within and near the site. Animals observed in each habitat during the five-day site visit were noted, although any list from such a short visit must be considered incomplete.

Aerial photography and topographic maps were used to create an overlay of habitat types. The overlay was then digitized into an Arc Info Geographic Information System (GIS), and the resulting GIS coverage was combined with existing maps of pavement and facilities at U Taphao (Exhibit 2.5). Habitat types were verified during the site visit, and photographs taken during a 24 January helicopter overflight of the site were used for reference during the mapping process.

Habitat types are described below, along with characteristic plant and animal species. More detailed information is then provided on animals observed during the site visit. Most of the plants identified are from the literature unless stated otherwise, while most of the animals listed are based on actual on-site observations.

2.2.1.a Plant Communities

Maxwell (1974) characterized the vegetation of the Sattahip area just west of and contiguous with the U Taphao project site. He identified seven natural floristic zones and an additional three disturbed or secondary growth zones. These zones are based on vegetation structure as well as species composition and are reasonably consistent with more recent national classifications, therefore they also may be used to describe

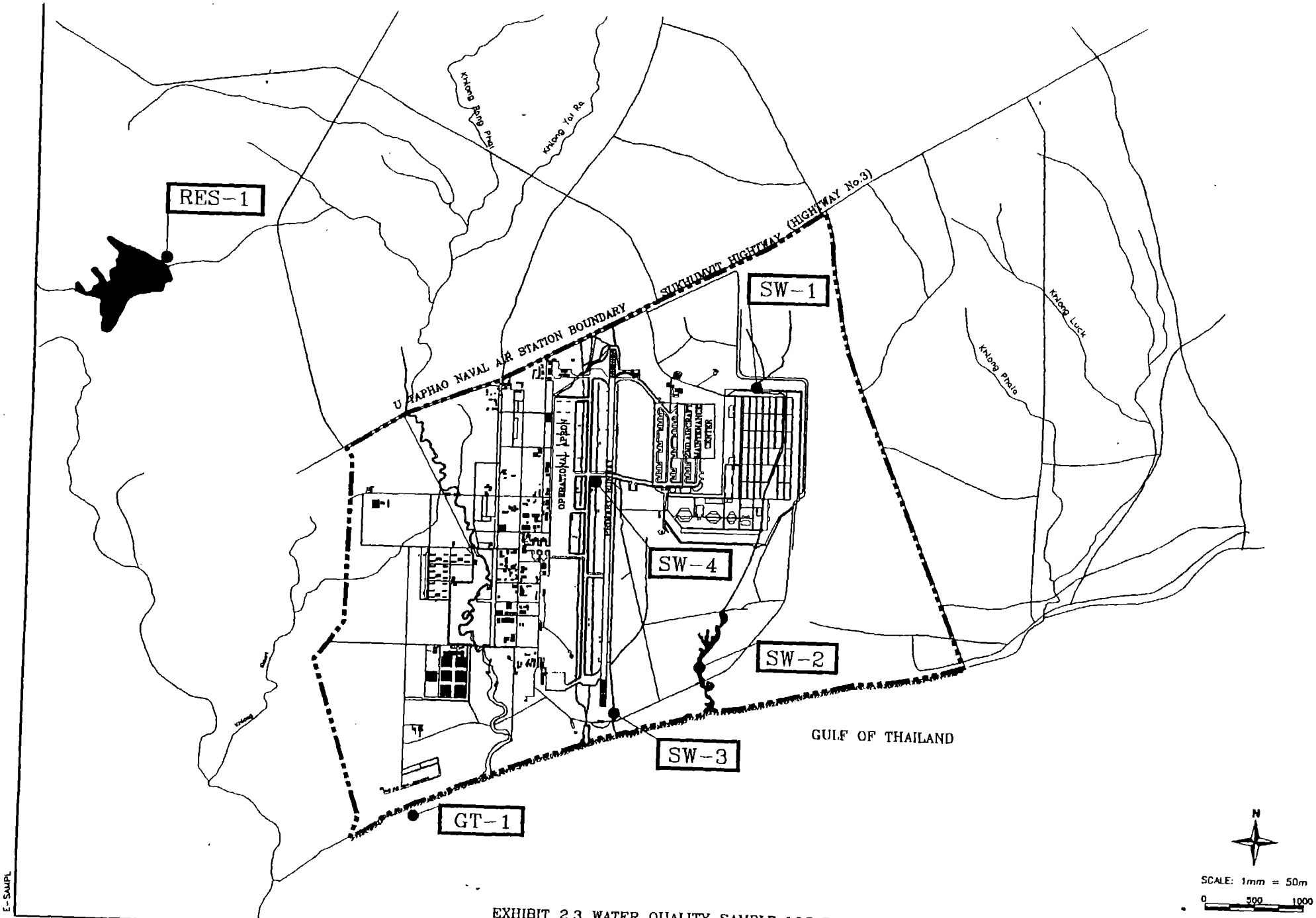

EXHIBIT 2.3 WATER QUALITY SAMPLE LOCATIONS

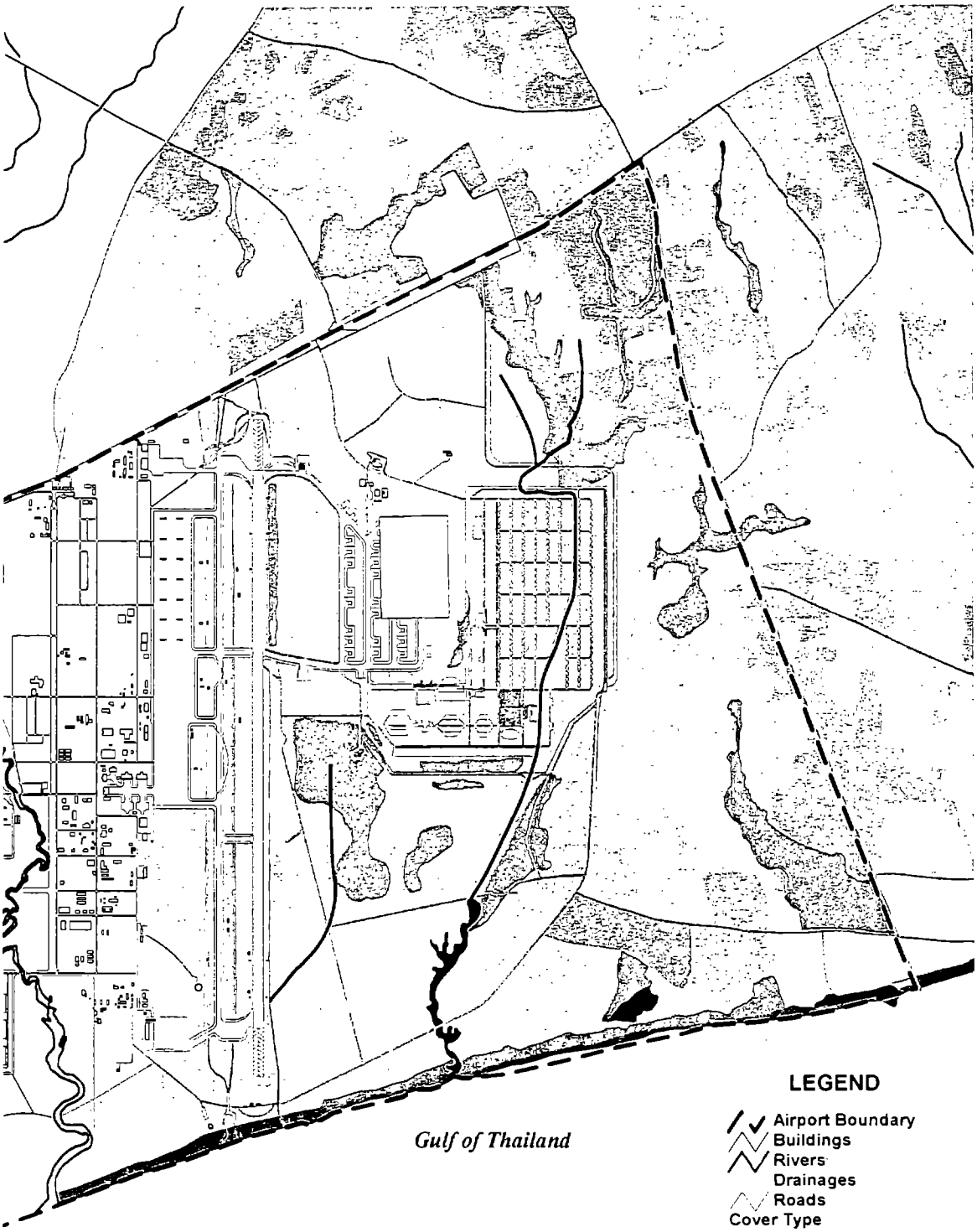

EXHIBIT 2.5 HABITAT MAP

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wildlife habitat. Some, but not all, of the habitat types identified by Maxwell (1974) are present at U Taphao. As a result, the following description of habitat types has been modified somewhat to more accurately describe conditions unique to U Taphao. Lists of characteristic plants are mostly from Maxwell (1974), supplemented by field observations during the brief site visit. Other references consulted include Maxwell (1980, 1994).

Closed Tree Canopy Habitats

Mangrove Swamp (tidally flooded Tropical Broad-Leaved Evergreen Sclerophyllus Closed Tree Canopy): This category includes mangrove swamps and related tidally influenced communities. Maxwell (1974) noted that mangrove swamps are not common in the Sattahip area because most of the shoreline in the region is sand rather than silt, but some larger examples of this habitat type occur near Rayong. In addition to mangrove, characteristic species include *Brugguiera cylindrica*, *Ceriops tagal* and *Avicennia spaerocarpa*. Only one very small area of this habitat type was noted during the field visit. Along the lowermost reaches of a stream and between the beach perimeter road and the Gulf of Thailand, a narrow fringe of trees and shrubs is present along a small estuary. A few mangroves are present on a quiet backwater, and cover a linear area less than 20-meters-long. Several birds were observed in this habitat during the site visit, including the Lesser Coucal.

Open-Tree Canopy (25-60 Percent) Habitats

Coconut and mango orchard (tropical broad-leaved evergreen open tree canopy, planted/cultivated): These cultivated areas are planted with relatively orderly rows of trees, either with lower growing crops in open spaces or with a grass or low shrub understory. Coconut plantations are present in the northeastern and southeastern portions of the U Taphao site, and mango plantation is present in the southeastern part. Both habitat types are common north and east of the project area. Although these plantations are maintained to some degree, they provide habitat for at least the more tolerant species of wildlife. A few birds, including the Green Bee-eater, were observed in coconut plantations during the site visit.

Shrubland (scrub) habitats

Scrub (tropical broad-leaved evergreen shrubland, with or without scattered tree canopy): These are areas of secondary growth where the original vegetation has been destroyed, and replaced by shrub and sapling cover. Characteristic species include: *Harrisonia perforata*, *Grewia paniculata*, *Lantana camara*, *Croton robustus*, *ambusia arundinacia* and *Eupatorium odoratum*. This habitat type is common at U Taphao, especially on the northern half of the site. Animals observed in this habitat type during the site visit included rats *(Rattus* sp.), Black-shouldered Kite, Scaly Munia, gecko *(Hemidactylus frenatus)* and Asiatic toad *Bufo melanostictus*.

Beach thicket (tropical broad-leaved evergreen shrubland): Referred to as the Barringtonia formation by Maxwell (1974), this community consists of woody shrubs and trees on the beach and shoreline. It is most common on rocky beaches, and thus is not widespread on the mostly sandy beaches of U Taphao. Typical species include: *Xylocarpus moluccensis*, *Guettardia speciosa*, *Pyrrosia adnascens, Pemphis acidula*, *Sophora tomentosa*, *Cocos nucifera*, *Thespesia populnea*, *Hibiscus tiliaceus* and *Opuntia elatior*.

Herbaceous Habitats

Wet Meadow (seasonally/temporarily Flooded Tropical Grassland): These low-lying and open communities are characterized by the presence of termite mounds. Relatively undisturbed examples are characterized by *Cyperus compactus*, *Cyperus pilosa*, *Rhyncospora corymbosa*, *Eleocharis dulcis*, *Jussiaea repens*, *Ottochloa nodosa*, and *Panicum repens*. Wet meadows at U Taphao, occurring relatively small in size, have been disturbed by past activities. They are usually associated with drainageways and thus hold shallow standing water only during the rainy season. Lower areas within the wet meadows support marsh species, including *Phragmites communis* and cattails, *Typha* sp. Relatively few animals were seen here during the site visit, in part because the dense, low vegetation provides excellent cover and makes observation difficult. Special sampling techniques are often necessary in wet meadow habitat. Birds observed included Large-tailed Nightjars and Barn Swallows.

Grassland (tropical grassland with a shrub layer, generally 10-25 percent): This community is open and dominated by grasses, with scattered shrubs and small trees. Woody species are similar to those described above for shrubland or scrub, but are kept at a low density by frequent burning. Two fires were observed during the four-day site visit. This habitat is widespread at U Taphao, especially on the southern half of the site. Animals observed included: Green Bee-eater, Black Drongo, Black-headed Bulbul, Barn Swallow, and the gecko, *Hemidactylus frenatus*.

Pes-caprae formation (low tropical forb vegetation): This habitat occurs on sand just behind the open beach along the Gulf of Thailand, and is characterized by low vegetation tolerant of salt spray. Species found here include: *Ipomoea pes-caprae*, *Canavalia maritima*, *Crotalaria medicaginea*, *Thuaria involuta* and *Spinifex littoreus*. Animals were relatively common, and included: Green Bee-eater, Barn Swallow, and the lizards *Platyurus platyurus* and *Calotes emma*.

Sparsely Vegetated Habitats

Open Beach (sparsely vegetated unconsolidated material): This is the open, nearly unvegetated area of sand within the range of tidal variation. The upper limit of the beach community at U Taphao is marked by a low wave-cut ridge approximately one meter in height. Several unidentified sandpipers were observed on the beach, but the lack of cover limits the vertebrate fauna.

Man-made Habitats

Upland crop: Small areas within the U Taphao boundary, and more extensive portions of surrounding lands, are utilized for agricultural purposes. During the site visit many areas were freshly plowed and were essentially bare soil.

Developed Land: This category includes various facilities within the U Taphao airbase, including runways, taxiways and other large paved surfaces, buildings and other structures. Ban Chang and smaller villages are also mapped as developed land. Several animals were observed in developed parts of the site, including Rock Pigeons, Common Mynas, and Asiatic toads, *Bufo melanostictus*. All are frequently found in association with human structures.

2.2.1.b Wildlife

Mammals

Except for feral dogs and cats, few mammals were observed during the U Taphao site visit. Several dead rats (*Rattus* sp.) were seen on roads just outside the site. The absence of extensive forest on the base, along with frequent disturbance from aircraft and vehicles, probably contribute to the near absence of observations. Site visits were also limited to daytime hours when the Royal Thai Navy was able to provide escort personnel, so no sampling was done during peak dawn and dusk periods when many species are active.

Birds

A limited number of bird observations were made during the five-day site visit. Additional visits during peak early morning activity periods and at various seasons would certainly add greatly to the list. Both resident and winter migrant species were observed during January 1997; all of the species seen are considered common. Lekagul and Round (1991) was used for field identification and for information on habitat and status. Brief summaries are provided below for each species observed during the site visit.

In general, bird activity was at moderate to low levels. Frequent human disturbance, including aircraft activity, ground vehicle use, and two fires in five days, may have contributed to the relatively low number of observations. Also, most of the site consists of relatively degraded habitat.

Chinese Pond Heron *Ardeola bacchus*. Several individuals of this species were observed foraging in Khlong Bang Phai, on the western part of the site.

Black-shouldered Kite *Elanus caeruleus*. One individual was observed soaring over scrub habitat not far from the terminal area.

Rock Pigeon *Columba livia*. This species was common near the civilian terminal and airport authority office. It was observed only in developed areas.

Lesser Coucal *Centropus bengalensis*. One individual was observed in shrubs between mangroves and open coastal habitats. It is a common resident.

Large-tailed Nightjar *Caprimulgus macrurus*. Another common resident species; a pair was flushed from wet meadow habitat east of the existing runway and south of the old B-52 revetments.

Green Bee-eater *Merops orientalis*. This was perhaps the most frequently observed bird during the site visit. Most open habitats were utilized, including beach, wet meadow grassland and scrub. Most sightings were of birds in flight or perched on wires. Lekagul and Round (1991) describe this species as a very common resident and inhabitant of dry open country at low elevations.

Barn Swallow *Hirundo rustica*. A very common winter visitor (Lekagul and Round, 1991), this species was frequently observed foraging over beach, wet meadow and scrub habitats during the site visit.

Black-headed Bulbul *Pycnonotus atriceps*. A small flock of this common resident species was observed along the upper reaches of the concrete-lined drainage ditch during collection of water quality samples. Perhaps a dozen birds, alighted for a few moments on a young tree within scrub habitat.

Black Drongo *Dicrurus macrocercus*. This species, described as a very common winter migrant (Lekagul and Round, 1991), was observed perching on wires over wet meadow habitat on the eastern margin of the site.

Common Myna *Acridotheres tristis*. Numerous individuals were present on mowed lawns and in trees near the civilian terminal and the Airport Authority office. It is a common resident, and was observed in developed areas throughout the region during the site visit.

Scaly-breasted Munia *Lonchura punctulata*. This very common resident was observed in scrub habitat along the upper part of the concrete-lined drainage channel.

In addition to the species listed above, small groups of shorebirds were observed once on the runway apron and once on the beach. These could not be approached closely enough to allow identification.

Reptiles and Amphibians

Reptile and amphian observations were limited because site visits were conducted only during normal daytime business hours. Many reptiles and especially amphibians are nocturnal, and are unlikely to be observed during the hot part of the day without special sampling techniques.

References used for identification include Taylor (1962; 1963; 1965; 1970; and Taylor and Ethel, 1958).

Remnants of the carapace of an unidentified turtle were found washed up on the shoreline of the Phlu Ta Luang reservoir.

The house gecko, *Hemidactylus frenatus*, was seen under rocks near the B-52 revetments. The species is abundant around human structures in the general project vicinity and is frequently observed at night.

The gecko, or chinchuk, *Platyurus platyurus* was common at U Taphao. Specimens were observed or captured under debris in the pes-caprae formation near the beach, in developed areas near the Airport Authority office, and on the walls and ceilings of structures near the B-52 revetments and at the Phlu Ta Luang reservoir.

The black-banded garden lizard, *Calotes emma*, is common at U Taphao. Individuals were observed in low vegetation immediately behind the beach, on trees and rock outcrops near the reservoir.

The Asiatic toad, *Bufo melanostictus*, is a common species found even inside Bangkok (Graham and Round, 1994). At U Taphao, adults were found near the civilian terminal, and tadpoles were observed in streams flowing through scrub in the northeastern part of the site.

The chorus frog, *Microhyla butleri*, was common along marshy shoreline at the Phlu Ta Luang reservoir northwest of U Taphao. Most individuals were found by sifting through leaf litter accumulated along the shoreline. Where sufficient cover was available, as many as six frogs were present per meter of shoreline.

In addition to the species reported above, Royal Thai Navy personnel report occasional observations of cobras (*Naja*), banded kraits (*Bungarus*) and monitor lizards (*Varanus* sp.).

2.2.2 Aquatic Ecology

This section is concerned primarily with the ecology of the Gulf of Thailand and associated estuarine areas in tidally influenced stream mouths.

Coral Reefs

No coral reefs are known to occur immediately offshore of the project area, and none were observed during a helicopter overflight of the area. The nearest known coral reefs are around offshore islands near Sattahip, southwest of U Taphao. These are reportedly in "reasonable condition" (Sema Group Belgium - Team Consulting Engineers, 1997). There are few reefs to the east along the shoreline of Rayong Province, with the reefs around Koh Samet National Park reported to be in very poor condition. Reef degradation has been attributed to pollutants, mechanical damage, and plunder (Sema Group Belgium - Team Consulting Engineers, 1997).

Mangrove Swamps

A small area of mangrove swamp was noted along a quiet estuarine backwater south and east of the existing runway. Scattered mangrove saplings were also observed in other parts of this and one other drainageway. If undisturbed, these areas could over time regenerate to mangrove swamp. However, mangroves were observed only within 100 meters of the Gulf of Thailand.

Fish and Other Aquatic Organisms

Dominant fish species of the Laem Chabang area include members of the families Leiognathidae, Nemipteridae, Carangidae, Platycephalidae, Clupeidae, Bothidae, Cybiidae, Cynoglossidae, Lutjanidae, Pomadasyidae, Serranidae and Sillaginidae. No information is presently available on fish or other aquatic animals of the immediate U Taphao area. Snakehead fish (*Ophioglossus* sp.) were observed in estuarine portions of drainages not far from the Gulf of Thailand during the site visit. Fishing may be of local economic importance in some nearby coastal areas; Rayong Province is the most important marine fishing area on the eastern seaboard, with 52.24 percent of the total catch (Sema Group - Team Consulting Engineers, 1997).

2.3 Wetlands

2.3.1 Introduction

Wetlands include a variety of areas which are either flooded, or permanently or seasonally saturated with water. Wetlands are identified by characteristics of vegetation, soils and hydrology. Wetlands near the project site range from tidal areas adjacent to the Gulf of Thailand to relatively small and isolated basins, which hold standing water only for a short time after rainfall.

2.3.2 Functions and Values

Wetlands at the project site provide a variety of functions and values. Wetlands provide flood storage, retaining water after heavy rainfall and releasing it slowly into nearby streams or into the ground water. Wetlands also provide water quality renovation, by allowing fine sediment carried in the water to settle out, and by filtering pollutants through aquatic and emergent vegetation. Wetlands also provide wildlife habitat. They are inhabited by numerous types of mammals, birds, reptiles, amphibians, fish, and invertebrates, some of which are of local income importance. Under certain circumstances, wetlands may also provide recreational, educational, or aesthetic value.

2.3.3 Wetland Identification and Classification

Cowardin et al. (1979) developed a hierarchical wetland classification system for the U.S. Fish and Wildlife Service. This system was intended:

> "To describe ecological units that have certain homogenous natural attributes; to arrange these units in a system that will aid decisions about resource management; to furnish units for inventory and mapping; and to provide uniformity in concepts and terminology." (Cowardin et al., 1979)

This wetland classification system is frequently used for environmental impact assessments. The higher level wetland categories, which are briefly summarized below, are applicable to wetlands at the U Taphao Naval Air Station and vicinity:

- Palustrine wetlands include shallow ponds, marshes, swamps and sloughs.
- Lacustrine wetlands include lakes and ponds.
- Riverine wetlands include rivers, creeks and streams.
- Estuarine wetlands are tidally influenced, and include salt marshes and brackish water wetlands.
- Marine wetlands include open ocean and associated coastline.

Methods

Wetlands were mapped primarily from aerial photography, and then verified during the site visit. Because all field work was conducted during the dry season, most wetlands did not hold water at the time of inspection. Vegetation and hydrology indicators were instead relied upon to determine the extent of wetland areas. Wetlands are shown in Exhibit 2.6.

Wet Meadow (palustrine wetlands): These wetlands are generally associated with shallow depressions, often along drainageways. They are characterized by the presence of conspicuous termite mounds and emergent vegetation including *Cyperus* sp., cattails, *Typha* sp., and common reed, *Phragmites communis*. They are distinct and easily mapped from aerial photos, because even during the dry season enough soil moisture is available for vegetation to remain relatively lush and green, while surrounding uplands are dry and brown.

Maxwell (1980) described similar wet meadows at Khao Khieo as follows:

> "Neither fully aquatic nor marshy... the habitat is quite dry and barren from December to June... from July to November these areas are wet, and especially during September and October, the unique association of herbs is fully developed and flowering reaches its peak."

Palustrine wetlands retain stormwater runoff, thus contributing to flood control and water quality renovation. They also provide wildlife habitat and likely serve as a breeding area for some species.

Streams (riverine wetlands): The major drainage-way through the eastern portion of the U Taphao site is a straight-sided, concrete-lined trapezoidal ditch. This structure was presumably built during the 1960s. Shallow substrate has accumulated in the bottom of the ditch, and low vegetation has become established in some locations. At the time of the site visit several centimeters of water was present for the entire length of the stream,

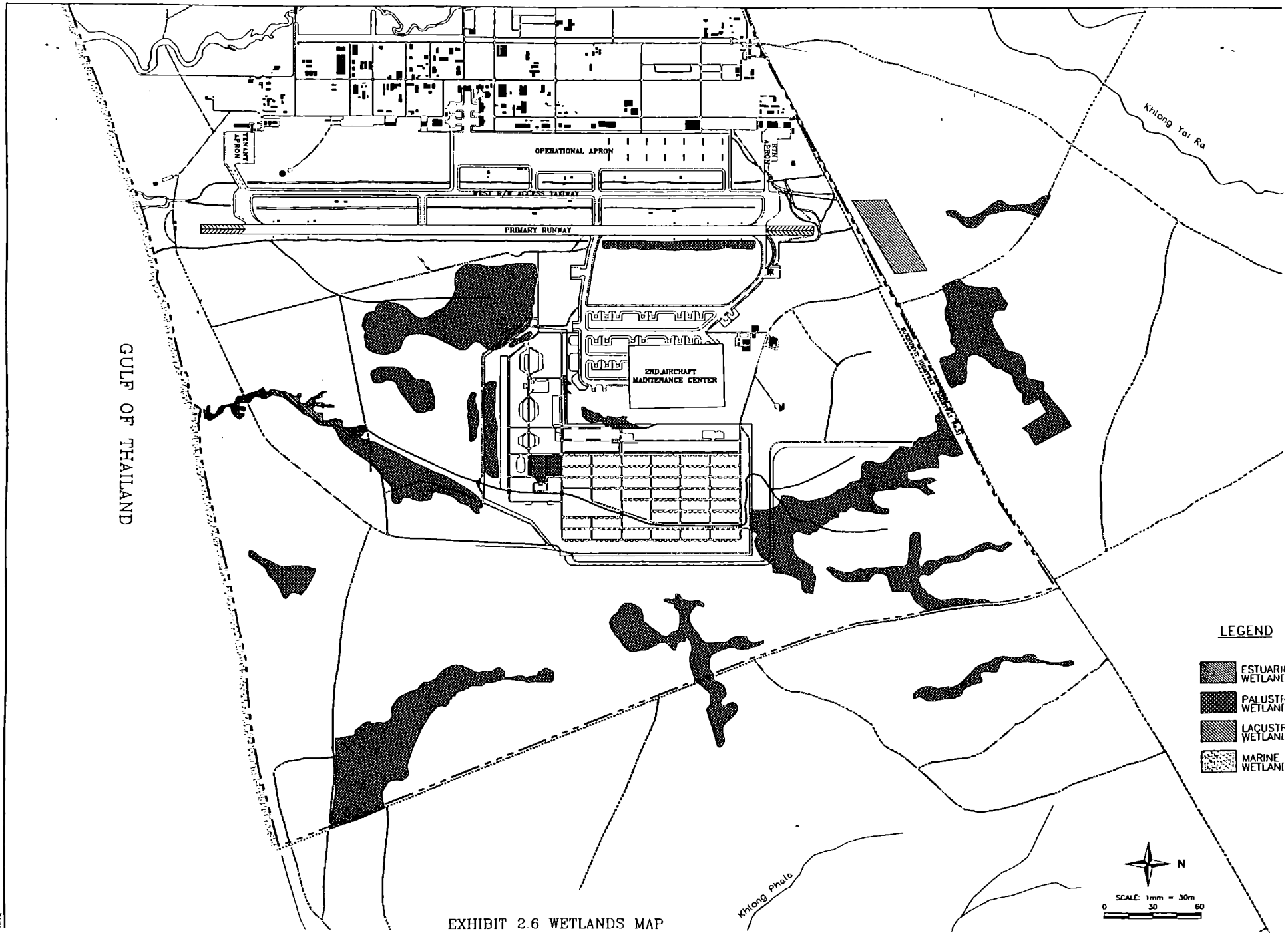

EXHIBIT 2.6 WETLANDS MAP

with slow flow evident. This stream provides limited wildlife habitat for common and tolerant species. Toad tadpoles and small cyprinid fish were noted in upper reaches of the stream. Birds were abundant in bordering trees and shrubs, presumably because of the year round availability of water. The stream also serves as an important conduit for stormwater runoff, helping to prevent flooding on the base.

Tidal Channels (estuarine wetlands): The lowermost reaches of riverine wetlands widen into tidally influenced estuarine wetlands just before entering the Gulf of Thailand. These areas are much wider and deeper than nearby upstream areas, are typically bordered by trees or shrubs, and include areas of submerged aquatic vegetation. They provide important habitat for fish, and for some semiaquatic and terrestrial animals.

Reservoir (lacustrine wetlands). The Phlu Ta Luang reservoir northwest of U Taphao occupies an impounded stream valley, and is relatively large and deep. This reservoir is a water source for the Royal Thai Navy. It also provides habitat for fish and some aquatic and semiaquatic animals, and is bordered by recreational facilities.

2.4 Human and Economic Development

2.4.1 Land Use

Land use for Rayong and Chon Buri Provinces is presented in Table 2.11. In the immediate project vicinity, major land uses in addition to U Taphao Naval Air Station include: residential housing; light commercial and retail; agricultural uses including coconut and mango plantations; and field crops; and idle land, generally overgrown with a mix of grassland and scrub. A map of existing regional land use is shown in Exhibit 2.7; projected furture land use is shown in Exhibit 2.8.

Table 2.11
Land Use (percent) in Rayong and Chon Buri Provinces.
From Sema Group - Team Consulting Engineers (1997)

	Rayong Province	Chon Buri Province
Housing	2.48%	3.11%
Paddy land	6.48	15.06
Field crops	34.96	52.99
Fruits and trees	53.98	23.73
Vegetables and flowers	0.12	1.94
Grassland	0.00	0.16
Idle land	0.92	1.20
Other	1.05	1.80

Nearby communities include Ban Chang, to the east on Route 3; Sattahip, to the west; and a number of smaller villages in the surrounding countryside.

The population of Rayong Province, as of 1994, was 467,359. An additional 962,402 people resided in Chon Buri Province.

The following discussion was summarized from Sema Group - Team Consulting Engineers (1997). By 1996, the total population of Thailand reached 61 million, of which 22 million live in the urban areas. The National Economic and Social Development Board estimates that the urban population will reach 31 million, compared

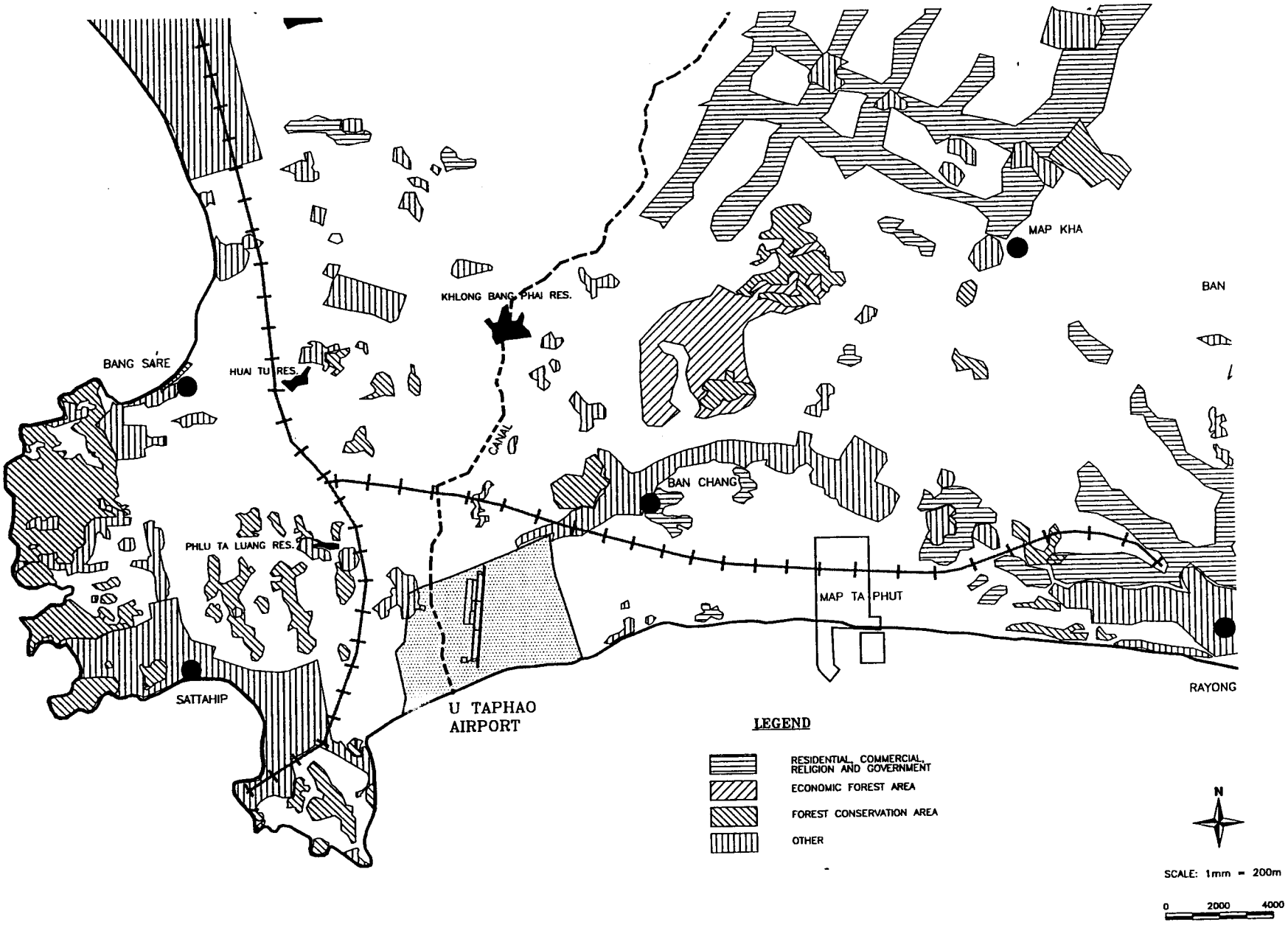

EXHIBIT 2.7 EXISTING LAND USE

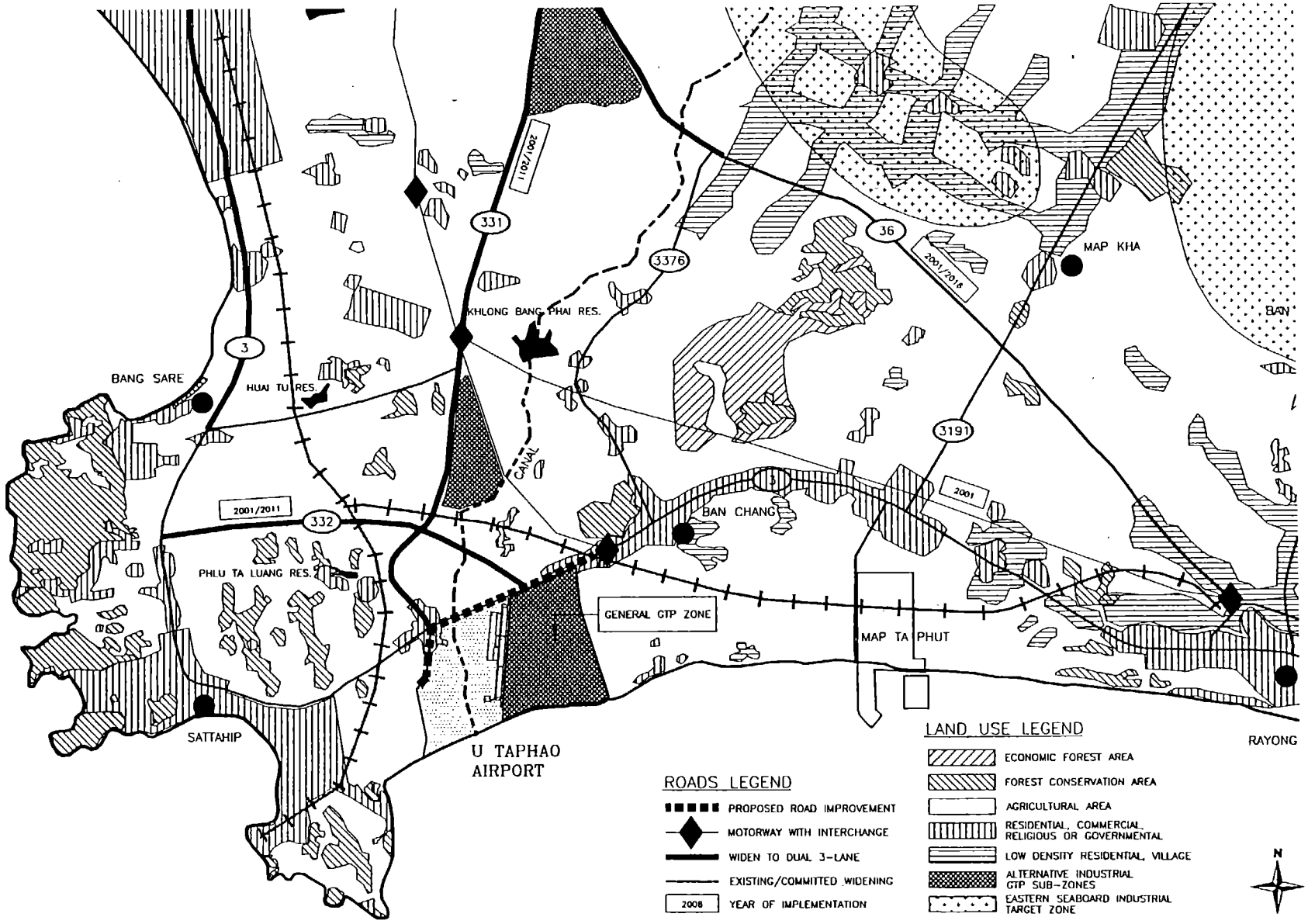

EXHIBIT 2.8 FUTURE LAND USE

-LNDUSE

with a total population of 67 million in 2005. With rapid urban growth, housing will also expand. The investment in the construction industry was 164,869 Baht in 1989. In 1995, this investment rose to 219,613 million Baht.

Housing projects slowed down between 1983 and 1986, but by 1985, competitors in housing businesses increased. A number of private developers began to construct low-cost housing. In 1996, slower growth was projected due to an oversupply of housing, strict monetary policy, and rising interest rates. Presently, resale houses play an important role in the housing industry due to high levels of speculation. Developers compete intensely in search of innovative strategies to boost sales. The typical housing project size has decreased. Pre-fabricated materials will play a more important role in order to economize on time, labor requirements and cost.

Between 1979 and 1982, the National Economic and Social Development Board, together with concerned Ministries, developed an accelerated plan to provide housing for low-income groups. Improvement of sites and services and slum upgrading programs were also introduced under this plan. Both plans were created to develop affordable shelters for low-income urban households. The National Housing Authority's third five-year plan for 1984-86 emphasized self-financing projects. The objectives of the plan were to help improve the housing, environment and infrastructure of middle to low-income communities throughout Thailand.

Between 1992 and 1996, the National Housing Authority (NHA) of Thailand constructed a total of 21,512 housing units, of which 16,134 were rental units and 5,378 units for purchase were hire purchasing units. The number of units constructed is equal to 87 percent of the target for construction during the 7th Plan (1992-96), which is 24,725 units. Between 1992-96, the NHA was allocated 2,735.53 million Baht from the Government.

Up to April 1996, the NHA covered 74,919 housing units in slum areas from the total target of 80,000 units during the 7th Plan period. Actions undertaken include 31,453 resettlement units, and improvement of 43,466 units in the existing locations. The NHA area offices have issued a total loan value of 300.46 million Baht, of which 233.14 million Baht, or 78 percent, are loans for home construction and improvement. The NHA is also investing 1,489 million Baht towards the improvement of the Prachaniwet Community, an area of 15 rai, which will involve improvement of 832 units.

The policy framework of the Eighth National Economic and Social Development Plan (1997-2001) has the following targets and strategies for the housing sector:

- Improve the living environment of low-income communities to ensure improvement of the standard of living and quality of life;
- Review the feasibility of using various plots of presently initialized land for development of housing facilities for urban poor. Identify plots of land in the suburban areas as resettlement sites for slum communities with provisions of adequate public transport services to convenient access to town centers;
- Introduce measures that will increase the potential for low-income groups to have their own accommodations; and
- Establish financial institutions to provide low interest loans for the benefit of low-income groups in urban and rural areas, reducing the financial burdens of the low-income groups by limiting the rate on personal income tax for interest on housing loans, as well as reduce the purchase tax.

In preparation for the 8th Plan, the NHA has commissioned a study on housing demand. Based on the results of this study, the total demand for housing in the BMR is projected to range between 650,000-700,000 units. Given the difference in Regional classification, some ESB II provinces are classified under the Central Region; the estimated increase

in demand for the Eastern Region during the same period is expected to range within 221,000-239,000 units.

It is not clear to what extent, the anticipated accelerated industrial development of the ESB II provinces has been taken into consideration in these projections. Nevertheless, if the projection figures cited previously are used as guidelines for budget allocation during the 8th Plan, some additional supply can at least be expected.

More specific to the needs of the ESB, several planned projects are likely to contribute to the increase in supply of low-cost housing. These include at least four projects in the Map Ta Phut - Rayong area.

2.4.2 Industries

Heavy industries such as chemicals, petroleum, paper, plastics, steel, and some types of manufacturing are concentrated near the port facilities at Map Ta Phut.

2.4.3 Infrastructure

Water treatment plants are located in Ban Chang and Sattahip. A water line from the Ban Chang plant, 10 km from the Global Transpark, parallels Route 3, and will likely be used to supply early clear and raw water needs for the GTP. The nearest reservoir is Khlong Bang Phai, 4 km to the northwest, but it is used by the Royal Thai Navy and has little excess capacity. Other reservoirs are available in the general region should they be needed.

Sewage treatment facilities are present at U Taphao Naval Air Station. A new facility, capable of treating domestic wastewater, is planned to meet the demand of expanded civilian facilities. Any commercial effluent not compatible with this facility would require prior treatment, and then be discharged to the wastewater facility.

Flood control and drainage facilities consist of a series of ditches and channels flowing into the Gulf of Thailand. These are described in greater detail in Section 2.1.4 of this document.

2.4.4 Transportation

One of the attractions of the U Taphao area is the confluence of all major transportation types. The existing airport is used for civilian airline and charter flights as well as military operations.

Route 3 (Sukhumvit Road) is at the northern boundary of the site. It runs from east of Bangkok along the coast to Trat. Other good roads run into the interior, including Routes 331, 332 and 304. A new toll motorway, Route 36, is nearing completion from Bangkok to Chon Buri, and will eventually be extended to Ban Chang, very near the Global Transpark. It is expected that existing roads and currently planned improvements will be able to handle all GTP related traffic.

The Map Ta Phut port facility is located approximately 26 km to the east, and additional port facilities are available at Sattahip although most of the capacity there is needed for Royal Thai Navy operations.

A recently constructed rail line is present just to the north, and runs between Map Ta Phut and Bangkok. It would be possible to extend a spur from this line to the Global Transpark, although this will not be immediately necessary.

2.4.5 Land Use Planning

A regional plan, the Eastern Seaboard Development Programme - Phase II (ESB II), has recently been completed (Sema Group - Team Consulting Engineers, 1997). This plan covers 11 provinces and is quite detailed to the provincial level. No site specific land use plan has been completed in this early stage of GTP design.

2.4.6 Power Sources and Transmission Lines

At present no electrical lines or other power sources exist east of the runway. A substation owned by the Electrical Generating Authority of Thailand is present on Royal Thai Navy property to the west at Sattahip. Another substation is located in Ban Chang.

2.4.7 Agricultural Development

Major crops of the eastern seaboard include rice, maize, cassava, sugar cane and sorghum. Increasing areas of land have been devoted to fruit and perennial trees, with major products including durian, mangosteen, rambutan and pineapple. Small-scale agriculture is common around the proposed GTP and a few areas of mango trees and field crops are present within the area of planned development.

2.4.8 Mineral Resources

There is conspicuous evidence of mining in the immediate vicinity (mostly northwest and west) of U Taphao. Large quantities of rock have been removed from hillsides, presumably for fill or construction material. Some of this activity was ongoing as of early 1997.

2.4.9 Waste Generation and Waste Handling at U Taphao Airport

In January 1997 TAMS Consultants, Inc. met with Royal Thai Navy and advisory personnel to discuss the former and current waste handling and disposal practices at the U Taphao Airport complex to gain a better understanding of the overall environmental conditions on the proposed Transpark development area. The information contained in this section is primarily based on these discussions. Supporting information was also obtained during the on-site field survey of the facilities, and during the collection of environmental samples.

While it is not the purpose of this study to investigate in detail the current operations at the existing commercial and military facilities it is important to understand their potential impact on the proposed Transpark development property, particularly with regard to waste disposal. Wastes currently disposed by the airport include solid wastes, medical wastes, hazardous wastes and ordnance disposal wastes.

2.4.10 Solid Wastes

The current solid waste handling and disposal practices at the existing U Taphao Airport facility are similar to those of many remote dual-use airport facilities. The specific waste streams, and the handling and disposal practices associated with them, are presented below. Where military and commercial handling and disposal practices differ significantly, they are discussed independently.

Currently, scrap metal objects, non-ordnance in nature, are segregated for pickup by waste haulers who bring them to reclamation facilities. Metal is removed from demolition debris and is similarly reclaimed. Some of the items resulting from demolition activities are reclaimed for reuse, such as doors, windows, corrugated metal and other reusable items. Paper waste, kitchen wastes and similar materials such as wood

products generated as a result of military operations are primarily disposed of in remote burn areas on site on the property proposed for the Transpark. It appears that this material is first landfilled and then burned. Small burned areas were observed on site, however it is not known how many of these areas were specifically for the burning of these wastes or were the result of brush fires. Material generated on the military side of the airport, which is not burnable and needs to be landfilled, is minimal in quantity and is usually carted off-site to nearby solid waste landfills. The local landfills are privately owned and the operators of the commercial side of the U Taphao Airport contract with either the landfill or the waste hauler for the disposal of their materials.

Depending on the nature of the specific items generated as a result of O & M and other miscellaneous activities reclamation, reuse, burning or landfilling are the primary alternatives used. Wastes generated from the on-site water treatment plant consist of filter sand and sludge tank wastes. This material is sent to Sattahip for regeneration of the reusable materials or are disposed there.

Ocean disposal is not currently conducted at this facility, and it is not known if previous ocean dumping occurred. Current landfilling operations at the airport facility are not conducted near the ocean.

2.4.11 Medical Wastes

The current practices regarding the disposal of medical wastes are not clearly understood. No medical wastes were observed on site, and it is assumed that these materials are typically sent to a local landfill for disposal or are incinerated on site. The recent construction of a modern medical facility adjacent to the airport opens up the possibility for the disposal of medical wastes at the hospital either by incineration or another method approved by the facility.

2.4.12 Hazardous Wastes

Hazardous wastes generated on site are limited and include those wastes resulting from vehicle and aircraft maintenance, solvent cleaning and chemicals used during other maintenance operations. Some hazardous wastes generated by the military are sent to Singapore for disposal. These materials are typically limited to solvent cleaning wastes and are minimal in quantity. Waste oils are burned on site on the property proposed for the Transpark. Because this airport is not used as a primary facility for aircraft maintenance, military or commercial, the waste quantities are minimal and usually result from emergency repair or small maintenance items. Overhauls of military aircraft are performed off site at the Thai Airways Maintenance Center. Hazardous wastes generated as a result of commercial operations are drummed and are sent off site for disposal.

2.4.13 Ordnance Disposal Wastes

The southeastern portion of the property proposed for the Transpark has been used over the years for disposal of unexploded ordnance. These devices are placed in the Unexploded Ordnance Demolition (UOD) area and detonated or burned. This area has not been used as an impact or target area by the military, however UOD personnel have found evidence of intact small mortar-type devices. During the Vietnam War, bombs of various configurations were used. It is not unreasonable to assume that certain unexploded bombs were detonated here or that other contaminants were burned off here. Residual concentrations of herbicides and pesticides in these areas resulting from their disposal is of concern, as well as the presence of bomb residue released after detonation or other disposal. The existence of unexploded ordnance is a possibility; and therefore this area should not be entered until cleared by an explosives expert. TAMS' personnel were not permitted to enter this area during our site visit.

2.4.14 Existing Conditions and Environmental Concerns

A preliminary assessment of the existing environmental conditions was performed in January 1997. After meeting with military and advisory personnel from the U Taphao Airport, TAMS conducted an on-site evaluation of existing conditions. This evaluation was performed primarily through visual observations supported with field monitoring instrument readings, including: a salinity-conductivity-temperature meter, dissolved oxygen meter (both of these instruments were used during the evaluation of the surface water sampling locations); pH measurement, a combustible gas indicator (CGI) having percent atmospheric oxygen (O_2) and percent lower explosion limit (LEL); measurement capabilities; and a noise monitor (see Section 2.1.8.).

General observations were made at the area proposed for the Transpark development. Surface conditions with regard to general housekeeping were good. There were very limited areas where debris was noticed, and the former B-52 and bomb storage areas were kept free of debris. Burn areas are contained and, with the exception of the UOD area, there is minimal concern that uncontrolled dumping of wastes, including hazardous wastes, has occurred. Subsurface conditions were not investigated through intrusive means, but were evaluated based on information received from the airport personnel and on assumptions regarding typical release scenarios. The existing conditions, which were observed and the areas of environmental concern, are discussed below.

2.4.15 Asbestos

Exposure to elevated levels of asbestos fibers causes severe respiratory diseases of which some are inoperable and may lead to premature death. Asbestos has been used in over 2,000 different items, some of these are present on site.

Upon arriving at the U Taphao Airport, it was immediately evident that most of the existing military facilities contained asbestos, which appeared to have been installed many years ago. The predominant material appears to be transite, which is a nonfriable form of asbestos-containing material. This means that it is not easily made airborne by light hand contact. In its undisturbed state, transite poses little or no threat to personnel on site. However, there are places where broken transite panels are on the ground and are being driven over by facility vehicles. This action grinds up the transite and releases the asbestos fibers into the air. One such place is at a pump station for one of the day tank storage areas.

Guard towers, which formerly protected both B-52s and bomb revetments, are located throughout the site. Each of the small roofs of these structures appears to be constructed of corrugated transite panels. Most of the other structures throughout the site also have roofs constructed of transite panels. Fortunately most of these roofs are in good condition, are not broken down and are in deserted or desolate areas posing limited if any exposure to on-site personnel. The former on-site kennel and adjacent three-story office building have roofs made of what appears to be transite. These roofs are quite large, however, they are in good shape.

Demolition of any of these structures should be carried out under controlled conditions so that workers are not exposed to the asbestos fibers and that the area is not contaminated with asbestos residue.

Some of the other items on the site which are suspected of containing asbestos and need to be managed properly now and during demolition activities include:

- asbestos gaskets (approximately 0.6 meters in diameter) some on the ground at one of the underground storage day tanks near the former B-52 revetments;

- fire rated doors;
- pipe insulation (not observed but suspected around old boilers and nearby pipe fittings);
- mastic wrap around underground storage tanks;
- window caulk; and
- acoustic tiles and 23-square-centimeters floor tiles.

2.4.16 Petroleum Contamination

This facility was originally constructed with the protection of the B-52s and bomb revetments in mind. Therefore, the fuel tank farm was located well away from the aircraft and ground operations which it supported. As a result, long underground pipelines connect the western fuel tank farm to the eastern activities. Leakage of aircraft fuel along these lines east of the existing runway is unknown at this time.

During the proposed construction activities it may be necessary to remove these underground pipelines and those supplying the B-52 day tanks. Leakage of fuel used during the previous operations at the facility is suspected. It is assumed that limited quantities of leaked fuel will be found in discrete locations along the path of the fuel lines and possibly at the underground day tanks as well. Due to the high water table in the area the fuel is anticipated to be contained within the first few feet of the ground surface.

The day tank areas near the former B-52 revetment areas contain two to four large underground storage tanks each (approximately 3 meters in diameter by 22.8-meters-long), and associated piping. When in operation these tanks would hold fuel for the B-52s awaiting fuel, or would receive fuel which was off loaded from the aircraft. Idle aircraft were not stored full while on the ground jeopardizing other aircraft, or the nearby bombs, in case of enemy attack or explosion. All of the pumps used to transfer the fuel to and from the B-52s have been removed. The tanks appear to have been cleaned well. During the site visit it was possible to see into many of the tanks through 0.6 meters diameter entryways. No volatile petroleum odor was detected, no residue was observed, nor was there an elevated lower explosive limit reading detected by the CGI. The unlined steel tanks appeared to be rusted inside, probably as a result of being exposed to atmosphere for many years.

At one location, where construction was ongoing, one of the underground day tanks had been removed from the ground, and was resting near the excavation. From the exterior the tank appeared intact. A tar-like coating covered the entire surface of the tank and there was no evidence of leakage on the outside of it. The excavation, from where the tank was removed, was mostly full of water, however, it was still possible to see the concrete form which supported the tank and the steel tie-down straps which held the tank in place. No floating petroleum product was noticed on the water indicating that most likely there had been no leakage of fuel from this tank. During the proposed construction activities each tank excavation area should be examined for leaks and the petroleum product, if any, removed.

A few of the B-52 revetments were inspected for signs of petroleum or other contamination. No areas of concern were observed during the inspection of the surface areas. However, at a couple of these areas, a petroleum odor was detected emanating from the 10 centimeters. pipes contained within the fuel transfer connections near the forward center of each bay. At these locations are hinged hatches which protect the connections for the off loading and fueling of the aircraft. The transfer pumps are missing and the pipe flanges have been left uncovered. These pipes run underground

directly to the day tanks, which in turn are connected to the pipes leading to the tank farm.

Because of the odor, it is assumed that the fuel lines leading to the day tanks need to be cleaned prior to removal during the proposed construction. This residual odor may be the result of poor or no cleaning of the pipes or leakage of fuel into the pipes as the result of the removal of the small transfer pumps.

2.4.17 Ordnance Disposal Contamination

The UOD area presents a unique set of contamination issues for the proposed Transpark development area. The disposal of ordnance, herbicides, pesticides and the burning of these and other unknown materials in the UOD area present conditions which need to be studied and understood more fully. Not only does this area pose a threat to personnel as a result of the potential for encountering unexploded ordnance, but also because of the potential exposure to chemical and other agents associated with the historic use of this facility. Prior to excavating in this area, or even the recontouring of the surface soils, unexploded ordnance (UXO) clearance should be obtained and then a full chemical evaluation of the surface soils and groundwater performed.

2.5 Quality of Life Values

2.5.1 Socio-economic Characteristics

In the past 10 years, Thailand has experienced rapid economic growth. Its Gross Domestic Product (GDP) had risen to 13.3 percent and stabilized around 8 percent in the early 1990s, although in 1996, the economy slowed down to 7.5 percent. This high growth has been induced mainly by the export oriented industrialization, which requires an accompanying fast growing urban sector.

Most economic information available for the project area is at the Provincial level. The following is summarized from Sema Group - Team Consulting Engineers (1997), and applies to the entire 11 province ESB II region. Supplemental field observations made during the TAMS/ACT 1997 site visit have been added where available and appropriate. The proposed project is within Rayong Province, but the western part of U Taphao Naval Air Station is in Chon Buri Province.

In recent years the eastern seaboard region has experienced more rapid economic growth rates than Thailand as a whole. Gross Provincial Product (GPP) in Chon Buri Province increased at a 9.03 percent annual rate in 1982, and 11.19 percent in 1994. In Rayong Province, GPP growth rates were 49.80 percent in 1982 and 10.25 percent in 1994.

Growth areas in Chon Buri Province included manufacturing, construction, transportation and communication, banking, insurance, and real estate, and services. Sectors which decreased in importance included agriculture, mining and quarrying, wholesale and retail trade, public administration and defense.

Growth areas in Rayong Province included mining and quarrying, construction, electricity and water supply, and banking, insurance and real estate services. Decreasing sectors included agriculture, manufacturing, wholesale and retail trade, ownership of dwellings and services.

Employment

The three major sectors of the labor force are: agricultural, which comprises 36.2 percent; industry, which comprises 20.24 percent; and the service sector, which involves 15 percent. Trading and construction comprised 13.62 percent and 10 percent, respectively.

Agriculture plays an important role in the growth of the economy. Agriculture and forests account for about 48 percent and 20 percent of the land, respectively. Rice, field crops and fruit trees are an important facets of the local economy. Areas where rice production is most important are Ayutthaya, Lop Buri, Chachoengsao, Prachinburi and Nakhon Nayok, while field crops play an important role in all of the ESB provinces. Currently, livestock production in Thailand is solely for the domestic market. In the ESB provinces, poultry, pork and cattle production have increased, while buffalo production has decreased. Coastal fisheries production in the ESB centers on 12 main ports in Chachoengsao, Chon Buri, Rayong and Trat.

Tourism has mainly been based in Pattaya, Chon Buri provinces, but recently, has rapidly grown into the more eastern province of the region. A huge influx of tourists visits Thailand every year, and, as a result, an expansion in higher quality hotels and restaurants has occurred. A primary reason that tourism has grown is the increase in demand by visitors to see and experience more varied and less crowded areas. The Tourism Authority of Thailand, as well as the National Economic and Social Development Board, have helped boost the capacity and popularity of Thai tourism.

The total population in 1995 was 5.7 million, of which approximately 3 million people were classified as the labor force. The employment rate, defined as the ratio of those that were in the labor force from the number of potentially economically active, was 67.28 percent. The rates of employed men and women were 76.28 percent and 58.26 percent, respectively. Chanthaburi had the highest rate of employment at 76.24 percent, followed by Chon Buri, Trat, Rayong and Nakhon Nayok. Lop Buri had the lowest percentage at 58.43 percent. More than 40 percent of the labor force is comprised of private sector employees. Self-employed workers comprised 28.77 percent of the work force.

Of those involved in the work force, 19 percent completed high school, 9.8 percent completed lower secondary school, and 3.6 percent completed upper secondary school. Only 2.6 percent completed a vocational education. About 6 percent of the work force was uneducated.

A critical problem is the low level of education and quality of the existing work force. High competition for labor underlies the high turnover rates of employment as workers move from one job to another with higher level of returns. The need to continually train new workers recruited for replacement not only puts strain on performance and work output and quality, but increases cost and affects marketing competitiveness.

Migrants from other provinces and regions comprise a large percentage of workers. A number of social changes accompany industrial development in areas such as ESB, not only in destination areas but also in rural areas that have experienced net out-migration of workers. The degree to which changes are positive is conditioned by the provisions of social services in terms of housing, traveling arrangements, availability of health services, educational services for children, child care centers, as well as other social and recreational facilities. The shortages of these services generally have a greater impact on the pace at which workers can settle down.
Another problem is the inadequacy of linking labor demand to supply. Although the public sector has begun to develop a database for workers, the knowledge of workers and available work is limited between the two resources.

The largest group of investments has been in agro-based industries, which is concentrated in Klaeng District of Rayong, Bang Pakong District of Chachoengsao, Sri Racha and Ban Bung Districts of Chon Buri and in Muang Rayong. Projected employment for the agro-business sector is 33,411.

The second largest groups are chemical, paper and plastics industries. The concentration of these industries will be in Rayong, Bang Pakong District of Chachoengsao and Sri Racha District of Chon Buri. Expansions of employment in the Ban Khai District of Rayong and Uthai District of Ayutthaya are expected. Approximately 22,879 workers are expected to be employed in these industries.

The third largest group is the light industry, which is the most labor intensive industry. The projected employment from these new investments is expected to be 52,892. Concentrations are expected to be in Bang Pakong, followed by the Sena District (Ayutthaya), Bang Lamung, Sri Racha and the Muang District of Chon Buri.

The fourth major group is electronics and electrical industries, which will mainly be located in Bang Pakong, Uthai, Bang Pa In (Ayutthaya), Sri Racha and Ban Bung. Approximately 49,357 new jobs are expected for this sector of the economy.

Metal products industries which consisted of, machinery and transport equipment is the fifth largest group of industries with concentrations in Chon Buri, Sri Racha and Bang Pakong. Approximately 22,669 workers will be employed.

The sixth major group is mining, metal industries and ceramics. These industries are expected to be located in Muang Rayong District and Bang Lamung. An estimated employment force of 11,809 workers is projected.

Based on these projected industries, Chon Buri is the province with the highest number of investments for all of the industrial sectors, followed by Chachoengsao, which ranks second with investments in agriculture, paper, plastics, electronics, light industries, machinery and transport sectors. Rayong ranks third with major investment sectors in agro-based industries, chemical industries, paper, plastics and service. Major industries in Saraburi include metal mining and ceramics, while electronics and agro-based industries will occur in Ayutthaya and Prachin Buri, respectively.

As a result, the greatest number of jobs will be created in Chon Buri, followed by Chachoengsao, Rayong, Ayutthaya and Saraburi. With nearly 80 percent of the work force having had only a minimum education, a substantial increase in educational investment is urgently needed. Given the accelerated need to develop a population of qualified workers, mobilization of efforts from the private sector, in addition to incremental increase in public investment of both technical and financial resources, is required.

Education and health services are not at a high enough level to serve as an influencing factor in the ESB. Insufficient and undereducated labor to meet the needs of the growing industrial sector and the associated services is a critical problem. Development of the social aspects is needed to create a basic environment that will attract a resident population able to provide the required work force.

The economy will shift to higher levels of technology as it loses its competitiveness in labor intensive activities, and as it takes advantage of its improved infrastructure to become the production base for the Thai market and markets in neighboring countries. The main challenge will be to effect an upgrade in the skill level of the work force.

Human resource development, in addition to this need for skill improvement, is crucial to the growth of the ESB II area, as the attraction of skilled and educated people to the

region is the key to its development. In order to effect this change, services by the private sector that will adapt to growing demand must be provided, and the public sector must provide high-quality social services to make the study area attractive to new residents. These social services are allocated on the basis of population. The balanced development of the entire area requires that social services must be up-graded at least to the level of Chon Buri, which is the province with the best services.

Educational Services

In 1995, there were a total of 7,114 educational facilities in the 11 ESB II provinces, of which 3,892 were formal educational facilities and 3,222 were non-formal establishments. During this time, there were an estimated 1.5 million students, of which 1.2 million were receiving formal education and 325,088 were involved in informal training. An aggregate teaching staff of 71,617 teachers existed, of which 61,722 taught in the formal system and 10,895 were in the non-formal system.

Chon Buri not only had more teachers than any of the other provinces, but these teachers also appeared to have the highest level of educational degrees. Although Chon Buri incurred the lowest rate (6.38 percent) of students continuing beyond the general education level, this rate was offset by this province producing the highest rate of students attending vocational schools, an indication of a more focused trend of education geared towards meeting the demands of the labor markets. Chon Buri also had the highest level of students continuing to a higher level of education.

The total number of schools among the provinces offering non-formal education was nearly 600, of which about 20 percent were located in Chon Buri.

2.5.2 Public Health

The following information was summarized from Sema Group - Team Consulting Engineers (1997). The existing health sector is defined by four categories: availability and distribution of medical establishments in the ESB II Provinces; the numbers and distribution of medical personnel; the number of patients and the more common illnesses recorded; and common health problems found in the ESB II Provinces.

In 1994, there were 147 medical facilities throughout the provinces. These facilities included central hospitals, general hospitals and community hospitals attached to the Ministry of Health. Only Chanthaburi, Chon Buri and Saraburi had central hospitals attached to the Ministry of Health. The remaining were classified as general hospitals, of which there was usually one hospital per province. Districts are served by community hospitals. For all hospitals, there were a total of 11,176 beds. A recently completed military hospital occupies the northwest corner of U Taphao Naval Air Station.

The total number of medical personnel throughout the ESB II provinces was 12,917. The average ratio of doctors to the population for the provinces was 1 to 187. The best ratio coverage is in Chon Buri for physicians, dentists, professional nurses and auxiliary nurses. Chanthaburi had the second highest ratio of physicians to people and had the best ratio of medical scientists. Distribution of the medical personnel for Saraburi appeared to be the highest among the provinces.

The total number of out-patients treated in hospitals in 1994 for all provinces in the ESB II was 6.7 million. The number of in-patients admitted was 345,307. Chon Buri had approximately 1.1 million out-patients, the highest number of all the provinces, and had 46,389 in-patients, which was second highest to Lop Buri. Saraburi and Ayutthaya followed second and third with the highest number of out-patients.

The two most prevalent illnesses in 1994 were respiratory diseases, which was the most common ailment, and illnesses of the digestive system.

2.5.3 Recreational Resources and Development

Rayong Province has become increasingly attractive as a tourist destination. In 1995, there were 1,840,874 visitors to the province. Of these, 82.3 percent were Thai nationals and the balance were foreign visitors (Sema Group - Team Consulting Engineers, 1997). Foreign visitors spent an estimated average of 2299.77 Baht per day. Attractions in Rayong Province include beaches and islands, such as Ko Samet National Park. Several hotels, a beach, and a large golf course are located immediately east of the proposed GTP.

2.5.4 Aesthetic Values

Within U Taphao Naval Air Station, the beach and immediate vicinity remain relatively unspoiled and provide an attractive vista along the Gulf of Thailand. Surrounding areas are typical of the eastern seaboard region. In some locations pleasant views of nearby hills and trees are available, but in others unsightly development has occurred.

2.5.5 Archaeological or Historical Treasures

No archaeological or historical features of importance are known from within the project site. Since much of the area within the military boundary was extensively modified during the 1960's, if any features or artifacts were present they were likely destroyed at that time by excavation, gradin, or filling. Any such features outside the boundary would not be affected by GTP development.

2.5.6 Cultural Values

At least six Buddhist temples are known to be present within a short distance of the site boundaries. No other types of cultural sites have been identified to date.

CHAPTER 3

PROBABLE ENVIRONMENTAL EFFECTS

CHAPTER 3

PROBABLE ENVIRONMENTAL EFFECTS

3.0 Noise Modeling Analysis

3.0.1 Aircraft Noise Contours and Impacts

The GTP will develop and mature over a number of years. Initially, there will be few additional aircraft operations so that in the early years of the GTP (Years one to three) there will be no appreciable difference in aircraft noise over the current level of military and passenger operations. By 2009, there could be up to 16 operations per day with several night time operations which will expand the existing contours somewhat.

Comparison of predicted aircraft noise for the existing condition 1996, 1999 and 2009 with the measured existing ambient noise levels, will show that at many locations aircraft noise levels may be more or less than the existing ambient levels. The difference depends, as might be expected, on the location of aircraft flight tracks and the type of aircraft operating on them. In some instances, the existing ambient measurements may be higher than the predicted aircraft noise levels simply' because the ambient measurement is a point-in-time measurement whereas the INM 5.1-generated aircraft noise levels are based on predicted annualized operations.

The noise from aircraft anticipated to operate at the GTP will be estimated using an airport noise computer model known as the Integrated Noise Model (INM 5.1). This program calculates the effects of 107 different types of aircraft flying user-defined flight tracks during various wind directions, aircraft climb and descent profiles, and engine power settings.

Aircraft noises were calculated for the same locations where ambient existing noise measurements were made (Exhibit 2.5), and for the development of lines of equal noise called noise contours. In some instances, the existing ambient measurements may be higher than the predicted aircraft noise levels simply because the ambient measurement is a point-in-time measurement whereas the INM-generated aircraft noise levels are based on predicted annualized operations.

Noise contours of Day-Night Average Sound Level (DNL) 55, 60, 65, 70, 75 and 80 were produced using the U.S. Department of Transportation (USDOT), Federal Aviation Administration's Integrated Noise Model, Version 5.1 for existing, opening day, year five and year 12 aircraft operation levels. Aircraft noise contours were produced using a multi-step process. The noise analysis incorporated the flight tracks, military, passenger and cargo aircraft fleet, schedule and runway usage developed for the GTP project.

Exhibit 3.1 shows noise contours for the existing condition. Exhibits 3.2, 3.3, and 3.4 show noise contours for opening day, year five and year 12. There is essentially no change in the noise contours from the existing condition to opening day. By year five contours extend somewhat greater distances to the north. In year 12 the increased number of night flights results in a slight additional expansion of the projected noise contours in all directions. However, the changes are relatively minor, with the greatest change of the DNL 65 contour from the existing condition to year 12 resulting in only a 1400-meter extension.

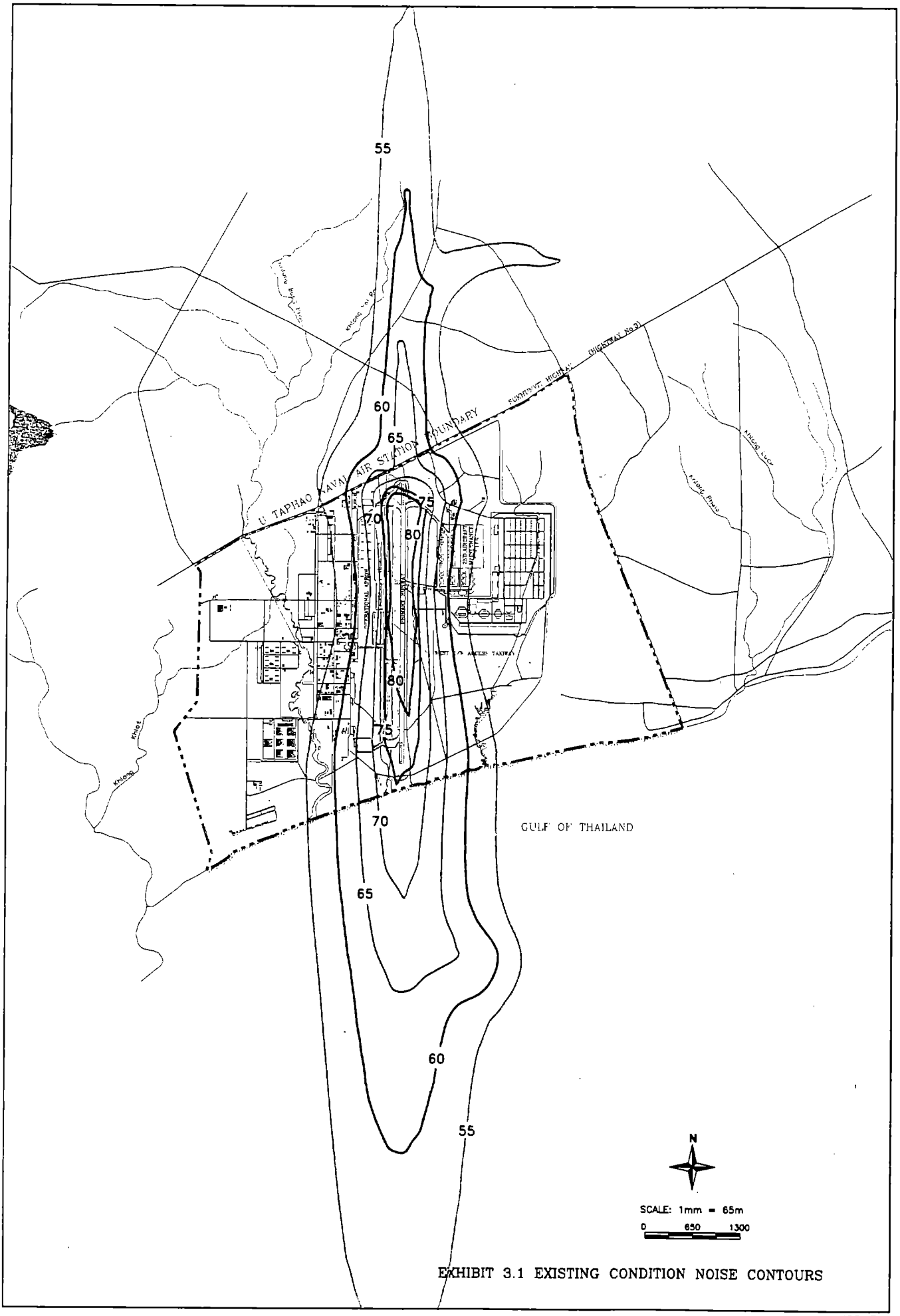

EXHIBIT 3.1 EXISTING CONDITION NOISE CONTOURS

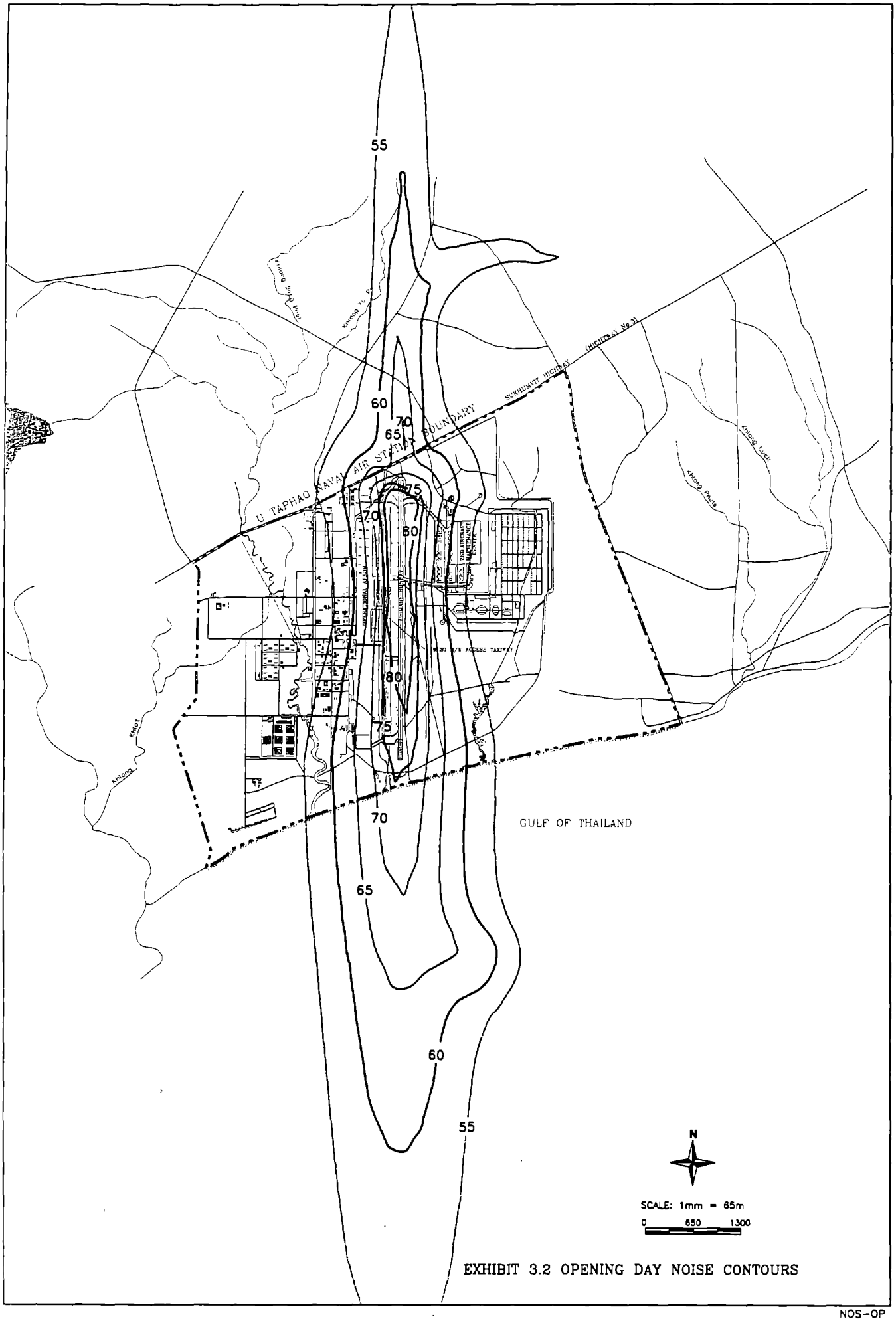

EXHIBIT 3.2 OPENING DAY NOISE CONTOURS

NOS-OP

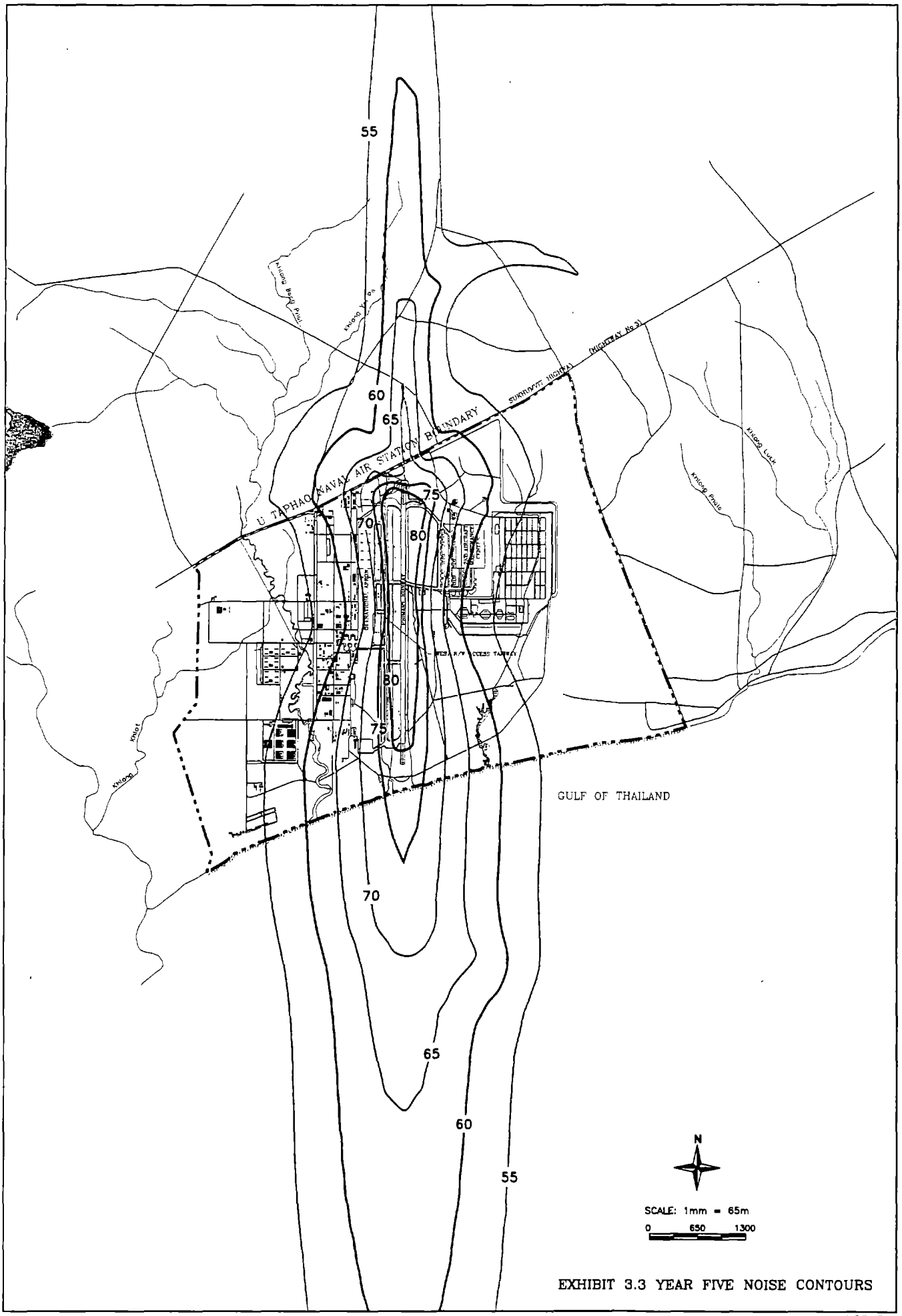

EXHIBIT 3.3 YEAR FIVE NOISE CONTOURS

NOS-5Y

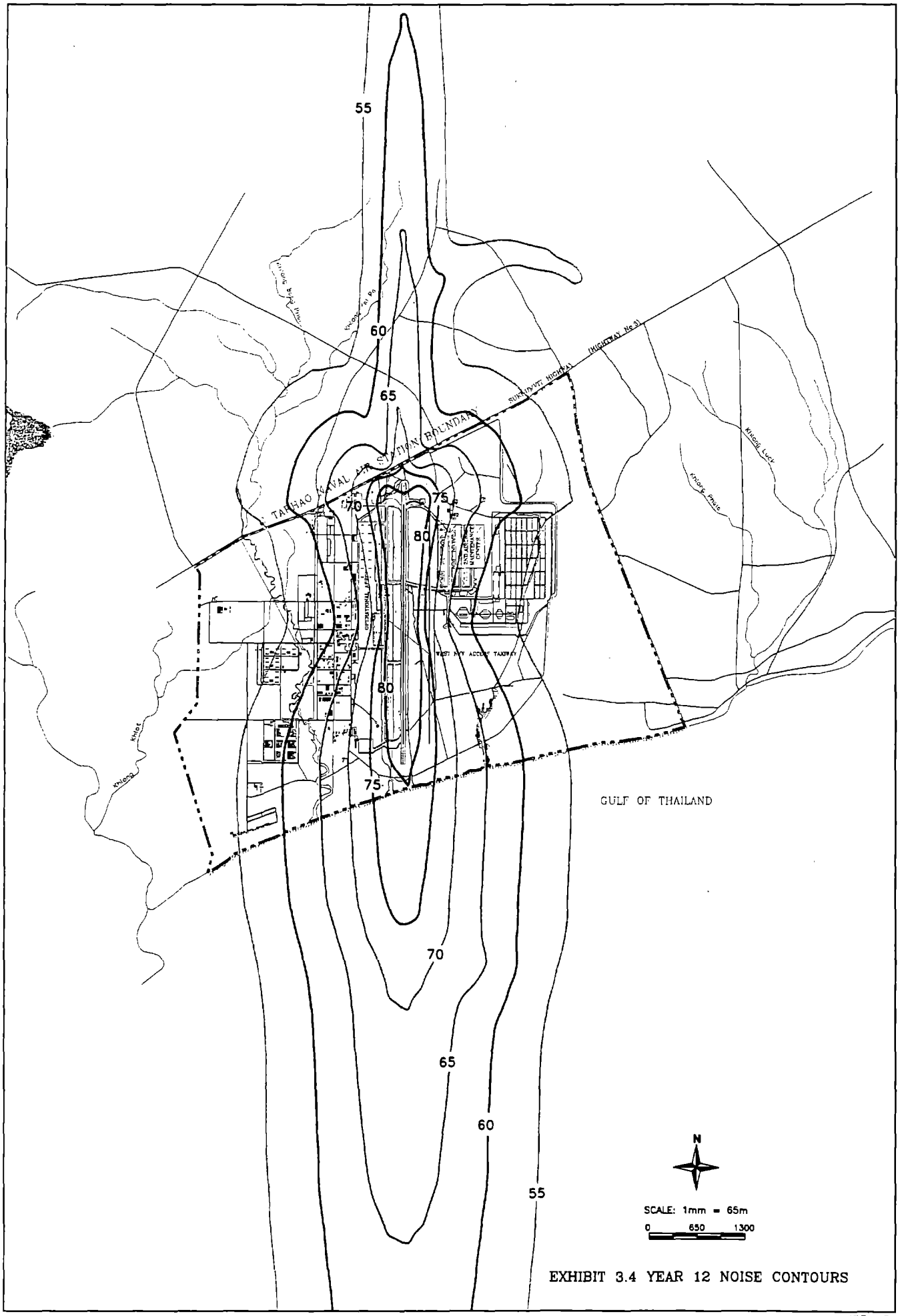

EXHIBIT 3.4 YEAR 12 NOISE CONTOURS

NOS-12Y

3.1 Air Quality

3.1.1 Construction Period Emissions

- Construction activities would result in short-term and temporary emissions from the following types of sources:
- Use of fossil fuel powered equipment such as dump trucks and bulldozers;
- Paving of roadways, parking lots and other surfaces with asphalt (there would be no on-site asphalt plant);
- Stripe painting of airfield, roadway and parking lot surfaces;
- Automobiles that are used by construction workers traveling within the airport construction site; and
- Fugitive dust emissions from earthmoving activities and operation of mobile equipment on unpaved surfaces.

3.1.2 Operational Period

Five additional flights per week are anticipated at U Taphao in 1999 with the opening of GTP. By 2009, there would be 16 additional daily flights. This additional level of activity would yield a minor incremental increase in the CO and NO_x emission burden of the airport.

Improvements are already planned for the road network serving the GTP. If improvements are implemented as planned, the road network would have adequate capacity to handle GTP related traffic, minimizing the pollution burden associated with long traffic queues at intersections.

Overall the construction and operation would have miminal impact on regional air quality.

3.2 Water Quality

When compared with drinking water criteria, surface water quality at the site appears to be acceptable. During construction and operation of proposed airport facilities, best management practices will need to be employed to minimize potential degradation of the on-site waters. For example, erosion control measures should be used and contamination of existing water from leaking vehicle fuel lines or improper refueling techniques should be avoided. During removal of underground storage tanks and underground pipelines, special care should be taken to contain any contamination detected and to remove and dispose of such material in an environmentally sound manner.

Construction methods within the unexploded ordnance demolition (UOD) area should be selected, or developed as necessary, to deal with the conditions discovered during more detailed site investigations. Controlling the release of any contaminants to either the surface or to the groundwater is critical because this area is in close proximity to important estuarine resources, and is not far from the Gulf of Thailand. During GTP operation runoff from aircraft refueling areas, the tank farm, and the vehicle maintenance facilities should be controlled and directed to the waste treatment facility.

Assuming reasonable efforts to prevent contamination as outlined above, and use of an adequate treatment facility, impacts to water quality should be low under both development options. Because of the one-kilometer military coastal security buffer, the most sensitive estuarine and marine resources will be reasonably well protected from impacts.

3.3 Fish And Wildlife Habitat

3.3.1 Terrestrial Flora and Fauna

Both development options would impact primarily scrub and grassland habitats, and to a lesser extent areas of wet meadow. These areas support a variety of common plant and animal species. No unique resources are likely to be affected, although wet meadows are less common regionally than scrub or grassland.

The least disturbed habitat areas on the site, as well as the most unusual ones, are within the one-kilometer coastal buffer and would not be directly impacted by site development. Sema Group - Team Consulting Engineers (1997) included a recommendation in their ESB II Development Programme that future industrial development be consolidated to avoid impacts to unique and fragile coastal resources such as these.

Khao Krok Tabaek, a scrub-covered hill northeast of the project site, may provide refuge for common mammal, bird and other animal species. It will not be directly impacted by the 1997 layout, but may be affected by increased noise levels related to closer runway proximity. These effects would be much more severe with the Louis Berger 1991 layout[2] because the second runway location would require that a substantial portion of the hill be removed. Khao Krok Tabaek has been designated as a Forest Conservation Area.

No endangered or threatened species are currently known to inhabit the project area (Nabhitabhata, 1993), and because of the generally degraded habitat types present, it is unlikely that any occur there.

3.3.2 Marine and Estuarine Ecology

Because the proposed development areas are well buffered from the Gulf of Thailand and associated small estuarine areas, direct impacts are unlikely. The increase in paved surface may contribute to more rapid runoff of rainfall, so it is recommended that measures be included in the final design to minimize the risk of erosion, sedimentation, or runoff of oil or other pollutants into the various drainage channels and ditches. For example, placement of a retention basin in the lower portion of the relocated drainage ditch could prevent silt or pollutants from reaching coastal areas.

3.4 Drainage

Site drainage will be altered through relocation of much of the existing concrete-lined channel. The new channel should be designed to accommodate potentially higher runoff rates associated with the increase in paved surface area. Relocation of this channel may affect the location and extent of areas which pond after rainfall. Erosion should continue to be a minimal concern with a stable channel design. This is an important consideration because this channel empties into potentially sensitive estuarine areas and eventually into the Gulf of Thailand. Smaller unlined ditches near the existing runway may also be affected. These ditches are currently choked with vegetation. Any reconstructed portions should be capable of handling increased flow rates.

3.5 Wetlands

The 1997 layout would require filling or modification of approximately 45 rai of palustrine wetlands, consisting of seasonally flooded wet meadows. These wetlands are generally of low to moderate quality. If it is decided that mitigation is desirable, excavation of low areas near natural shallow drainageways within the base perimeter, followed by natural revegetation, would quickly establish similar wetland areas. The relocation of approximately 2,935 meters of the concrete drainage channel would be required. The relocated channel

[2]Louis Berger International, Inc., Asian Engineering Consultants Corp., Ltd., and Index International Group Co., Ltd. March 1991. Feasibility and Master Plan, Rayong-U Taphao International Airport.

would be somewhat longer than the currently existing one, resulting in a net gain of riverine wetland area. The 1991 layout would require filling or modification of approximately 42 rai of palustrine wetlands, once again consisting of seasonally flooded wet meadows. The relocation of approximately, 3,617 meters of the concrete drainage channel would be required.

3.6 Solid Waste

Solid waste generated during construction and during the operation of the new facility will be disposed of as is currently done by the commercial tenants. The solid waste materials will be contracted for disposal at a local landfill. No disposal of solid wastes will be permitted on site or in the Gulf of Thailand.

3.7 Hazardous Materials

Hazardous wastes generated during construction and during the operation of the new facility will be disposed of as is currently done by the commercial tenants. Special contracts may need to be arranged with the governing body for the disposal of materials, such as waste oils and oily rags. In any event these materials will be drummed on site and properly labeled prior to their being transported off site for disposal. Asbestos will be prevented from being released into the environment during the demolition phase of the construction activities. Demolition of the existing structures will be phased so that the removal of asbestos containing materials is performed first, so that demolition can then proceed unencumbered.

3.8 Temporary Construction Impacts

Equipment noise during construction will have a minor effect on wildlife. Most animal species currently present on the project site are presumably tolerant of aircraft noise, and will be subjected only to changes in type and duration of noise. Most of the construction area is well removed from residential areas, so noise effects on humans are expected to be minimal.

During airport construction, large expanses of soil will be exposed for various lengths of time. During the dry season, windblown dust can contribute to degradation of air quality.

Dry season burning currently contributes to degradation of regional air quality, and presumably would continue to do so during construction. As construction progresses, less combustible material will be available and the risk of fire, either intentional or accidental, will gradually decrease.

During the wet season, increased surface runoff can carry silt into nearby drainageways, as well as contribute to potentially severe stream channel erosion. Although this is unlikely to have serious adverse effects within the construction area, some downstream channel segments are sensitive and could be harmed by siltation. Estuarine areas adjacent to the Gulf of Thailand are especially sensitive. Standard construction erosion control practices can minimize the risk of siltation.

CHAPTER 4

TABULATION OF INITIAL EXAMINATIONS

CHAPTER 4

TABULATION OF INITIAL EXAMINATIONS

Table 4.1
Tabulation of Initial Examinations

Type of Impact	Impacts of the Proposed Action on the Environment		Impacts of the Environment on the Proposed Action	
Physical Resources				
Surface Water Hydrology	2		3	
Surface Water Quality		1		-
Ground Water Hydrology	1		1	
Ground Water Quality		1		-
Climate	-		-	
Air Quality/Noise	2		-	
Soils	-		-	
Land Quality (Pollution)	1		-	
Mineral Resources	-		-	
Geology/Seismology		-		-
Ecological Resources				
Fisheries	1		-	
Aquatic Biology	1		-	
Forests/Vegetative Cover	1		-	
Terrestrial Wildlife	1		-	
Endangered Species		-		-
Human Use Values				
Industries	2		3	
Highways/Railways		-		3
Navigation	-		3	
Power		1		1
Water Supply		1		1
Agriculture	2		-	
Housing	1		1	
Flood Control/Drainage	1		1	
Land Uses	2		1	
Sanitation	1		-	
Quality of Life Values				
Aesthetics	-		-	
Cultural	1		1	
Archaeological		-		-
Public Health		-		-
Socio-economics	3		-	
Public Safety		-		-
Recreation	1		-	
Dedicated Use Areas		-		-

Notes: Numbers indicate probable magnitude of significant impacts (adverse or positive): 3 = major; 2 = intermediate; 1 = significant. - = little or no impact.

CHAPTER 5

CONCLUSIONS

CHAPTER 5

CONCLUSIONS

5.0 Conclusions and Recommendations for Future Analysis

Commercial airport projects have been identified by the Ministry of Science, Technology and Energy as among those requiring a complete Environmental Impact Assessment (EIA). Airport expansion or improvement, as well as new construction, has been specifically included in this guidance (National Environment Board, 1992). Thus, preparation of a complete EIA is recommended for the GTP. As much information as possible has been included in this Initial Environmental Examination to facilitate the rapid completion of an expanded and more thorough document.

Because aircraft operations and related ground traffic are expected to increase only slightly in the first few years of GTP operation, initial impacts are not expected to be severe. In the longer term, issues such as increased aircraft noise, increased ground traffic, air quality, surface water quality, and ground water quality will need to be addressed. There will also be quality of life impacts. Some of these will be beneficial, such as improved economic opportunities and improvement of services for local residents. These improvements will need to be balanced against potential negative effects, at least for some individuals or communities, associated with more rapid economic growth.

Information needs for major environmental headings are summarized below, based on requirements outlined by the National Environment Board (1979; 1992).

5.0.1 Water Quality

Surface water quality samples should be collected twice, once during the dry season and once during the wet season. Parameters required include dissolved oxygen, pH, BOD, NO_3-N, TKN, total coliform, faecal coliform, suspended solids, and oil/grease. At present, dry season results are available for some, but not all, of these parameters.

Ground water quality samples should also be collected twice, once in the dry season and once in the rainy season. The following parameters should be included: pH, conductivity, suspended solids, hardness, NO_3-N, chloride, sulphate, iron, magnesium and turbidity.

5.0.2 Air Quality

Air quality samples are recommended from at least three areas, one on site, one upwind, and one downwind. Recommended parameters include dust, carbon monoxide, nitrogen dioxide, hydrocarbons, as well as relevant weather variables such as temperature, rainfall, humidity, wind direction, wind speed and barometric pressure.

5.0.3 Noise

Noise samples are recommended at sensitive locations such as schools, hospitals and residential communities in the flight path. In each area, continuous 24 hour readings on three different days are suggested by published guidelines.

5.0.4 Terrestrial Ecology

The following ecological characterizations are recommended if a complete EIA is done:

- Characterization of the vegetation within each of the major plant community types identified in Section 2.3.1;
- Identification of any economically valuable species;
- Refinement of the habitat map prepared for this Initial Environmental Examination (Figure 2.6);
- A more detailed inventory of wildlife, including mammals, birds, reptiles, and amphibians, including information on relative abundance and habitat relationships;
- Information on bird distribution and density within the site, including identification of any sensitive nesting areas or any concentrations of birds which might pose an aircraft hazard; and
- Field work should be conducted during both the dry and rainy seasons, timed to coincide with any important nesting or migratory periods if possible.

5.0.5 Aquatic Ecology

The following characterizations of aquatic ecology are recommended:

- Inventory of the fish, benthic macroinvertebrates, and aquatic vegetation at representative locations within streams, channels and estuaries on the site.
- Inventory of the nearshore aquatic organisms in the Gulf of Thailand.

5.0.6 Human Use Value

As GTP planning progresses, it should be possible to update the projected land use plan in Exhibit 3.2. More specific expectation can be developed on the airport property and surrounding areas, taking into consideration the recommendations of the ESB II development programme and other existing planning documents.

5.0.7 Quality of Life Values

The long-term planning process would be aided by more detailed projections for socio-economic changes, employment opportunities, educational services and recreational resources. Further information on archaeological, historical, or cultural features in the U Taphao area would also be helpful.

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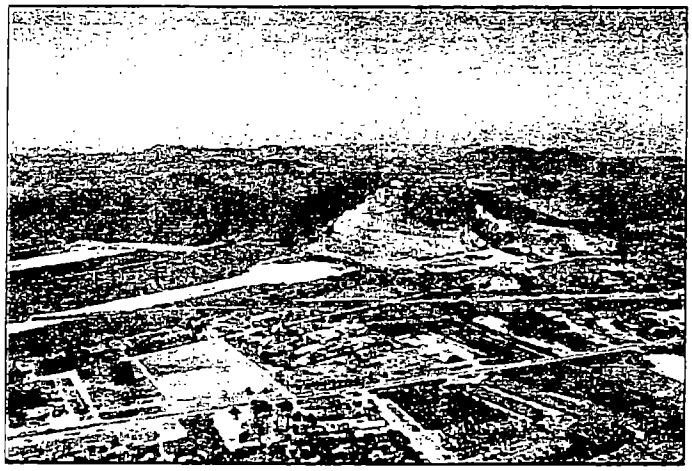
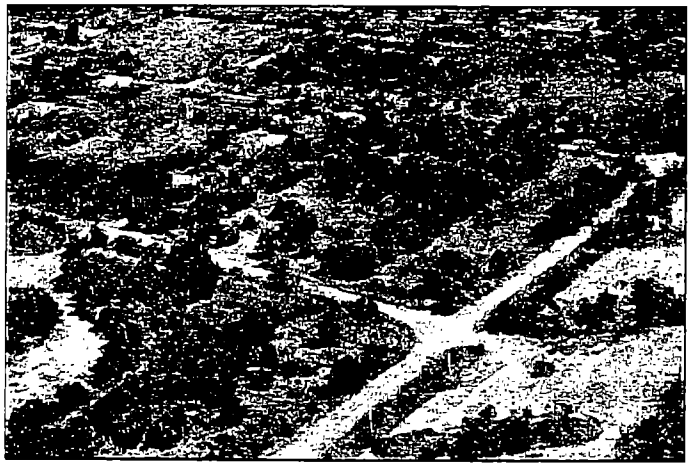
APPENDIX 1

PHOTOGRAPHS OF THE SITE

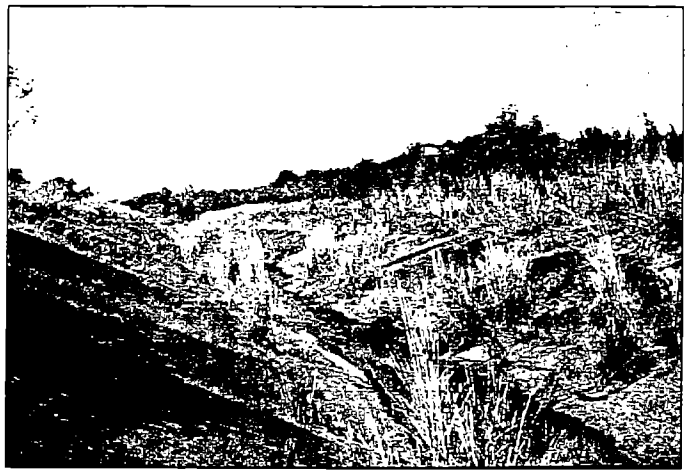


Aerial view of the area northwest of U Taphao; hills north of Sattahip are visible, as is the Phlu Ta Luang reservoir



Aerial view of former bomb storage areas

Aerial view of the eastern part of U Taphao; coconut palm



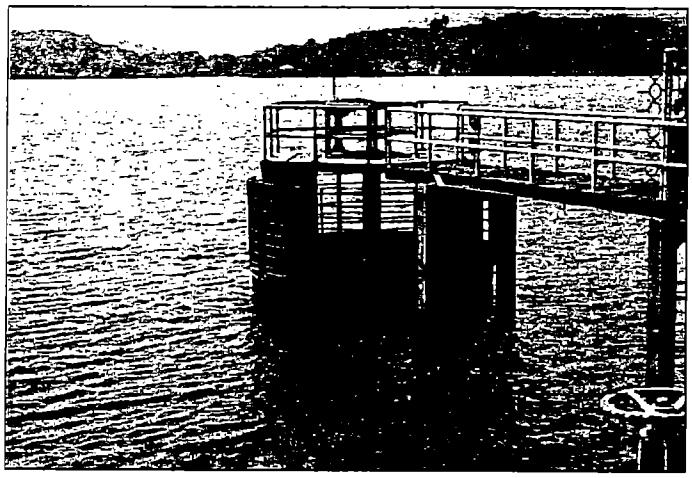
Concrete lined drainage channel

Water quality sample station SW-1

Water Quality station SW-2

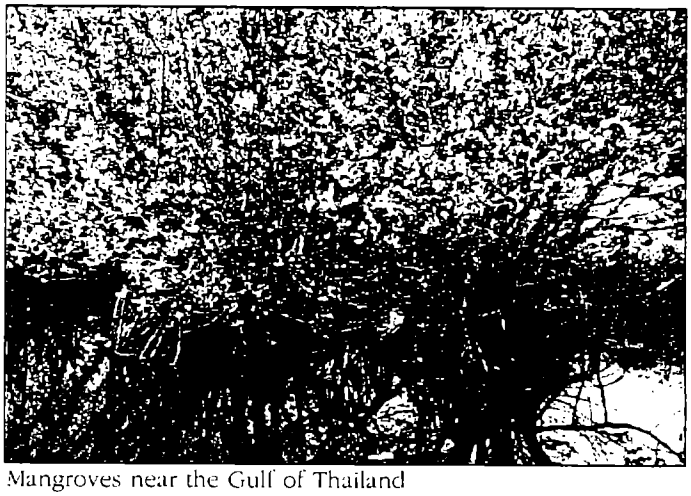
Water quality station SW-3

Water quality station SW-4



Water quality station RES-1, Phlu Ta Luang reservoir

Water quality station GT-1, Gulf of Thailand

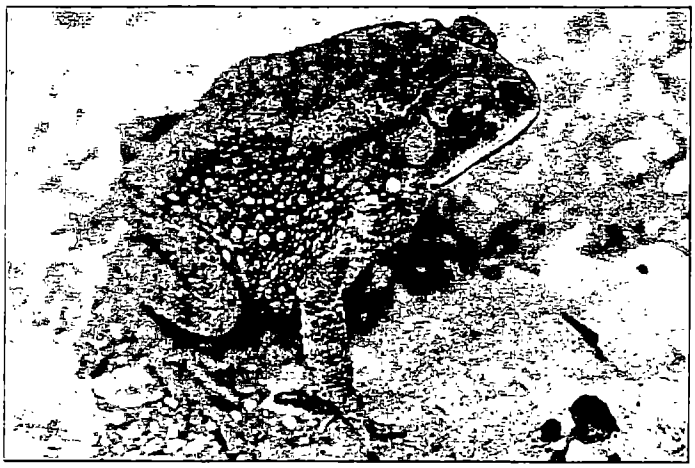


Mangroves near the Gulf of Thailand

Coconut palm plantation

Scrub and grassland habitats

Wet meadow habitat; note the conspicuous termite mounds

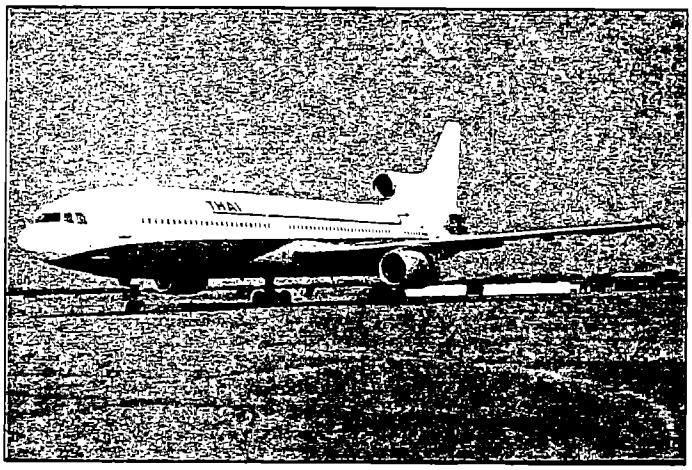


An Asiatic toad *(Bufo melanostictus)* from U Taphao

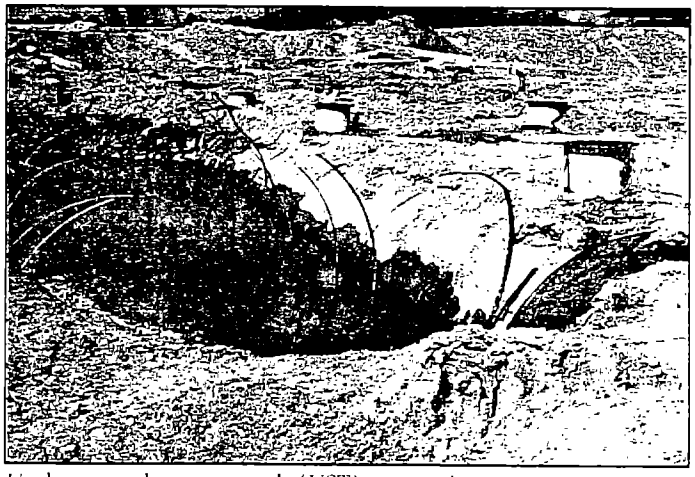
Pes-caprae formation and adjacent open beach habitats, with the Gulf of Thailand in the background; this particular location is dominated by *Spinifex littoreus*

Estuarine habitat near the Gulf of Thailand

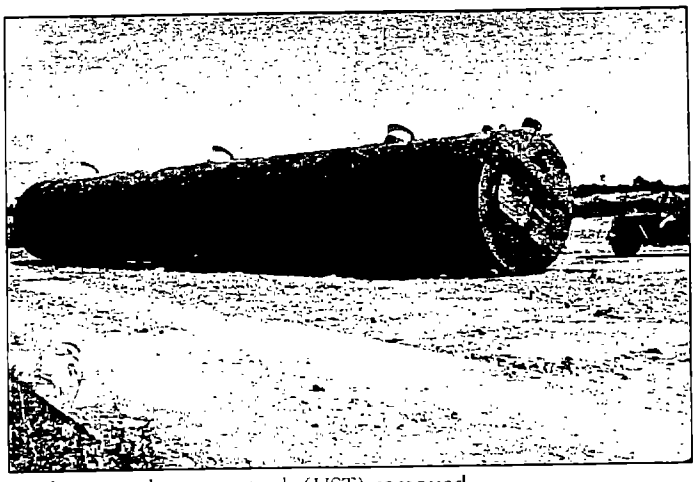
A black-banded garden lizard *(Calotes emma)* from U Taphao



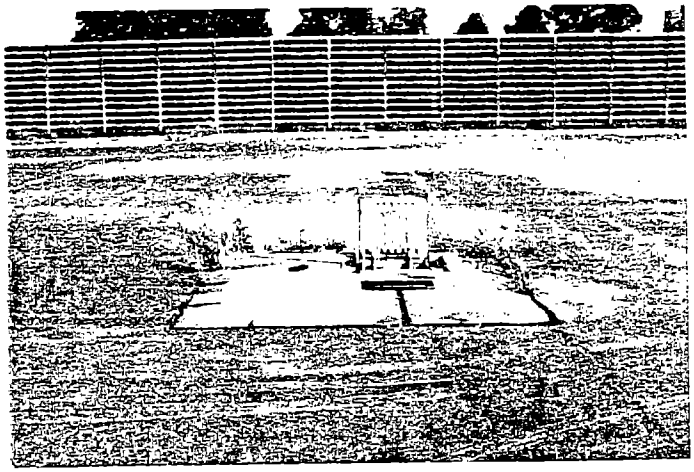
Thai Airways L-1011 jet at U Taphao Airport



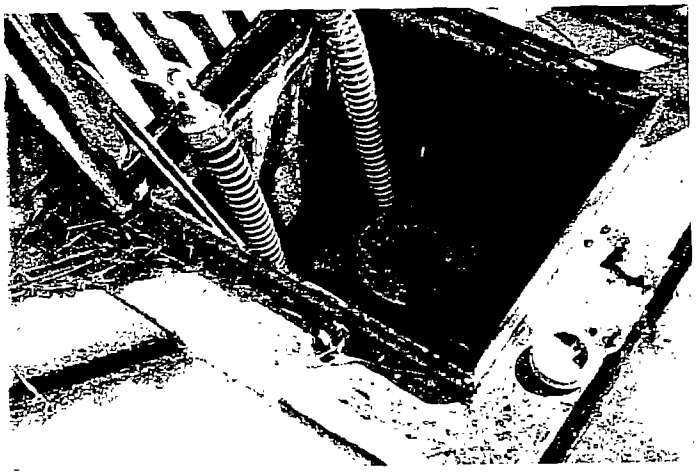
Underground storage tank (UST) excavation



Underground storage tank (UST) removed

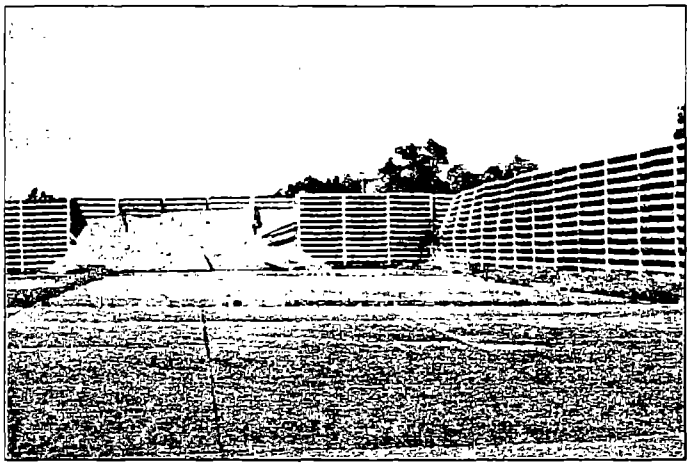


B-52 transfer line



B-52 transfer line, close up

Asbestos debris



B-52 revetment

Part 8
Service Fee and Penalty

Section 88 In any pollution control area or locality where a central wastewater treatment plant of a central waste disposal facility has been constructed and brought into operation as a public utility service, funded by government budget or revenue of the local administration and money allocated from the Fund as provided in this Act, the National Environment Board shall, with the advice of the Pollution Control Committee, fix the rates of service fee to be applicable within the limits of each pollution control area or locality, being the site of and served by the operation of such facility.

The service fee rates fixed according to the foregoing first paragraph shall be notified and published in the Government Gazette.

Section 89 The rates of service fee fixed according to section 88 for treatment of wastewaters or for disposal of wastes eminated from point sources pursuant to section 71 and section 72 may be varied as appropriate.

The owner or possessor of the point source of pollution governed by the provision of section 72, in the category of domestic household, that can be classified as a small-scale user is entitled to be exempted from the payment of service fees in accordance with the rules and conditions stipulated by the National Environment Board, with the advice of the Pollution Control Committee.

Section 90 Any owner or possessor of point source of pollution who avoidedly refrains from sending wastewaters or wastes to the central wastewater treatment plant or the central waste disposal facility as required by section 71 or section 72 and illegally discharges such wastewaters or wastes into the environment outside the limits of the site of the point source owned or possessed by him, or does send the wastewaters or wastes to the central wastewater treatment plant or the central waste disposal facility of the public service for treatment but fails or refuses to make payment for the service fees without being entitled to the exemption as provided by section 89, second paragraph, shall be liable to pay as a penalty four time as much the amount of service fee that he is liable to pay at the rate fixed in accordance with section 88 until the provision of this Act is observed by him.

Section 91 Any owner or possessor of the point source of pollution, required by section 70 to have an on-site facility for wastewater treatment or waste disposal, who illegally discharges wastewaters or wastes into the central wastewater treatment plant or the central waste disposal facility of the public service, shall be liable to pay as a daily penalty four time as much the amount of daily expenses for the normal operation of his on-site facility for wastewater treatment or waste disposal throughout the duration of such illegal discharge and shall also be liable to pay damages if such illegal discharge has caused any damage or defection to the central wastewater treatment plant or the central waste disposal facility of the public service.

Section 92 Any owner or possessor of the point source of pollution subject to the requirements of section 68 or section 70, who refrains from using his on-site facilities or equipment for the control of air pollution, noise pollution and vibrations, or refrains from operating his on-site facilities for the treatment of wastewaters or disposal of wastes and illegally discharges such untreated wastewaters or wastes into the environment outside the limits of the site of the point source of pollution, shall be liable to pay as a daily penalty four time as much the amount of daily expenses for the normal

operation of his facilities, equipment or process for wastewater treatment or waste disposal throughout the duration of such illegal discharge.

Section 93 The local authority or the competent official of the government agency responsible for the operation of the public wastewater treatment plant or waste disposal facility shall have the power and duty to collect service fees, penalties and claim for damages as provided in this Part, particularly in connection with the operation of the central wastewater treatment plant or the central waste disposal facility of the public service which is made available by such local authority or government agency.

The service fees and penalties collectable in accordance with the foregoing first paragraph shall be exempted from being remitted to the Treasury as government revenues, but shall be deducted and remitted to the Fund at the ratio specified by the Fund Committee, whereas the balance therefrom shall be used as expenditures for operation and maintenance of the central wastewater treatment plant or the central waste disposal facility of the local authority or government agency which is responsible to collect such service fees and penalties.

Chapter V
Promotional Measures

Section 94 The owner or possessor of any point source of pollution, who has the duty according to this Act or other related laws to install an on-site facility for treatment of polluted air or wastewaters or for disposal of any other wastes, including the procurement of equipment, instrument, tools, appliances or materials necessary for control of pollution from such point source, or the Service Contractor licensed pursuant to this Act, is entitled to request for promotional supports and assistance from the government service in the following matters :

(1) Request for assistance regarding import duties for the import into the Kingdom of necessary machinery, equipment, instrument, tools, appliances or materials which are not available in the Kingdom.

(2) Application for permission to bring foreign experts or specialists into the country to carry out works concerning the installation, monitoring, control or operation of air pollution control systems, wastewater treatment works or waste disposal facilities in case qualified persons within the Kingdom are not available for recruitment and commissioning to supervise and control machinery, equipment, instrument or tools imported into the Kingdom pursuant to sub-section (1), including application for exemption of income tax that will incur from the performance of work as a supervisor of such person within the Kingdom.

The owner or possessor of the point source of pollution who has no legal duty as referred to in the foregoing first paragraph, but nonetheless wishes to install an on-site facility with his own equipment, instrument, tools or appliances for air pollution control, wastewater treatment or for disposal of other wastes eminated from his activities or business undertakings, is also entitled to request for promotional supports and assistance from the government service in accordance with the foregoing first paragraph.

Section 95 The request for promotional supports and assistance according to section 94 shall be made to the National Environment Board in accordance with the rules, procedures, methods

APPENDIX 2

ENHANCEMENT AND CONSERVATION OF NATIONAL ENVIRONMENTAL QUALITY ACT B.E. 2535

ENHANCEMENT AND CONSERVATION OF NATIONAL ENVIRONMENTAL QUALITY ACT B.E. 2535

TRANSLTAED BY ENVIRONMENT LAW CENTER

PUBLISHED BY DEPARTMENT OF ENVIRONMENTAL QUALITY PROMOTION
MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT

ENHANCEMENT AND CONSERVATION OF NATIONAL ENVIRONMENTAL QUALITY ACT, B.E. 2535

BHUMIBOL ADULYADEJ, REX.
Given on the 29th Day of March B.E. 2535,
Being the 47th Year of the Present Reign

His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that :

Whereas it is deem expedient to reform and improve the law on enhancement and conservation of national environmental quality.

Be it, therefore, enacted by the King, by and with the advice and consent of the National Legislative Assembly. acting as the National Assembly, as follows :

Section 1 This Act shall be called "The Enhancement and Conservation of National Environmental Quality Act. B.E. 2535"

Section 2 This Act shall come into effect after the elapse of a period of sixty days from the date following its publication in the Government Gazette.

Section 3 The following Acts shall be repealed :

(1) The Enhancement and Conservation of National Environmental Quality Act, B.E. 2518.

(2) The Enhancement and Conservation of National Environmental Quality Act (No. 2), B.E. 2521.

(3) The Enhancement and Conservation of National Environmental Quality Act (No. 3), B.E. 2522.

Section 4 In this Act,

"**Environment**" means natural things which form the physical and biological conditions surrounding man and man-made things.

"**Environmental Quality**" means the balance of nature, being composed of animals, plants, natural resources and man-made objects which is for the benefit of subsistence of mankind and the sustenance of human-being and nature.

"**Environmental Quality Standards**" means the parameters of quality standards for water, air, noise and other conditions of the environment which are determined as the general criteria for enhancement and conservation of environmental quality.

"**Fund**" means the Environmental Fund.

"**Pollutant**" means wastes, hazardous substances and other polluting substances as well as residues. sediments or remainders of such matters, which are discharged from point sources of pollution or naturally occur in the environment, that have or are likely to have impacts on environmental quality or to cause conditions poisonous or harmful to the health and hygiene of the public, and shall mean to include radiation, heat, light, noise, odour, vibration or other nuisances eminated or

discharged from point sources of pollution.

"Pollution" means the state or environment that has been affected, changed or contaminated by pollutants, resulting in deterioration of environmental quality. such as water pollution, air pollution, soil pollution.

"Point Source of Pollution" means any community, factory, building, structure, vehicle, place of business or activity or any other thing from which pollution is generated.

"Waste" means refuse, garbage, filth, dirt, wastewater. polluted air, polluting substances or any other hazardous substances which are discharged or originated from point sources of pollution, including residues, sediments or remainders of such matters, either in the state of solid, liquid or gas.

"Wastewater" means waste in liquid state including polluting or contaminating substances contained in such liquid.

"Polluted Air" means waste in gaseous state in the form of vapour, steam, exhaust, fume, odour. smoke, gas, dust, soot, ash or other polluting substances in the form of particulate matters that can be suspended in the atmospheric air.

"Hazardous Substance" means explosive substances. inflammable substances, oxidizing and peroxiding substances, toxic substances, pathogenic substances, radioactive substances, genetic transforming substances, corrosive substances, irritating substances, or other substances whether chemical or not, which may cause danger to human-being, animal, plant, property or the environment.

"Nuisance" means nuisance according to the law on public health.

"Factory" means factories according to the law on industrial plants.

"Building" means buildings according to the law on building control.

"Vehicle" means automobiles or motorcycles according to the law on automobiles, vessels according to the law on Thai vessels and aircrafts according to the law on aviation.

"Monitoring Control Operator" means the person licensed to monitor, control. assess, operate and maintain wastewater treatment or waste disposal facility, or equipment, instrument, tools, appliances for control, treatment or disposal of any other pollution, which the owner or possessor of point source of pollution manages to construct and bring into operation by his own investment and expenses for the treatment of wastewaters or disposal of wastes or any other pollutants.

"Service Contractor" means the person licensed to render for hire the services of wastewater treatment or waste disposal or monitoring of environmental quality.

"Conservation Area" means the areas designated as national parks, wildlife reserves, tourism preserve and other protected areas pursuant to the governing laws related thereto.

"Local Official" means

(1) President of the Municipal Council within a municipality.

(2) President of the Sanitary District Board within a sanitary district.

(3) Changwat Governor within a local administration organization.

(4) Governor of the Bangkok Metropolitan Administration within Bangkok Metropolis.

(5) Permanent Secretary of Pattaya City Administration within the City of Pattaya.

(6) Head of local administrator in the administration of the local administration organization other than (1) to (5) above, established by specific law governing thereof, within such local administration organization.

"Pollution Control Official" means the person appointed by the Minister to perform the functions concerning pollution control under this Act.

"Competent Official" means the person appointed by the Minister to have power and duty to take action under this Act.

"Minister" means the Minister of Science, Technology and Environment.

Section 5 In case any provision under this Act refers to Changwat or mandates the power and duty of the Changwat Governor, such reference or mandate shall denote the inclusion of Bangkok Metropolitan Administration or the power and duty of the Governor of Bangkok Metropolitan Administration, as may be the case.

Section 6 For the purpose of public participation in the enhancement and conservation of national environmental quality, the following rights and duties may be accorded to individual person as provided by this Act or governing law related thereto :

(1) To be informed and obtain information and data from the government service in matters concerning the enhancement and conservation of environmental quality, except the information or data that are officially classified as secret intelligence pertaining to national security, or secrets pertaining to the right to privacy, property rights, or the rights in trade or business of any person which are duly protected by law.

(2) To be remedied or compensated by the State in case damage or injury is sustained as a consequence of dangers arisen from contamination by pollutants or spread of pollution, and such incident is caused by any activity or project initiated, supported or undertaken by government agency or state enterprise.

(3) To petition or lodge complaint against the offender in case of being a witness to any act committed in violation or infringement of the laws relating to pollution control or conservation of natural resources.

(4) To co-operate and assist government officials in the performance of duty relating to the enhancement and conservation of environmental quality.

(5) To strictly observe the provisions of this Act or other laws concerning the enhancement and conservation of environmental quality.

Section 7 In order to encourage public participation in the promotion and conservation of environmental quality, non-governmental organizations (NGOs) having the status of a juristic person under Thai law or foreign law which are directly engaged in activities concerning environmental protection or conservation of natural resources without any objective to be involved in politics or to make profits from the engagement in such activities, shall be entitled to register with the Ministry of Science, Technology and Environment as the NGOs for environmental protection and conservation of natural resources in accordance with the rules, procedures and conditions prescribed by ministerial regulation.

Section 8 The NGOs that have been registered pursuant to section 7 may request for government assistance or support in the following matters :

(1) The organization of volunteers to assist in the performance of duty of government officials under this Act or other laws concerning the enhancement and conservation of environmental quality.

(2) Public relations campaign and dissemination of information or data to promote public awareness and proper understanding and knowledge about environmental protection and conservation of nature and natural resources.

(3) Providing assistance to people in certain areas of the country to initiate projects or activities for environmental protection and conservation of natural resources in such areas.

(4) Conducting study and research in respect of environmental protection and conservation of natural resources and bringing to the attention of the Government or agencies concerned on what are the viewpoints and suggestions based upon the outcome of such study and research.

(5) Providing legal aid to people who are in jeopardy of or afflicted by pollution damage caused by leakage of pollutants or contamination as well as acting as representative of such pollution victims to bring lawsuit and litigate claim in court for compensation or damages to which they are entitled as legal remedies.

In case any registered NGOs, in the carrying out of activities indicated in the first paragraph, encounter problems or difficulties and request for help from the National Environment Board, the Prime Minister shall, with the recommendation of the National Environment board, have the power to direct for appropriate recourse or order the government agency or state enterprise concerned to render assistance or facilitation as seen fit under the circumstances.

The Fund Committee, with the approval of the National Environment Board, may consider to allocate grants or loans in support of any activity of the registered NGOs as deemed appropriate.

The registered NGOs may propose for nomination of candidates as representatives of the private sector to be appointed by the cabinet as qualified members of the National Environment Board.

In case any registered NGO's activities are undertaken by causing disturbances or contrary to public order or unsuitable, the Minister shall have the power to revoke the registration of the NGO involving in such activities.

Section 9 In case there is an emergency or public danger arising from natural disaster or pollution caused by contamination and spread of pollutants which will, if left without any remedial actions, seriously endanger the safety of life, body or health of the people, or aggravatedly cause damage to the properties of the people or the State, the Prime Minister shall have the power to order, as deemed appropriate, government agencies, state enterprises or any persons, including the persons who are or may be the victims of such danger or damage, to take prompt action, individually or jointly, in order to be able to control, extinguish or mitigate the adverse effects of such danger or damage. In case any polluters are known and can be identified, the Prime Minister shall be empowered to enjoin such persons from any acts which may aggravate the adverse effects of pollution during the occurrence of such endangering incident.

The Prime Minister may delegate the power to give orders pursuant to the first paragraph to the Changwat Governor to exercise such power and act on his behalf within the territorial jurisdiction of that Changwat. The said delegation of power shall be made by a written order and published in the Government Gazette.

When any order is given by the Prime Minister by virtue of the first paragraph, or by the Changwat Governor acting on behalf of the Prime Minister by virtue of the second paragraph, such order shall be published in the Government Gazette without delay.

Section 10 In order to prevent, remedy, extinguish or mitigate the emergency or danger of pollution envisaged by section 9, the Minister shall determine preventive measures and prepare a contingency plan to rectify the situation in advance.

Section 11 The Prime Minister and the Minister of Science, Technology and Environment shall have charge and control of the execution of this Act, insofar as it is concerned with their respective powers and duties conferred upon them under this Act.

The Minister of Science, Technology and Environment shall have the power to appoint pollution control officials and other competent officials, issue ministerial regulations prescribing fees not exceeding the rates attached hereto and prescribing other activities for the execution of this Act.

The Ministerial Regulations shall come into force upon their publication in the Government Gazette.

Chapter I
National Environment Board

Section 12 There shall be a National Environment Board consisting of the Prime Minister as the Chairman, a Deputy Prime Minister designated by the Prime Minister as the first Vice Chairman, the Minister of Science, Technology and Environment as the second Vice Chairman, the Minister of Defence, the Minister of Finance, the Minister of Agriculture and Cooperatives, the Minister of Transport and Communications, the Minister of Interior, the Minister of Education, the Minister of Public Health, the Minister of Industry, the Secretary-General of the National Economic and Social Development Board, the Secretary-General of the Board of Investment, the Director of the Bureau of the Budget as members *ex officio* and members qualified in environmental matters not more than eight persons of which no less than half shall be representatives from the private sector and the Permanent Secretary of the Ministry of Science, Technology and Environment as member and secretary.

The appointment of qualified members shall be made by drawing from persons who are knowledgeable and known for their expertises, contributions and experiences in the matters concerning the enhancement and conservation of environmental quality.

Section 13 The National Environment Board shall have the power and duty as follows :

(1) To submit policy and plan for enhancement and conservation of national environmental quality to the cabinet for approval.

(2) To prescribe environmental quality standards pursuant to section 32.

(3) To consider and give approval to the Environmental Quality Management Plan proposed by the Minister according to section 35.

(4) To consider and give approval to the Changwat Action Plan for environmental quality management according to section 37.

(5) To make recommendations to the cabinet in respect of financial, fiscal, taxation and investment promotion measures for the implementation of the policy and plan for enhancement and conservation of national environmental quality.

(6) To propose for amendment or improvement of laws relating to the enhancement and

conservation of environmental quality to the cabinet.

(7) To consider and give approval to the action plan for prevention and remedy of danger caused by contamination of pollutants or spread of pollution proposed by the Pollution Control Committee pursuant to section 53 (1).

(8) To consider and give approval to the setting of emission or effluent standards proposed by the Minister pursuant to section 55.

(9) To supervise, oversee and expedite the enactment of royal decrees and issuance of ministerial regulations, rules, local ordinances, notifications, bye-laws and orders which are necessary to ensure systematic operation of the laws relating to enhancement and conservation of environmental quality to the fullest extent possible.

(10) To submit opinion to the Prime Minister for his directions in case it appears that any government agency or state enterprise infringes or refrains from complying with the laws and regulations for environmental protection which may cause extensive damage to the environment.

(11) To specify measures for the strengthening and fostering of co-operation and co-ordination among government agencies, state enterprises and the private sector in matters concerning the promotion and conservation of environmental quality.

(12) To supervise the Fund management and administration.

(13) To submit reports on national environmental quality situation to the cabinet at least once a year.

(14) To perform other functions as may be provided by this Act or other laws to be within the authority of the National Environment Board.

Section 14 A qualified member appointed by the cabinet shall hold office for a term of three years and may be re-appointed for a period of not more than one consecutive term.

In case an additional appointment of qualified member is made during the term of those members who have already been appointed to hold office, the term of additional membership shall be equal to the remainder of the term of those members who have already been appointed before.

Section 15 In addition to the expiration of the term of office according to section 14, a qualified member appointed by the cabinet shall vacate office upon :

(1) death;

(2) resignation;

(3) being a bankrupt:

(4) being an incompetent or quasi-incompetent person;

(5) being punished by a final judgement to a term of imprisonment except for an offence committed through negligence or a petty offence.

(6) Being dismissed by the cabinet for incompetence or misconduct or having vested interests in any activity or business that may have a direct impact on or adversely affect the environmental quality.

When a qualified member vacates office before the expiration of his term of office, the cabinet may appoint another person to fill the vacancy and such person shall hold office only for the remaining

term of his predecessor.

Section 16 In convening the National Environment Board meeting, if the Chairman is absent or unable to perform the function, the first Vice Chairman shall act as the Chairman. If the Chairman and the first Vice Chairman are both absent or unable to perform the function, the second Vice Chairman shall act as the Chairman. If the Chairman and both the two Vice Chairmen are all absent or unable to perform the function, the members who attend the meeting shall elect one of the attending members to act as the chairman of the meeting.

Section 17 A meeting of the National Environment Board requires the presence of not less than one-half of the total member of its members to constitute a quorum.

The decision of a meeting shall be made by a majority of votes. In casting votes, each member shall have one vote. In case of an equality of votes, the Chairman of the meeting shall have an additional vote as a casting vote.

Section 18 The National Environment Board may appoint an expert committee or subcommittee to consider or carry out any matter as may be entrusted by the National Environment Board.

Section 16 and section 17 shall apply *mutatis mutandis* to the meeting of the expert committee or subcommitee.

Section 19 The National Environment Board shall have the power to require government agencies, state enterprises and other persons to deliver documents relating to the examination of impacts on environmental quality and documents or data concerning the projects or workplans of such government agencies, state enterprises and persons for its consideration. For this purpose, the Board may summon persons concerned to give explanation. If the Board is of the opinion that any project or workplan may seriously affect the environmental quality, it shall recommend remedial measures to the cabinet.

In case the documents or data required to be delivered to the National Environment Board pursuant to the first paragraph are relevant to trade secrets in the nature of a patent and protected by the law on patent rights, the National Environment Board shall specify suitable measures and methods for preventing such documents or data from being disclosed to anyone to ensure that they shall only be used strictly for the purpose of this section.

Section 20 In the performance of its function, the National Environment Board, the expert committee or the sub-committee may invite any person to present facts, explanation, opinion or technical advice as it deems fit and may request co-operation from any person with a view to ascertaining any fact or surveying any activity which may have an adverse effect on environmental quality.

Section 21 In the performance of its duties under this Act, the National Environment Board may entrust the Office of Environmental Policy and Planning, the Pollution Control Department or the Environmental Quality Promotion Department under the Ministry of Science, Technology and Environment with the operation or preparation of propositions to be made to the National Environment Board for further actions.

Chapter II
Environmental Fund

Section 22 There shall be established a fund called the "Environmental Fund" in the Ministry of Finance with the following moneys and properties :

(1) Money from the Fuel Oil Fund in the amount determined by the Prime Minister.

(2) Money transfered from the Revolving Fund for Environmental Development and Quality of Life established by the Annual Budget for the Fiscal Year of B.E. 2535 Act, B.E. 2535.

(3) Service fees and penalties collected by virtue of this Act.

(4) Grants from the Government from time to time.

(5) Moneys or properties donated by donors in the private sector both domestic and foreign, by foreign governments or by international organizations.

(6) Interest and benefits accrued from this Fund.

(7) Other moneys received for the operation of this Fund.

The Comptroller-General's Department, Ministry of Finance, shall keep the moneys and properties of the Environmental Fund and make disbursements from the fund in accordance with this Act.

Section 23 Fund disbursements shall be made for the following activities and purposes :

(1) As grants to government agency or local administration for investment in and operation of the central wastewater treatment plant or central waste disposal facility, including the acquisition and procurement of land, materials, equipment, instrument. tools and appliances necessary for the operation and maintenance of such facility.

(2) As loans to local administration or state enterprise for making available of air pollution control system, wastewater treatment or waste disposal facilities to be used specifically in the activities of such local administration or state enterprise.

(3) As loans to private person in case such person has the legal duty to make available and install an on-site facility of his own for the treatment of polluted air, wastewater or waste disposal or any other equipment for the control, treatment or eliminate pollutants that are generated by his activity or business undertaking, or such person is licensed to undertake business as a Service Contractor to render services of wastewater treatment or waste disposal under this Act.

(4) As aids or grants to support any activity concerning the promotion and conservation of environmental quality as the Fund Committee sees fit and with the approval of the National Environment Board.

(5) As expenditures for administering the Fund.

Section 24 There shall be a Fund Committee consisting of the Permanent Secretary of the Ministry of Science, Technology and Environment as the Chairman, the Permanent Secretary of the Ministry of Agriculture and Cooperatives, the Secretary-General of the National Economic and Social Development Board, the Director of the Bureau of the Budget. the Director-General of the Department of Local Administration. the Comptroller-General of the Comptroller-General's Department, the Director-General of the Department of Public Works, the Director-General of the Department of Industrial

Works, the Director-General of the Department of Mineral Resources, the Director-General of the Pollution Control Department, the Director-General of the Environmental Quality Promotion Department and not more than five qualified persons appointed by the National Environment Board as members and the Secretary-General of the Office of Environmental Policy and Planning as member and secretary.

Section 14 and section 15 shall apply *mutatis mutandis* to the holding office of the qualified members of the Fund Committee.

Section 25 The Fund Committee shall have the power and duty as follows :

(1) To consider on Fund allocation for use in the activities prescribed by section 23.

(2) To prescribe rules, conditions, procedures and methods concerning application for allocation or loan from the Fund.

(3) To lay down administrative rules and procedures concerning the power, duties and working methods of the Fund managers according to section 29 and section 30 as well as mechanisms for co-ordination among the Fund Committee, the Comptroller-General's Department and the Fund managers according to section 29 and section 30.

(4) To lay down rules and procedures for the receipt and disbursement of moneys from the Fund.

(5) To fix durations for repayment of loans from the Fund according to section 23 (2) or (3) as well as interest rates and securities as necessary and appropriate.

(6) To determine the ratio and criteria for deduction of service fees and penalties that are required by section 93 to be remitted to the Fund.

(7) To perform any other functions provided under this Act.

The prescription of rules according to sub-section (2), (3) or (4) and guidelines for action under sub-section (1) or (5) shall be approved by the National Environment Board.

The Fund Committee may appoint a subcommittee to consider or carry out any matter as may be entrusted by the Fund Committee.

Section 26 Section 16, section 17 and section 20 shall apply *mutatis mutandis* to the performance of functions of the Fund Committee and the subcommittee appointed by the Fund Committee.

Section 27 In consideration to allocate money from the Fund for the purpose of section 23 (1), the Fund Committee shall give first priority to the request for allocation under the Changwat Action Plan for environmental quality management according to section 39 to construct or operate the wastewater treatment plant or waste disposal facility, for which certain amount of government budget has been earmarked or revenues of the local administration have been allocated as additional contributions to the Fund allocation.

The proportion between the government budget or contributions from the local revenues and the Fund allocation to be determined by the Fund Committee according to the first paragraph shall be determined in accordance with the rules laid down by the National Environment Board.

Section 28 The Fund allocation as loans to the local administration, state enterprise or private person pursuant to section 23 (2) or (3) shall be determined by the Fund Committee in accordance with the rules and conditions stipulated by the National Environment Borad.

In order to encourage compliance with this Act, the Fund Committee may, with the approval of the National Environment Board, allocate from the Fund as an exceptional long-term loan to any local administration, state enterprise, or private person and may determine to reduce the interest rates or make exemption to the payment of such interest as deemed appropriate.

Section 29 The Comptroller-General of the Comptroller-General's Department, Ministry of Finance, shall be the Fund manager in relation to such portion of the Fund to be allocated as grants to the government agency or the local administration for investment in and operation of the central facility for wastewater treatment or waste disposal according to section 23 (1) and those portions of the Fund to be allocated for the purposes other than those provided by section 23 (2) and (3).

Section 30 The Fund Committee may authorize an appropriate financial institution owned by the State or the Industrial Financing Corporation of Thailand to be the Fund manager in relation to such portion of the Fund that will be allocated as loans to the local administration, state enterprise or private person pursuant to section 23 (2) or (3).

In carrying out the management of Fund according to the First paragraph, the Fund manager has the duty to study and analyse the investment and technical feasibility of the project and shall be empowered to enter the loan agreement on behalf of the Fund Committee in the capacity as the lender, to keep and disburse moneys to the borrowers from this portion of the Fund in accordance with the terms and conditions of the loan agreement, to pursue, demand and receive repayments and interest from the borrowers in order to pay back to the Fund, and shall be empowered to lay down rules and procedures, with the approval of the Fund Committee, for such matters.

Under the loan agreement to be entered into according to the second paragraph, there must be a condition stipulated as an essential element of the agreement that the borrower shall have the duty to make use of the loan specifically for the purpose of meeting the requirements with which the borrower has the legal duty to comply under this Act or other related laws.

Section 31 The moneys received into the Fund and kept by the Comptroller-General's Department, Ministry of Finance, shall be managed by deposit in saving or fixed accounts with State-owned financial institutions in order to earn accrued interest.

All moneys earned by the Fund according to section 22 shall be paid into its account for the purpose of uses in the activities indicated in section 23 and shall not be remitted to the Treasury as revenues of the Government.

It shall be the duty of all government agencies concerned to take actions within their powers and functions that are necessary for effective implementation of the Environmental Quality Management Plan and in order to ensure that actions are taken to achieve the objectives and goals as prescribed, it shall be the duty of the Ministry of Science, Technology and Environment to give advice to government agencies and state enterprises which are concerned with the formulation of workplans or the taking of any actions with a view to implementing the Environmental Quality Management Plan.

Section 36 The Environmental Quality Management Plan pursuant to section 35 may be a short, intermediate or long-term plan, as appropriate, and should contain workplans and guidances for action in the following matters :

(1) Management of air, water and environmental quality in any other area of concerns.

(2) Pollution control from point sources.

(3) Conservation of natural environment, natural resources or caltural environment pertaining to aesthetic values.

(4) Estimation of financing to be appropriated from government budget and allocated from the Fund which is necessary for implementation of the Plan.

(5) Scheme for institutional arrangements and administrative orders by which co-operation and co-ordination among government agencies concerned and between the public service and private sector could be further promoted and strengthened, including the determination of a manpower allocation scheme which is required for implementation of the Plan.

(6) Enactment of laws and issuance of regulations, local ordinances, rules, orders and notifications necessary for implementation of the Plan.

(7) Scheme for inspection, monitoring and assessment of environmental quality by which the results of implementation of the Plan and enforcement of law related thereto can be evaluated objectively.

Section 37 After the Environmental Quality Management Plan has been published in the Government Gazette, it shall be the duty of the Governor of the Changwat, in which there is a locality designated as environmentally protected area according to section 43, or as pollution control area according to section 59, to formulate an action plan for environmental quality management at Changwat level and submit it to the National Environment Board for approval within one hundred and twenty days from the date on which the Governor of that Chanwat is directed by the National Environment Board to prepare the Changwat action plan for environmental quality management. If, however, there is a reasonable ground, the said duration may be extended as appropriate by the National Environment Board.

In preparing a Changwat Action Plan for the pollution control area according to section 59, the Governor shall incorporate into it the action plan for mitigation and elimination of pollution prepared by the local authority pursuant to section 60 and the local action plan shall form an integral part of the Changwat Action Plan.

In case there is any Changwat, in which no locality is designated as an environmentally protected area according to section 43, or as pollution control area according to section 59, that is nevertheless desirous to enhance and conserve the environmental quality within the limits of its territorial jurisdiction, the Governor of that Changwat may prepare a Changwat Action Plan, within the

framework of and in conformity with the requirements of the Environmental Quality Management Plan, and submit it to the National Environment Board for approval.

Section 38 The Changwat Action Plan to be submitted to the National Environment Board shall be an action plan which proposes a system of integrated management of environmental quality in conformity with the guidances specified in the Environmental Quality Management Plan, taking into account the severity of the problems and economic, social and environmental conditions of that Changwat, and should address and contain essential elements in the following matters :

(1) Plan for control of pollution from point sources.

(2) Plan for procurement and acquisition of land, materials, equipment, tools and appliances which are essential for the construction, installation, improvement, modification, repair, maintenance and operation of central wastewater treatment plants or central waste disposal facilities belonging to government agency or local administration concerned.

(3) Plan for collection of taxes, duties and service fees for operation and maintenance of central wastewater treatment plants or central waste disposal facilities referred to in sub-section (2) above.

(4) Plan for inspection, monitoring and control of wastewaters and other waste matters which are discharged from point sources of pollution.

(5) Law enforcement plan for the prevention and suppression of violation or infringement of laws and regulations pertaining to pollution control and conservation of nature, natural resources and cultural environment pertaining to aesthetic values.

Section 39 The Changwat Action Plan for environmental quality management to be given first priority for the consideration of the National Environment Board must propose an estimate of budgetary appropriation and allocation from the Fund for the construction or procurement for the acquisition of a central wastewater treatment plant or a central waste disposal facility pursuant to section 38 (2). In case any Changwat is not ready to take steps for the procurement and acquisition of the central wastewater treatment plant or the central waste disposal facility, it may instead propose a plan to promote private investment in the construction and operation of wastewater treatment or waste disposal facilities in order to make available of such services within its jurisdiction.

The Changwat Action Plan to be prepared according to the first paragraph with a request for budgetary appropriation and allocation from the Fund shall be accompanied by drawings, plans, specifications and an estimated price of the project for construction, installation, improvement, modification, repair, maintenance as well as the process and method for operation of the proposed central wastewater treatment plant or central waste disposal facility.

For the purpose of approving the Changwat Action Plan with a request for budgetary appropriation in accordance with the first paragraph, the Office of Environmental Policy and Planning shall be responsible for the gathering and analysis of the Changwat Action Plans for environmental quality management in order to make a proposal for annual budgets of the Office to be earmarked specifically for this purpose.

Section 40 In case the management of environmental quality in any matters will have to be carried out in an area adjoining the territorial jurisdictions of two or more provinces due to the geographical conditions or the characteristics of the natural ecosystems of that area, or for the

purpose of a sound, systematic and proper management in accordance with the principle of integrated management of environmental quality and natural resources, the Governors of the relevant provinces shall jointly prepare the action plan mandatorily required by section 37.

Section 41 In case any Changwat, which is mandatorily required to prepare the action plan according to section 37, fails or is incapable to evolve such a plan, or has prepared and submitted the plan as required but failed to get the approval of the National Environment Board for any reason, the National Environment Board shall consider the nature of the problems encountered by that Changwat and evaluate whether its environmental quality is adversely affected to such an extent that any action is warrant to rectify the situation. If action is deemed necessary, the National Environment Board shall propose to the Prime Minister to issue an order directing the Ministry of Science, Technology and Environment to prepare the Changwat Action Plan on behalf of the Changwat in question.

Part 3
Conservation and Environmentally Protected Areas

Section 42 Protection and management of areas within the limits of national parks and wildlife reserves shall be in accordance with the Environmental Quality Management Plan effective by virtue of section 35 and governed by the laws related thereto.

Section 43 In case it appears that any area is characterized as watershed area, or characterized by unique natural ecosystems which are different from other areas in general, or naturally composed of fragile ecosystems which are sensitive and vulnerable to destruction or impacts of human activities, or worthy of being conserved due to its natural or aesthetic values or amenities, and such area is yet to be designated as a conservation area, the Minister shall, with the advice of the National Environment Board, be empowered to issue ministerial regulation designating such area as an environmentally protected area.

Section 44 In issuing the ministerial regulation pursuant to section 43, any one or more of the following protective measures shall be prescribed thereunder :

(1) Land use prescriptions for preserving the natural conditions of such area or for preventing its natural ecosystems or its aesthetic values or amenities from being adversely impacted.

(2) Prohibition of any acts or activities that may be harmful or adversely affect or change the pristine state of the ecosystems of such area.

(3) Specifying types and sizes of projects or activities undertaken by government agencies, state enterprises or private entities, to be constructed or operated in such area, which shall have the legal duty to submit reports of environmental impact assessment.

(4) Determination of management approach and method specific to the management of such area including the scope of functions and responsibilities of relevant government agencies for the purpose of co-operation and co-ordination that are conducive to efficient performance of work towards the preservation of natural conditions or ecosystems or aesthetic values and amenities in such area.

(5) Prescriptions of any other protective measures which are deemed proper and suitable to the conditions of such area.

Section 45 In any area, despite having been designted as a conservation area, a master town and country plan area, a specific town and country plan area, a building control area, an industrial estate area pursuant to the governing laws related thereto, or designated as a pollution control area pursuant to this Act, but which nevertheless appears to have been adversely affected by environmental problems which assume a critical proportion to such an extent that an immediate action has become imperative and yet no action is taken by government agencies concerned to rectify the situation due to a lack of clear legal authorization or otherwise failure to do so, the Minister shall, with the approval of the National Environment Board, propose for a cabinet authorization to take any one or several protective measures provided by section 44, as necessary and appropriate, in order to control and solve the problems in such area.

When cabinet authorization is obtained as provided in the first paragraph, the Minister shall, by notification published in the Government Gazette, determine the limits of such area and prescribe in detail the protective measures and the duration for which such measures shall be effectively taken therein.

With the approval of the National Environment Board and the cabinet, the duration of effectiveness specified according to the second paragraph may be extended by notification published in the Government Gazette.

Part 4
Environmental Impact Assessment

Section 46 For the purpose of environmental quality promotion and conservation, the Minister shall, with the approval of the National Environment Board, have the power to specify, by notification published in the Government Gazette types and sizes of projects or activities, likely to have environmental impact, of any government agency, state enterprise or private person, which are required to prepare reports on environmental assessment for submission to seek approval in accordance with section 47, section 48 and section 49.

In the notification issued according to the first paragraph, procedures, rules, methods and guidelines shall be laid down for the preparation of environmental impact assessment report for each type and size of project or activity, including related documents that are required to be filed together with the report.

In case there has been an environmental impact assessment concerning project or activity of any particular type or size, or site selection for such project or activity in any particular area and such assessment can be used as a standard assessment applicable to the project or activity of the same type or size or to the site selection of such project or activity in the area of similar nature, the Minister may, with the approval of the National Environment Board, issue a notification in the Government Gazette exempting such project or activity of the same or similar nature from the requirement of environmental impact assessment, provided that the proponent of such project or activity shall express its consent to comply with various measures prescribed in the environmental impact assessment report which is applicable as the standard for assessment of such project or activity in accordance with the rules and methods specified by the Minister.

Section 47 In case the project or activity which is required to prepare the environmental impact assessment according to section 46 is the project or activity of a government agency or of a

state enterprise or to be jointly undertaken with private enterprise which is required the approval of the cabinet in accordance with official rules and regulations, the government agency or state enterprise responsible for such project or activity shall have the duty to prepare the environmental impact assessment report at the stage of conducting a feasibility study for such project, such report shall be filed with the National Environment Board for its review and comments and then submitted to the cabinet for consideration.

In considering to give approval to the environmental impact assessment report filed according to the first paragraph, the cabinet may as well request any person or institution, being an expert or specialized in environmental impact assessment, to study and submit report or opinion for its consideration thereof.

For project or activity of government agency or state enterprise which is not required to be approved by the cabinet according to the first paragraph, the government agency or state enterprise responsible for such project or activity shall prepare and file the environmental impact assessment report in order to obtain approval prior to the initiation of such project or activity in accordance with the rules and procedures as provided by section 48 and 49.

Section 48 In case the project or activity which is required by section 46 to prepare the environmental impact assessment report is the project or activity which is required by law to obtain permission prior to construction or operation, the person applying for the permission shall have the duty to file the environmental impact assessment report with the permitting authority under such law and with the Office of Environmental Policy and Planning simultaneously. The report to be filed as aforesaid may be made in the form of an initial environmental examination (I.E.E.) in accordance with the rules and procedures determined by the Minister pursuant to section 46. second paragraph.

The official who is legally authorized to grant permission shall withhold the granting of permission for the project or activity referred to in the first paragraph until having been notified by the Office of Environmental Policy and Planning of the result of consideration pertaining to the review of the environmental impact assessment report in accordance with section 49.

The Office of Environmental Policy and Planning shall examine the environmental impact assessment report and related documents filed therewith. If it is found that the report as filed is not correctly made in accordance with the rules and procedured specified by virtue of section 46, second paragraph, or the accompanied documents and data are incomplete. the Office of Environmental Policy and Planning shall notify the person applying for permission who files the report within fifteen days from the date of receiving such report.

In case the Office of Environmental Policy and Planning finds that the environmental impact assessment report together with related documents as filed is duly made and completed with the data as required, or has been duly amended or modified in accordance with the foregoing third paragraph, it shall review and make preliminary comments on the report within thirty days from the date of receiving such report in order that the report together with the preliminary comments shall be referred to the committee of experts for further consideration.

The appointment of the committee of experts according to the foregoing fourth paragraph shall be in accordance with the rules and procedures determined by the National Environment Board. The committee shall be composed of expert members who are qualified or specialized in various fields of related disciplines and the authority legally competent to grant permission for the given project or activity under review, or its representative, shall be included in its membership.

Section 49 The review and consideration by the committee of experts according to section 48 shall be carried out within forty-five days from the date of receiving the environmental impact assessment report from the Office of Environmental Policy and Planning. If the committee of experts fails to conclude its review and consideration within the said period, the report shall be deemed to have been approved by it.

In case the committee of experts approves or is deemed to have given approval to the report, the official legally empowered to grant permission shall accordingly order that the permission be granted to the person who applies for it.

In case approval of the report is denied by the committee of experts, the permitting authority shall withhold the granting of permission to the person applying for it until such person will resubmit the environmental impact assessment report that has been amended or entirely redone in conformity with the guidelines and detailed requirements determined by the order of the committee of experts.

When such person has resubmitted the environmental impact assessment report that has been amended or entirely redone, the committee of experts shall review and conclude its consideration within thirty days from the date of receiving the resubmitted report. If the committee of experts fails to conclude its review and consideration within the said period, it shall be deemed that the committee has approved the report and the permitting authority shall accordingly grant permission to the person who applies for it.

In case it is deemed reasonable the Minister may issue notification in the Government Gazette requiring that the project or activity of the type and size specified by the notification issued by virtue of section 46 also file the environmental impact assessment report when the application is made for renewal of permission for such project or activity in accordance with the same procedures as applicable to the application for the permission.

Section 50 For the purpose of review and consideration of the environmental impact assessment report pursuant to section 48 and section 49 and site inspection is deemed appropriate, the committee of experts or the competent official assigned by the committee shall be authorized to inspect the site of the project or activity identified in the report for which approval thereof is sought.

When the committee of experts has approved the environmental impact assessment report pursuant to section 49, the official who is legally competent to grant permission or the renewal of permission shall stipulate as the conditions of permission or renewal thereof all the mitigation measures proposed in the environment impact assessment report and all such conditions shall be deemed the conditions prescribed by virtue of the governing laws on the subject matter.

Section 51 For the purpose of compliance with section 47 and section 48, the Minister may, with the approval of the National Environment Board, require that the environmental impact assessment report as required by section 46 be prepared or certified by the person who is licensed to be a specialist in environmental impact assessment.

Application and issuance of licence, qualifications of specialists who will be eligible to prepare environmental impact assessment reports, control of the licensee's performance, renewal of licence, issuance of certificate in lieu of the licence, suspension or revocation of the licence and fee payments for the application and issuance of licence shall be in accordance with the rules, procedures and conditions stipulated by ministerial regulation.

Chapter IV
Pollution Control

Part 1
Pollution Control Committee

Section 52 For the purpose of pollution control under this Act. there shall be a committee called the "Pollution Control Committee" (PCC) which consists of the Permanent Secretary of the Ministry of Science, Technology and Environment as the Chairman. the Director-General of the Department of Local Administration, the Director-General of the Police Department, the Director-General of the Department of Land Transport, the Director-General of the Harbour Department, the Director-General of the Department of Public Works, the Director-General of the Department of Mineral Resources, the Director-General of the Department of Industrial Works, the Director-General of the Health Department, the Director-General of the Department of Agriculture, the Director-General of the Department of Environmental Quality Promotion, the Secretary-General of the Office of Environmental Policy and Planning, the Permanent Secretary for the Bangkok Metropolitan Administration and not more than five qualified persons appointed by the National Environmental Board as members and the Director-General of the Department of Pollution Control as member and secretary.

Section 14 and section 15 shall apply *mutatis mutandis* to the holding office of the qualified members in the Pollution Control Committee.

Section 53 The Polution Control Committee shall have the power and duty as follows :

(1) To submit an action plan for prevention or remedy of pollution harzards or contamination to the National Environment Board.

(2) To give opinion and recommend the National Environment Board on proposed amendments to or improvement of any laws cencerning the control, pevention. reduction or eradication of pollution.

(3) To propose incentive measures regarding taxation and private investment promotion in relation to pollution control and promotion and conservation of environmental quality to the National Environment Board.

(4) To recommend the National Environment Board on the determination of service fee rates for the central waste water treatment or central waste disposal services of the government.

(5) To give advice to the Minister on the setting of emission or effluent standards under section 55.

(6) To give advice to the Minister concerning the types of point sources of pollution that will be required to comply with section 68 and section 69.

(7) To make recommendation on the issuing of ministerial regulations specifying the types and categories of hazardous wastes under section 79.

(8) To coordinate government agencies, state enterprises and the private sector in their actions to control, prevent, mitigate or eradicate pollution.

(9) To prepare and submit the report on pollution situation to the National Environment Board once a year.

(10) To consider and resolve on the challenge to the order of the pollution control official under this Act.

(11) To perform other functions designated by this Act or other law to be the power and duty of the Pollution Control Committee.

(12) To carry out other matters assigned by the National Environment Board.

The Pollution Control Committe may appoint a subcommittee to consider or carry out any matter as may be assigned by the Pollution Control Committee.

Section 54 Section 16, section 17 and section 20 shall apply *mutatis mutandis* to the performance of functions of the Pollution Control Committee and subcommittee.

Part 2
Emission or Effluent Standards

Section 55 The Minister shall, with the advice of the Pollution Control Committee and the approval of the National Environment Board, have the power to publish notification in the Government Gazette prescribing emission or effluent standards for the control of wastewater discharge, pollutted air emissions, or discharge of other wastes or pollutants from point sources into the environment, in order to meet the environmental quality standards set by virtue of this Act for the conservation of national environmental quality.

Section 56 In case there have been standrads prescribed by virtue of the other laws concerning wastewater discharges, pollutted air emissions, or discharge of other wastes or pollutants from point sources of pollution into the environment and such standards are no less stringent than the emission or effluent standards set by the Minister by virtue of section 55, such standards shall continue to be effective by virtue of the laws related thereto. If however, such standards are less stringent than the emission or effluent standards set by the Minister pursuant to section 55, the government agencies empowered by such laws shall amend such standards in conformity with the emission or effluent standards under this Act. If there is any obstacle preventing from doing so, the National Environment Board shall resolve on such matter and the government agencies concerned shall act in accordance with such resolution.

Section 57 In case any government agency is empowered by the other law to prescribe emission or effluent standards in any matter, but that government agency fails to exercise its power. the Minister shall, with the recommendation of the Pollution Control Committee and with the approval of the National Environment Board, publish notification in the Government Gazette prescribing the emission or effluent standards in question and such standards shall be deemed to have been set by the governing law on such matter.

Section 58 If it is deemed reasonable, the Changwat Governor shall have the power to publish notification in the Government Gazette prescribing a special set of emission or effluent standards applicable to the pollution control area designated by section 59, higher than the standards set pursuant to section 55 or the standards set by virtue of other law which remain in force according to section 56.

Part 3
Pollution Control Area

Section 59 In case it appears that any locality is affected by pollution problems and there is a tendency that such problems may be aggravated to cause health hazards to the public or adverse impact on the environmental quality, the National Environment Board shall have power to publish notification in the Government Gazette designating such locality as a pollution control area in order to control. reduce and eliminate pollution.

Section 60 For the purpose of the Changwat Action Plan for environmental quality management to be prepared according to section 37, the local official in the locality designated as the pollution control area pursuant to section 59, shall prepare and submit an action plan for reduction and eradication of pollution in such area to the Changwat Governor in order to incorporate such plan into the Changwat Action Plan for environment quality management.

In preparing the action plan for reduction and eradication of pollution, steps shall be taken as follows :

(1) to survey and collect data concerning point sources of pollution located within the limits of that pollution control area.

(2) to make an inventory showing the number, type and size of point sources of pollution under survey and collection of data according to (1) above.

(3) to study, analyse and assess the state of pollution. as well as the scope, nature. severity of the problem and impacts on environmental quality in order to specify suitable and necessary measures for mitigation and eradication of pollution in that pollution control area.

The pollution control official shall give advice and assistance to the local official necessary for the preparation of the action plan to reduce and eradicate pollution according to the first and second paragraphs.

Section 61 The action plan for reduction and eradication of pollution in the pollution control area under section 60 shall propose the estimation and request for government budget and Fund allocations for construction or operation of the central wastewater treatment plant or the central waste disposal facility necessary to reduce and eradicate pollution in that pollution control area.

Section 62 In case it is necessary to acquire a piece of land to be used as the site of the central wastewater treatment or central waste disposal facility for any pollution control area but state-owned land is not available, steps shall be taken to select and acquire land for the siting purpose. If there are expenses, the estimate and request for government budget and Fund allocation shall be made in the Changwat Action Plan.

If it is unable to proceed under the first paragraph. suitable land shall be selected and proposed to the Minister in order to take steps to expropriate such land in accordance with the law on expropiation of immovable property.

Section 63 The Changwat Governor shall supervise and oversee the local official's actions under section 59. If no action is taken by the local official within a reasonable time, the Changwat Governor shall have the power to take action on behalf of the local authority upon notification to such

local authority and the National Environment Board.

Part 4
Air and Noise Pollution

Section 64 Usable vehicle shall conform to the emission standards prescribed for such vehicle pursuant to section 55.

Section 65 If it is found that the use of any vehicle is in violation of section 64, the competent official shall have the power to prohibit the use of such vehicle permanently or until it will have been modified or improved to meet the emission standard requirements prescribed pursuant to section 55.

Section 66 In issuing the order prohibiting to use of vehicle according to section 65, the competent official shall make the sign clearly shown by the words "Use Prohibited Permanently" or "Use Prohibited temporarily" or any other sign, known and understood by the general public to have the same meaning, on any part of such vehicle.

The making or removal of the sign under the first paragraph, or the use of vehicle while the said sign is on, shall be in accordance with the rules, methods and conditions specified in the ministerial regulation.

Section 67 In performing his duty under section 65, the competent official has the power to stop and inspect the vehicle, enter into the vehicle or to do any act necessary to check and test the engine and equipment of such vehicle.

Section 68 The Minister shall, with the advice of the Pollution Control Committee, have the power to publish notification in the Government Gazette specifying the types of point sources of pollution that shall be controlled in regard to the emission of polluted air, ray, or other pollutants, in the form of smoke, fume, gas, soot, dust, ash, particle or any other form of air pollutant, to the atmosphere, in conformity with the emission standards prescribed under section 55, or standards prescribed by any government agency by virtue of the other law which remain in force according to section 56, or standards set by the Changwat Governer in special case for the pollution control area according to section 58.

The owner or possessor of the point source of pollution under the first paragraph has the duty to install or bring into operation an on-site facility for air pollution control, equipment or other instrument as determined by the pollution control official in order to control, dispose, reduce or eliminate pollutants which may affect the air quality, unless such facility, equipment or instrument has already been in place and still in a working condition upon the inspection and test by the pollution control official. For the purpose of this section, the pollution control official may also require that the operation of such facility, equipment or instrument be controlled by the Monitoring Control Operator.

The provisions of the first and second paragraphs shall apply *mutatis mutandis* to the point source of pollution which emit or generate noise or vibration in excess of the emission standards set pursuant to section 55, or the standards set by any government agency by virtue the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Part 5
Water Pollution

Section 69 The Minister shall, with the advice of the Pollution Control Committee, have the power to publish notification in the Government Gazette specifying the types of point sources of pollution that shall be controlled in regard to the discharge of wastewaters or wastes into public water sources or into the environment outside the limits of such point sources, in conformity with the effluent standards set pursuant to section 55, or the standards set by any government agency by virtue of the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Section 70 The owner or possessor of the point source of pollution under section 69 has the duty to construct, install or bring into operation an on-site facility for wastewater treatment or waste disposal as determined by the pollution control official. For this purpose, the pollution control official may also require that such owner or possessor commission a Monitoring Control Operator to control the wastewater treatment or waste disposal facility that shall be constructed, installed or brought into operation accordingly.

If any point source of pollution has had an on-site facility for wastewater treatment or waste disposal before the date of notification of the Minister under section 69, the owner or possessor of such point source of pollution shall inform the pollution control official to check the functioning system of the facility. If its capability to treat wastewaters or dispose of wastes fails to meet the applicable standards, the owner or possessor has the duty to modify or improve it in conformity with the pollution control official's directions.

Section 71 In any pollution control area or locality where a central wastewater treatment plant or a central waste disposal facility has been brought into operation by the administration concerned, the owner or possessor of the point source of pollution according to section 70, first paragraph, who has not yet constructed, installed or brought into operation the on-site facility for wastewater treatment or waste disposal according to the prescription of the pollution control official, or may not want to construct or make arrangements for such a system, shall have the duty to send the wastewaters or wastes generated by his activities to the central wastewater treatment plant or central waste disposal facility in the pollution control area or in that locality for treatment or disposal and shall have the duty to pay the service fees at the rates fixed by virtue of this Act or the other related laws.

Section 72 In any pollution control area or locality where the central waste water treatment plant or central waste disposal facility has been brought into operation by the administration concerned, the owner or possessor of any point source of pollution, except those under section 69, shall have the duty to send wastewaters or wastes from his source of pollution to the central waste water treatment plant or the central waste disposal facility in that pollution control area or locality for treatment or disposal and shall have the duty to pay service fees at the rates fixed by virtue of this Act or the other related laws, except such point source of pollution has already had its own wastewater treatment or waste disposal facility which is capable to meet the standards prescribed under this Act.

Section 73 No person shall be employed as a Monitoring Control Operator or as a Service Contractor, who renders for hire the services of wastewater treatment or waste disposal, without obtaining the licence from the local official.

Application and issuance of licence, qualifications of the applicant, control of the licensee's performance, renewal of licence, issuance of certificate in lieu of the licence, suspension or revocation of the licence and fee payments for the application and issuance of licence shall be in accordance with the rules, procedures and conditions stipulated by ministerial regulation.

The person who has obtained a licence to be a Service Contractor shall also be deemed to have obtained a licence to be a Monitoring Control Operator.

In rendering the services of wastewater treatment or waste disposal by the Service Contractor according to the first paragraph, the service charges shall not exceed the rates fixed by the ministerial regulation.

Section 74 In any pollution control area or locality where the central wastewater treatment or central waste disposal facility of the public service is yet to be put into operation, but there is nonetheless a Service Contractor who is licensed to render such services within that area, the owner or possessor of the point source of pollution according to section 70 and section 71 shall be required to send the wastewaters or wastes from his point source for treatment or disposal by such Service Contractor in accordance with the rules, regulations, methods and conditions prescribed by the local official, with the advice of the pollution control official.

Section 75 In any pollution control area or locality where the central wastewater treatment or central waste disposal facility is yet to be put into service by the government and there is no licensed Service Contractor rendering services therein, the local official may, with the advice of the pollution control official, determine a temporary method necessary for the treatment of wastewaters or disposal of wastes from point sources of pollution under section 70 and section 71 until the central wastewater treatment or central waste disposal facility will have been constructed, installed and put into operation within such pollution control area or locality.

The temporary method for wastewater treatment or waste disposal according to the first paragraph shall mean to include the collection, transport or conveyance of wastewaters or wastes by whatever appropriate means to be treated or disposed by the central wastewater treatment plant or central waste disposal facility of the government in the other area; or to allow the licensed Service Contractor rendering services in the other area to render the same services in that pollution control area or locality temporarily; or to allow such licensed Service Contractor to collect and transport wastewaters or wastes to treat or dispose by his own wastewater treatment or waste disposal facility located outside that pollution control area or locality.

Section 76 Wastewaters treated by either the central wastewaters treatment plant of the government or by the wastewater treatment facility of the Service Contractor must also have the properties which meet the requirements of the effluent standards prescribed by virtue of section 55, or the standards prescribed by virtue of the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Section 77 The government agency or the local authority which makes provision for the services of central wastewater treatment or central waste disposal facilities by using government budget, or revenues of the local authority, and Fund allocations under this Act shall be responsible for the management and control of such facilities. In this respect, the responsible agency or local

authority may employ a licensed Service Contractor under this Act to manage and control the operation of such facilities.

Regulations, rules and methods for conveyance, collection and transport of wastewaters or wastes from the point sources of pollution to the central wastewater treatment plant or central waste disposal facility as well as prescriptions, prohibitions, restrictions and other conditions for discharging and draining of wastewaters or wastes from factories and other point sources of pollution under section 72 into the systems of central wastewater treatment or central waste disposal facilities shall be prescribed by the ministerial regulation.

Part 6
Other Pollution and Hazardous Waste

Section 78 The collection, transport and other arrangements for the treatment and disposal of garbage and other solid wastes; the prevention and control of pollution from mining both on land and in the sea; the prevention and control of pollution from the exploration and drilling for oil, natural gas and all kinds of hydrocarbon both on land and in the sea; and the prevention and control of pollution resulting or originated from the discharge of oil and the dumping of wastes and other matters from sea-going vessels, tankers, and other types of vessel, shall be in accordance with the governing laws related thereto.

Section 79 In case there is no specific law applicable thereto, the Minister shall, with the advice of the Pollution Control Committee, have the power to issue ministerial regulation specifying the types and categories of hazardous wastes generated from the production and usage of chemicals or hazardous substances in the production process of industry, agriculture, sanitation and other activities which shall be brought under control. For this purpose, rules, regulations, measures and methods must also be prescribed for the control of collection, storage, safety measures, transportation, import into the Kingdom, export out of the Kingdom, and for proper and technically sound management, treatment and disposal of such hazardous wastes.

Part 7
Monitoring, Inspection and Control

Section 80 The owner or possessor of the point source of pollution, required by virtue of section 68 or section 70, to have his own facility for treatment of polluted air, equipment or instrument for control of the discharge of polluted air or other pollutants or the wastewater treatment or waste disposal facility, shall have the duty to collect statistics and data showing the daily functioning of the said facility or equipment and instrument, and make detailed notes thereof to be kept as recorded evidence at the site of that point source of pollution, and shall submit report summarizing the functioning results of the facility, equipment or instrument to the local official of the locality where such point source is situate at least once a month.

The collection of statistics and data, the making of notes and reports shall be in accordance with the rules, procedures, methods and format specified by ministerial regulation.

In case the facility for treatment of polluted air, wastewaters or waste disposal or equipment and instrument indicated in the first paragraph requires a Monitoring Control Operator as determined

by the pollution control official, the Monitoring Control Operator shall have the duty to act under the first paragraph on behalf of the owner or possessor.

The Service Contractor licensed to render wastewater treatment or waste disposal services shall have the duty to do the same as the owner or possessor of the point source of pollution is required under the first paragraph.

Section 81 The local official shall gather the reports received according to section 80 and send them to the pollution control official, who has jurisdiciton over that locality, on a regular basis at least once a month. In doing so, the local official may make comments for consideration of the pollution control official.

Section 82 In order to perform his functions under this Act, the pollution control official is empowered as follows :

(1) To enter into the building, place and site of the factory or point source of pollution or the site of wastewater treatment or waste disposal facility which belongs to any person, between the sun rise and sun set or during the working hours, to inspect the functioning process of wastewater treatment or waste disposal facility, air pollution control system or equipment and other instrument for the control of polluted air or other pollutants, as well as to examine the notes, statistics or data on the functioning of the said facility, equipment and instrument, or when there is a reasonable suspicion that there is a non-compliance with this Act.

(2) To issue an order in writing directing the owner or possessor, the Monitoring Control Operator, or the licensed Service Contractor rendering the services of wastewater treatment or waste disposal, to correct, change, improve or repair the air pollution control, wastewater treatment or waste disposal facility or other equipment and instrument for the control of polluted air or other pollutants. If however, the point source of pollution is a factory, the official under the law on industrial plants shall be notified to take action within his power and duty. If such official fails to do so, the pollution control official shall have the power to take action in accordance with this Act.

(3) To issue a written order directing the owner or possessor of the point source of pollution which is not a factory to pay penalties as provided under section 90. section 91 or section 92. If the point source of pollution is a factory the official under the law on industrial plants shall be notified to order the owner or possessor of such factory to pay the penalties and. in doing so, such official under the law on industrial plants shall be deemed to be the pollution control official under this Act. If, however, such official fails to issue the penalty order within a reasonable time, the pollution control official shall then have the power to issue the order directing the owner or possessor of such factory to pay the penalties.

(4) To issue a written order directing the Service Contractor licensed to render the services of wastewater treatment or waste disposal to stop or shut down his services, or revoking his license in case such Service Contractor violates or does not comply with this Act. or any ministerial regulation, local ordinance, rule, notification or condition issued or stipulated by virtue of this Act, or does not comply with the order of the pollution control official issued by virtue of this Act.

(5) To issue a written order suspending the Monitoring Control Operator under section 68 or section 70 in case such Monitoring Control Operator violates or does not comply with this Act. or any ministerial regulation, local ordinance, rule, notification, or condition issued or stipulated by virtue of this Act, or does not comply with the order of the pollution control official issued by virtue of this Act.

Section 83 In case it is deemed reasonable in the interest of co-ordination of action among agencies concerned, the pollution control official may :

(1) Recommend the official who has the legal power to control the point source of pollution, to close down its operation, to suspend or revoke the license of its owner or operator, or to bar its use or utilization in any way, especially in connection with the point source of pollution under section 68, section 69 or section 74 which has no intention to treat the polluted air, wastewaters or other wastes and illegally discharges the untreated wastes into the environment outside the limits of its site and premise.

(2) Recommend the local official to take legal action against the owner or possessor of the point source of pollution under section 71 or section 72 in order to coerce him to send wastewaters or wastes to be treated or disposed in accordance with this Act.

(3) Give advice and suggestions to the local official or the government agency concerned in connection with the operation and maintenance of the central wastewater treatment plant or the central waste disposal facility under the responsibility of such local official or government agency.

Section 84 In the performance of duty under this Act, the competent official or the pollution control official must produce his identity card at the request of the person concerned.

The identity card of the competent official and pollution control official shall be in such a form as prescribed in the ministerial regulation.

Section 85 The owner or occupier of premises, vehicles or any person concerned shall facilitate the performance of duty under this Act by the competent official or the pollution control official who shall be official under the Penal Code.

Section 86 The performance of duty by the competent official under section 50, first paragraph, or section 65 and the performance of duty by the pollution control official under section 82 (1) shall be done in the presence of the owner or occupier of the premise or vehicles; if such person cannot be found, it shall be done in the presence of at least two other persons requested by the competent official or the pollution control official to attend as withnesses.

Section 87 The owner or possessor of the point source of pollution, the Service Contractor licensed to render services of wastewater treatment or waste disposal, the Monitoring Control Operator or any other person who is not satisfied with the order of the pollution control official under section 82 (2), (3), (4) or (5), is entitled to challenge such order by petition to the Pollution Control Committee within thirty days form the date of receiving the order of the pollution control official.

If the petitioner does not agree with the decision of the Pollution Control Committee, he shall appeal to the Minister within thirty days from the date of receiving notification of the Pollution Control Committee's decision.

The decision of the Minister shall be final.

and formats prescribed by ministerial regulation.

The National Environment Board shall consider and proceed with the request for promotional supports and assistance according to the foregoing first paragraph as it sees fit, taking into account the economic. financial and investment necessities of each individual applicant. In case it is considered appropriate to give assistance to the applicant, the National Environment Board shall recommend the government agencies concerned to act within their powers and functions to render promotional supports and assistance to the applicant accordingly.

Chapter VI
Civil Liability

Section 96 If leakage or contamination caused by or originated from any point source of pollution is the cause of death, bodily harm or health injury of any person or has caused damage in any manner to the property of any private person or of the State, the owner or possessor of such point source shall be liable to pay compensation or damages therefor, regardless of whether such leakage or contamination is the result of a willful or negligent act of the owner or possessor thereof, except in case it can be proved that such pollution leakage or contamination is the result of :

(1) Force majure or war.

(2) An act done in compliance with the order of the Government or State authorities.

(3) An act or omission of the person who sustains injury or damage, or of any third party who is directly or indirectly responsible for the leakage or contamination.

The compensation or damages to which the owner or possessor of the point source of pollution shall be liable according to the foregoing first paragraph shall mean to include all the expenses actually incurred by the government service for the clean-up of pollution arisen from such incident of leakage or contamination.

Section 97 Any person who commits an unlawful act or omission by whatever means resulting in the destruction, loss or damage to natural resources owned by the State or belonging to the public domain shall be liable to make compensation to the State representing the total value of natural resources so destroyed, lost or damaged by such an unlawful act or omission.

Chapter VII
Penal Provisions

Section 98 Any person who violates or refuses to observe the order issued by virtue of section 8 or obstructs any act done in compliance with such order shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

In case the person who violates or refuses to observe the order or obstructs any act done in compliance with such order is the person who has caused danger or damage arisen from pollution, such person shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 99 Any person who illegally encroaches upon, occupies, or enters into public land to act in any manner which results in the destruction, loss or damage to natural resources or treasures worthy of being conserved, or causes the occurrence of pollution having impact on the environment within the limits of environmentally protected area designated by virtue of section 43 shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 100 Any person who violates or refrains from observing the restrictions stipulated by ministerial regulation issued according to section 44 or by notification given by the Minister according to section 45 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 101 Any person who spreads or disseminates false information about the danger from any point source of pollution with the intention to destroy its reputation or to undermine public trust on the lawful operation of its business or activity shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

If the spread or dissemination of information according to the foregoing first paragraph is done by means of publication, announcement, advertisement or reports through newspaper, radio, television or other forms of mass media, the person who commits such act shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 102 Any person who violates the order of competent official forbidding the use of vehicle according to section 65 shall be punished by fine not exceeding five thousand baht.

Section 103 Any person who refuses to observe the order given by competent official according to section 67 shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 104 Any owner or possessor of the point source of pollution who refrains from observing the provision of section 71, or any person who refrains from observing the provision of section 72, or the rules laid down by the local authority by virtue of section 74 or section 75, first paragraph, or the ministerial regulation issued by virtue of section 80 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 105 Any person who renders services as a Monitoring Control Operator or as a Service Contractor for wastewater treatment or waste disposal without the license granted according to section 73 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 106 Any owner or possessor of the point source of pollution or any Monitoring Control Operator or any Service Contractor rendering the services of wastewater treatment or waste disposal, who refrains from collecting statistics or data or from making notes or reports as required by Section 80 shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 107 Any Monitoring Control Operator or Service Contractor having the duty to make notes or reports according to this Act, who intentionally makes such notes or reports showing false

information or statements shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht or both.

Section 108 Any person who obstructs or refuses to comply with the order of the pollution control official given in the performance of his duty according to Section 82 (2) shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht. or both.

Section 109 Any Service Contractor rendering services for wastewater treatment or waste disposal ordered by the pollution control official to stop or close down his services pursuant to Section 82 (5). or any Monitoring Control Operator whose license has been revoked by the order of the pollution control official pursuant to Section 82 (6), who violates or refuses to comply with such order of the pollution control official or continues to carry on his service in violation of such order shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 110 Any owner or possessor of the point source of pollution who employs the person. whose license to be a Monitoring Control Operator has been revoked. to supervise and monitor the operation of air pollution control. wastewater treatment or waste disposal facility that he has the duty install and operate according to this Act. shall be punished by fine not exceeding fifty thousand baht.

Section 111 In case the offender who is liable to be punished according to this Act is a juristic person. the directors or managers of such juristic person. or any person who is responsible for the business operation of such juristic person, shall also be punishable by the same penalties prescribed by law for such offence. unless it can be proved that they have no part to play in the commission of such offence.

Interim Provisions

Section 112 In the period during which the National Environment Board is yet to be appointed in accordance with section 12 of this Act, the National Environment Board appointed prior to the date of effectiveness of this Act shall continue to hold office in order to perform its function until the new Board shall be appointed and take over the office.

Section 113 All ministerial regulations, rules. procedures, notifications or orders, issued by virtue of the Enhancement and Conservation of National Environmental Quality Act. B.E. 2518 which remain in force on the date of effectiveness of this Act. shall continue to be effective. insofar as they are not in conflict with or contrary to this Act. unless and until ministerial regulations. rules. procedures, notifications or orders will have been issued in accordance with this Act.

Section 114 The person. who has ben holding a licence as an eligible person to prepare reports concerning the study and measures for the prevention of and remedy for the adverse effect on environmental quality by virtue of the Enhancement and Conservation of National Environmental Quality Act. B.E. 2518, shall continue to be eligible to prepare the environmental impact assessment report provided by this Act. until such person is required by the Minister to apply for licence in accordance with this Act.

Section 115 For all the reports concerning the study and measures for the prevention of and remedy for the adverse effect on environmental quality required for any project or activity pursuant to the Enhancement and Conservation of the National Environmental Quality Act, B.E. 2518, that have been filed prior to the date on which this Act shall come into effect and still pending review by the Office of National Environment Board, the review and approval of such reports shall be further proceeded with in accordance with the rules and procedures laid down by virtue of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2518. For this purpose, the power and duty of the Office of National Environment Board in become the power and duty of the Office of Environmental Policy and Planning.

Countersigned by :
Anand Panyarachun
Prime Minister

APPENDIX 3

GUIDELINE FOR ENVIRONMENTAL IMPACT ASSESSMENT OF COMMERICAL AIRPORT

GUIDELINE

FOR

ENVIRONMENTAL IMPACT ASSESSMENT

OF

COMMERCIAL AIRPORT

SEPTEMBER 1992

GUIDELINE FOR ENVIRONMENTAL IMPACT ASSESSMENT OF COMMERCIAL AIRPORT

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GUIDELINE FOR ENVIRONMENTAL IMPACT ASSESSMENT OF COMMERCIAL AIRPORT

1. BACKGROUND

Commercial airport project has been one of the projects initiated by The Ministry of Science and Technology and Energy under the topic of "Project Types and Sizes" or "Project that need to have the Environmental Impact Assessment" with the rationals as follows (Reference 1):

Commercial Airport Project means the construction of a new airport, the expansion or the improvement in terms of increasing the runways, both in size and in numbers to serve bigger aircrafts. In general, the improvement also involves in acquiring the new pieces of land, or increasing the airport area. This kind of project might create many environmental impacts for example, the changing of geography, the evacuation of the local people around the area, noise pollution which can effect the health condition of the people near by or airport workers. In addition, it will cause heavy traffic congestion on land and the expansion of community. Thus, whenever airport construction is considered, it would be recommended to set up the mitigation measures since the project start up period to avoid the impact on environment. As we all know that an airport construction is a big project and takes times, need to have an Environment Impact Assessment prepared.

The Environmental Impact Assessment will be involved by the project owner, the project permitting agency, the consultant who does the project feasibility study and the Office of the National Environmental Board.

2. ESSENTIAL FACTORS AND INFORMATION

2.1 Essential Factors in Impact Evaluation

The Commercial Airport Project tends to effect in 5 major areas, i.e. noise level, air and water quality, social, and socio-economic impacts (Reference 2).

To develop the project for instance, finding the project site, managing and expanding the runway, introducing the jet aircrafts or ever larger size aircrafts tends to cause the environment impact. Besides those mentioned, there are still some factors to put into consideration. The tendency of the impact from the past experiences can be concluded as

2.1.1 Physical Resources

(1) The project might change the natural water regime of rivers near the site, for example, obstructing the surface water flow and increase the quantity and speed of the water. In addition, it can cause the soil erosion during the construction and effect the water utilization downstream from the site.

(2) In preparation of the site and increase the number of runway, it can effect the water resources. The waste water from the runway may be in form of oil, toxic chemical etc. Besides, the amount of water used in the project and the waste water from the buildings and airport terminals can be very large in comparison with the amount of water used in a small town.

(3) During the construction period, the project can cause the air pollution in terms of dust. Mostly, the exhausted gas comes out of the aircrafts and from the vehicles in and out the airport. The level of impact depends very much on the duration of the construction, numbers of flights, types of the aircrafts, numbers of vehicles and the location of the airport.

(4) The community near the site and areas which require quietness like schools, universities, hospitals, temples and residential area may be disturbed by the noise from the construction and the aircrafts. The impact will be higher during the night time.

2.1.2 Biological Resources

(1) The direct impact on biological resource can be the destruction of plants and wildlife ecology during the construction. The consequences of the problem can also change the hydrological system, air quality and noise level along with the land utilization close to the site.

(2) Swamps ponds and peat swamps which are habitats of aquatic and wildlife can be effected from the obstruction of the water flow, the changing of water level and the water contamination.

(3) If the site is located near the coastal area or the river mouth, it can easily effect the valuable sensitive ecology. For instance, it can destroy the coral reefs which also means the destruction of the aquatic habitats.

(4) If the site is also close to the bird's sanctuary and the flight pattern are against the direction of the birds' migration, it can cause the aircrafts accidents.

2.1.3 Human Use Value

(1) The project may influence the alteration of the land use pattern. There might be the migration of the old community, the city expansion, changing the commercial zone along the way to the airport. The new land utilization might not conform with the previous plan which are formerly planned by other organizations.

(2) The transportations near site might be effected by the project construction during the loading the material, equipments, and some activities such as the commutation of the passengers and the contractor's employees. Besides, there will be the new road constructions to join the existing ones and the site. It can cause the traffic congestion and accidents by the taking off and landing of the aircrafts too close to the main roads or cities.

(3) The site and existing drainage system might be effected by the runway, the building and the new road constructions. The heavy rainfall may cause flood the area if there is no appropriate drainage system.

(4) Infrastructure and energy resources might be affected by the existence of the project.

(5) During the project constructions, there might be problems like the shortage of construction materials.

(6) Focusing on the garbage disposal both wet and dry, if there are no appropriate ways to treat them, it'll cause problems, such as, bad odor and the dirtiness.

2.1.4 Quantity of Life

(1) Land acquisition : the problems always exist when the land owners have to move out of their old homes. The compensation money is not enough to compensate with what they've lost. Besides, there are some social problems since they have to adjust themselves with the new environment.

(2) Regional or local economics can be greatly changed because there might be the alteration of the residential and business areas. There might be some increasing or decreasing in job opportunity and some lost of production from the paddy fields, orchards and commercial buildings.

(3) Discuss about the positive and negative impacts of the project, which may cause the land price to increase, the city and the infrastructure expansion. The price of land near the site may decrease since there's noise pollution, traffic congestion and deteriorated environment.

(4) Public health and security of people and project workers may be effected by the polluted environment during the construction period, i.e. noise, dust etc. The noise from the aircrafts, the vehicles coming in and out produce exhausted gas and decrease the living qualities of the people.

(5) Cultural, archaeological and historical buildings and the aesthetic values in the area might be changed. Even the project team tries to properly design the landscape, the airport might deter the previous aesthetic condition. In addition, some cultural tourist attractions and important religious places might be effected.

--- Basic Information for the Impact Assessment

The essential database for the initial impact evaluation are maps, statistics and government plans which can be obtained from the interviews and the visits to the related institutes. This information will lead to the assessment of impact and the detail information of each factor. The example of essential data needed are as follows (Reference 3).

(1) Maps 1:50,000 or 1:20,000 to 1:2,000 (if available) to study the detail of the area and the project site.

(2) Aerial photography of the project area 1:50,000 or 1:15,000.

(3) Map showing the transportation routes both air and land. The amount of the present and future traffic along with the network.

(4) The project plans and the facilities.

(5) The construction plan, i.e. the construction time, the materials and the sources.

(6) The masterplan for the social and economic development prepared by the local or central administration.

(7) The land utilization plans prepared by the City Planning Office, The Land Development Department with the objective data the land use plan and the present and future land use distribution for residential, commercial, industrial areas and institutions, etc.

(8) City maps and the buildings near by from the aerial photography.

(9) Population distribution map of the area close to the site prepared by the population statistics data.

(10) The land use distribution maps by the City Planning Office.

(11) The maps illustrating the land use expansion trend by The City Planning Office.

(12) The maps indicating the public and the private areas.

(13) Lists and maps showing the historical, cultural and archaeological sites and the historical places registered with Department of Fine Arts.

(14) Maps showing public facilities such as libraries, mass transportations, police stations, public health centers, fire stations, waste water treatment plants, garbage treatment plants and also the office of municipality, government offices etc.

15) Tax and Tariff data for each municipality which has the relationship with the availability of the mass-transportation and the infrastructure services.

16) Land holding tax data of the site and nearby provided by the local tax office.

17) The average income of the residents in the area from The National Statistics Board.

18) Summary of employment statistics for various parts of the country.

19) Socio-Economics data with the significant information of each community under studied from statistics or the provincial development plan.

(20) Geographic maps showing swamp, pools, mountains, etc.

(21) Soil investigation maps from The Land Development Department.

(22) Geological maps from The Department of Mineral Resources.

(23) Maps showing the characteristics of plants and wildlife from The Royal Forestry Department or other conservation offices.

(24) Lists of rare plants and wild animals from The Royal Forestry Department.

(25) Maps showing lowland and flooded area from The Royal Irrigation Department.

(26) Watershed classification map from The National Environmental Board.

(27) Meteorological map from Meteorological Department.

3. ENVIRONMENTAL IMPACT ASSESSMENT GUIDELINES

In order to describe the environment of the site, firstly we should consider how much the area is effected by the project. In general, area within one kilometer radius around the site is directly effected. But there're some other factors to be put into consideration, for example, the impact on the cities, regions or the country. Thus, we should consider them before evaluating each factor.

To evaluate the environmental impact and the analyse the environmental changes, we should seriously think about the site location, the construction and the project operation. Besides, we should give the details of the environmental changes before and after to be able to compare and predict the future of the environment. Finally, the tables showing the conclusion of the impact should be presented along with the sizes of the impact or showing the comparison symbolically (Reference 4, 5 and 6).

3.1 Physical Resources

Natural resources of the site and nearby that should be considered are surface and underground water, both quantity and quality, air quality and noise pollution.

3.1.1 Surface Water Hydrology and Underground Water

(1) The data should be presented as follows:

- The data of weather condition, amount of rainfall and the highest level of rainfall.
- The details about the surface water runoff and the direction of water flow around the site and nearby along with the figures showing the amount of peak surface runoff different periods of the year.
- The description of the erosion, the character and amount of the sedimentation within the water resources close to the site.
- The description of the quantity, the underground water flow of the area and the site water utilization.

(2) The impact should be evaluated as follows:

- The impact from land filling, the water resources around the site and nearby during the dry and rainy season.
- The impact from the changes in quality, direction, and erosion of the water resources around the site and nearby.

- In the case of surface and underground water utilization, we should consider the fact of city expansion which is the consequence of the project and we have to make sure that the natural water resources will be adequate for this purpose.
- The impact on the amount of sediment quantity when the natural regime of the water resources are obstructed by the project construction.

3.1.2 Quality of Surface and Underground Water

(1) The data should be presented as follows:

(a) Quality of surface water

- The description of surface water utilization, water condition one site and nearby.
- The map showing the reservoirs which can be effected by draining waste water into the map must cover 3 areas.
  - · Upstream of the site
  - · On site
  - · Downstream of the site
- The water samplings need to be collected twice in the dry and rainy seasons according to these parameter analysis:
  - · Dissolved oxygen
  - · pH
  - · BOD
  - · NO_3-N
  - · TKN
  - · Total coliform
  - · Faecal coliform
  - · Suspended solid

And in the case of having a maintenance unit or fuel and gas storage, it is recommended to test the amount of oil/grease.

- Put the analysis results on the list and make comparison with what of the surface water using the standard of the National Environmental Board (Reference 7). Make a chart showing the parameter analysis results in comparison with the results from all sampling units.
- Maps showing wastewater generated area, e.g., residential areas, terminals, restaurant and waste water treatment unit along with waste water drainage point.

(b) Undergroundwater quality

- The description of undergroundwater, water utilization on site and nearby.
- The maps showing the water sampling areas on site and nearby during the dry and rainy seasons according to these parameter analysis:
  - pH
  - Conductivity
  - Suspended solid
  - Hardness
  - NO_3-N
  - Chloride
  - Sulphate
  - Fe
  - Mn
  - Turbidity

If the communities around the site utilize underwater, Total coliform and Faecal coliform should also be tested.

- Compare the results of the above mentioned parameter analysis with the undergroundwater standard of The National Environmental Board in case that the residents using the water for consumption purposes.
- Make a chart showing the parameter analysis result in comparison with what received from all sampling units.

(2) The impact should be evaluated as follows:

- The impact of the sedimentation from site to the nearby water resources.
- The consequence of wastewater drainage to the nearby water resources.
- The impact during the airport construction causing the increase of suspended solid in the nearby water resources considering the amount of suspended solid from previous samples.
- The impact from draining the waste water to the existing water resources and may effect the quality of the undergroundwater. If the level of the underground water is high, it needs to evaluate these two important parameter, Total coliform and Faecal coliform.
- The amount of waste water during the airport construction and operation considering the total amount of the waste water from every unit such as the kitchens, toilets, washing units, aircraft maintenance and floor cleaning, etc.
- The conclusion of the wastewater quality from the site according to the above parameters.
- Compare the quality of the wastewater with the wastewater standard of The National Environmental Board.
- The impact from the treatment of aircraft wastewater.

3.1.3 Air Quality

(1) The data should be presented as follows:

- The data about the wind direction and speed at the meteorological station near the site and other necessary information.
- The map showing at least 3 sampling areas, upwind, on site and downwind, three days at each area. Besides, the area should be sensitive to the impact of air quality changes, for instance, schools, hospitals which are close to the airport.

topography, locations, the distance to the airport boundary and the distance from the mid of the runway of the sampling stations.

- Analyse these parameters, dust, carbon monoxide, nitrogen dioxide, hydrocarbon and compare with the standard of The National Environmental Board.
- Describe the weather condition on sampling days, such as, pressure, temperature, humidity, wind direction, speed, percent calm period, rainfall.

(2) The impact should be evaluated as follows (Reference 8):

- The information on types of air pollution from the aircrafts, duration of the aircrafts for taking off and landing, which can be found from USEPA (1978), Compilation of Air Pollution Emission Factors (Reference 8) should be presented in the report.
- Evaluating the air pollution from various distance from the runways in an hour average in consideration with the existing air pollution level at the same area then compare with the standard of The National Environmental Board.
- Evaluating the air pollution by using the mathematics models, the calculation formula and the basic calculating processes should be presented in the report.
- The amount of vehicles per day in and out of the site.
- The expected amount of pollution produced by the vehicles commuting between the main roads and the site.
- The level of air pollution from different distances on the road mentioned. The mathematics model to be used with the calculation formula and the basic calculating processes should be presented.
- After the evaluation, plus the existing air quality at the same area then compare with the standard of The National Environmental Board.
- In the impact evaluation, it is suggested to make a predictions at least 10 years after the operation.

3.1.4 Noise

(1) The data should be presented as follows:

- The map demonstrating the sensitive locations where the level of noise pollution is checked such as schools, hospitals, the areas aircrafts usually pass while taking off or landing, near by communities, etc.
- Describing the topographic condition, activities, the distance from the airport boundary and the distance from the middle of the runways.
- Continuously checking the level of noise within 24 hours at least 3 days per area and calculating Leq 24 and Ldn.
- Describing the weather condition of the days, the noise being tested.

(2) The impact should be evaluated according to the according guideline (Reference 10, 11 and 12):

- Noise contour map, NEF (Noise Exposure Forecast) which can be used to analyse the noise impact of the aircrafts on the communities and the land utilization.
- Calculating NEF contour value in any area with the formula of airport traffic index, the EPNL value or the EPNL value at different areas around the airport at different distance from the runway while landing and taking off and the schedules of each flight.
- The map showing NEF values after the operation of the airport.
- The map should demonstrate the flight path of aircrafts.
- In evaluating the noise level, it's suggested to make predictions at least 10 years after the operation.
- The boundary NEF-30 is the level that will not disturb the public.
- NEF value can be shown in term of Ldn or Leq(24) value in order to compare the level of noise at the present condition.

3.2 Ecological Resources

The ecology should be categorized into 2 major groups terrestrial and aquatic ecology. The investigated details should depend on the specific site conditions, whether they are forests, meadows, seas, urban areas or the communities. However, it is suggested to investigate the site and the area nearby to calculate the lost of the biological and natural resources and to appropriately plan the land utilization around the site.

3.2.1 Terrestrial Ecology

(1) The data should be presented according to the following guidelines:

- Plant species, dominate species, variety, fertility, density.
- Specifying economic species found, economic value for the community and specifying the rare species of plants.
- Vegetation map, vegetation profile, photos, zoning of the ecological resources and dominant species.
- Types and amounts of wildlife found by direct and indirect count and give the data of mammals, reptiles, amphibians and birds.
- Specifying the areas the animals found which should be divided according to the botanical zones and also identifying if it's on site or out.
- Focusing on birds, the data should tell the density of birds in Thailand and compare with the amounts found by using this hypothesis, "The amount of birds found has been related to the amount of birds of the country in general" The nesting area, sources of food should be indicated on the map.
- Concluding the ecological value of land in comparison to the local and regional level.
- The map using overlay technique, demonstrating the importance and the content of the ecology.

(2) The impact should be presented according to the following guidelines.

- Calculating the lost of the deforested area, the amounts of woods and comparing with what will gain when there's no airport.
- Evaluating the impact on the amount of woods cut, land clearing and the loss from the animal migration.
- Evaluating the direct and indirect impact on ecology, such as, land erosion, the changing of water regime, the water quantity, the route of animal migration etc.
- Evaluating the impact of project activities that disturb the natural life of wild animals and plant growth.
- Evaluating the impact of the project which can cause the forest and ecological encroachment to the nearby area.
- Evaluating the impact of types and amounts of birds relate to the flight safety. The past statistics should be studied. The charts specifying the types of birds which usually are problems along with the amounts to predict the possibility of accidents, concluding the flying habits, feeding habits, the nests, density and geographic factors which the accidents can occurs should be presented.

3.2.2 Aquatic Ecology

(1) The data should be presented according to the following guidelines:

- Specifying the aquatic ecology to be influenced by the project.
- Surveying and collecting data of aquatic resources, types of planktons, benthic animals, fish and aquatic plants upstream and downstream from the site, which can be the representation of the ecology before the project development.
- Presenting the dominant species of the plankton, species, variety and density.
- Surveying fish species should be done by using nylon nets at the sampling areas, collecting various types of fish, separating, measuring, weighing and recording all concerned information.

- Presenting fish charts with sizes, weight and amounts. theoretically, the data collection should be done at least in dry and rainy seasons. The information on the aquatic plants with density (approximately), the plant dispersal in the area being surveyed should be presented.
- Indicating the significance of the area in terms of fishery, ecology and other utilization.

(2) The impact should be presented according to the following guidelines:

- Evaluating the water quality during the construction and after the airport operation.
- Evaluating the impact of the quantity of wastewater from proposed site, sediment load during the construction which effect aquatic creatures like fish. Specifying the fish species that are the most sensitive and have tendency to be mostly effected.
- Considering the consequences of other water utilization such as fishery.
- After the operation, the water resources may receive the wastewater from the expanding community induced by the project. These should be put into consideration by calculating the amount of waste water from the passengers in comparison with the water resource receiving capacity.

3.3 Human Use Value

- In this case, it means land utilizations transportations and communications, infrastructures, industries, agriculture, waste treatment and drainage, which are related to local people. For instance, people who receive services from the project, the communiters. At some points, the concerned may be at the provincial level e.g., land use, while the waste treatment and drainage are specifically on site and nearby area.

3.3.1 Land Use

(1) The data should be presented according to the following guidelines.

- Presenting the land characteristics and types of land utilizations along with maps and the charts of the site and nearby area.
- Maps showing important places like schools, government offices, temples, churches, residents, public park, etc.
- Detailed map of the taking-off and landing areas along with the height of the terminals.
- Land utilization plans, the land divisions, and the tendency of future utilization of the area.
- Land utilization plans of the project in terms of the future expansion.

(2) The impact should be evaluated on to the following items:

- The tendency of future land utilization near the project by using the data from City Planning Division.
- Comparing the changes of land utilizations to be effected by the project, and the sequential activities before and after the project development.
- Comparing the pros and cons of the changes mentioned with the regional and provincial land utilizations.
- The impact on the height of the buildings and the tendency of the urban area expansion near the site.
- The tendency of the increase land prices near the site and the lower price caused by the project.
- Presenting the draft land use planning around the airport considering the impact of the future ecological changes.
- The impact of city expansion, the growth of construction near by activities the site.

3.3.2 Transportations and Communications

(1) The information of interest include:

- The present air-land transportation map in the local area or the plans of future expansion with maps and charts.

- Numbers of flight, types of aircrafts, types of airports nearby and estimated amounts of passengers according to the project owners.
- The amounts of traffic on the roads linked between the main roads and the site especially at the main intersections during the rush hours, and the tendency in the future after the operation by calculating from the estimate amounts of passengers.
- Road constructions from the site to the main roads, the capacity to serve the public.

(2) The impacts should be evaluated according to the following guidelines.

- The changes of previous air, land and train utilizations effected by the project.
- The impacts during construction from the transportation of construction materials which can cause the traffic congestion.
  - Find the data about the excavating and filling activities from the project contractor.
  - Calculating the amounts of trucks load to the site.
  - Comparing the amounts of traffic at the highest peak in order to estimate the congestion caused by the project.
- The post impact after the operation.
  - Studying the increasing rates of vehicles with the amounts of traffic congestion at the highest peak then predicting the future amounts without the project.
  - Estimating the future critical areas of the road-networks in case there's no projects by calculating the ratio between the amounts of traffic at the highest peak at the surveying station and the road capacity to sauce for the service level by AASHTO.
  - Predicting the future amounts of traffic after the operation.

- Evaluating the impact from the increasing amounts of traffic caused by the project by calculating the amounts at the highest peak in the future and estimating the impact sizes on each streets involved.

- The impacts from the project facilities such as roads on site, parking lots, terminals etc.
- The site positive impacts for the transportations and communications.
- The tendency of the land transportations and communications problems in case there's the airport expansion in the future.

3.3.3 Infrastructures and Other Facilities

(1) The data should be presented according to the following guidelines.

(a) Electricity, pipe water and other public facilities.

- The information about electricity utilization, pipe water and other public facilities around the site for example mass transportations, fire and police stations, public parks and libraries, etc.
- The information about electricity utilization, pipe water and other facilities provided by the government or the service expansion specifying for the project.

(b) Waste Treatment

- The amount and types of garbage on site and nearby along with the present storage method and treatment.
- The nearest areas to dump the garbage and any problems concerned with the present waste pollution of the area.
- The project recommendations concerning with ways to treat the waste coming out of the project, other facilities and also the garbage dumping area on site.

(c) Drainage

If not presented under the topic of hydrology, the data should be presented as follows:

- Drainage and flood prevention system at normal situation and during the flooding seasons along with map of draining system on site and nearby community.
- Presently the project drainage systems and describing the relationship with the existing system.

(d) Waste Water Treatment

See under 3.1.2 the quality of surface and underground water

(2) The impact should be evaluated according to the following guidelines.

(a) Electricity, pipe water etc.

- The impact on sharing and obstructing the use of electricity, pipe water, and other public facilities on site and nearby communities.
- The positive impact when the communities share the public services which are expanded for the project.

(b) Waste Treatment

- The amount of waste from several parts of the project such as kitchens, passenger lounge, etc. and estimating at least 10 years of operation.
- The waste dumping areas, waste property, types and the treatment.

(c) The drainage should be evaluated both in the rainy and dry seasons.

- The impact on the nearby community according to the water draining from the site and since the project activities may obstruct the natural draining system or changing the direction of the natural flow.
- The impact of the water draining to and from the agricultural area by the site.

3.4 The Quality of Life

The investigation should be stressed on the socio-economic information of the affecting communities.

- The land owners who are directly effected by project.
- People live or work near the site who have to bear the pollution/during the construction and the operation.
- People who are indirectly effected by the project i.e. the commuters, people who share the project services or the project areas.

Thus in order to evaluate the impacts, it's suggested to conduct the studies on 3 groups of population to get the result as precisely as possible. The number of samples should depend on the amount and density of population of the area effected.

To evaluate the impacts on the quality of life, it's recommended to firstly analyse the impact on the life style of people on site or nearby. Then do it in the larger areas such as, in the districts, provinces and regions so the results can be compared in both small and specific to the larger scales. Sometimes some impact might be very insignificant in a small area so people do not pay attention to it. But where comparing it in a larger scale, it can present some important factors for economic condition. Also, it needs to evaluate the cost/benefit to study the advantages and drawbacks of the project.

3.4.1 The Evacuation

(1) The basic information should be presented as follows:

- Surveying and listing the number of family, populations to be moved out of the site and families/populations who will remain on the nearby area. The information about the housing, numbers of the family members, age, level of education, race, the land and housing ownership, density housing condition, income level, business, the land price, property price, etc.
- Surveying the opinions of the evacuee focusing on the price of land paid, the disappointment from other social, personnel, family economic problems, the satisfaction on new home and neighbourhood etc.

- Surveying the opinions of the population who remain close to the site about the pollution, the obstruction of community expansion, the city expansion as a consequence of having the project and other impacts.
- The evacuation plan of the site, for example, time, compensation and other assistance. (Reference 13)

(2) The impacts should be evaluated according to the following guidelines.

- Social changes near the site or in the areas that are moved, for instance, the changes in population, the impact from the urban growth, job opportunity, the tendency of population growth, etc.
- The impact on the remaining community.
- The changes of the social condition of the people who move out from their old neighbourhood, for example, loosing touch will the old community.
- The appropriateness of the compensations for both mentally and economically losses.
- Comparing the lose of home, land, business, income, job etc. with the positive impact on economic conditions.

3.4.2 Economic Condition

(1) The basic information that should be presented are as follows:

- The data about the income, employment, local economic conditions near the site or in the area involved.
- The economic conditions in districts, provinces and regions involved in the activities such as, industry, agriculture, commercial, tourism, etc.
- The economic needs such as the convenience for industrial and agricultural sectors which will have sequential impact on economics in the regions.
- The economic development plans, provincial and regional level for the next 5-10 years.

(2) The impact should be evaluated according to the following guidelines.

- The project needs to clearly show its benefit for example, to save travelling time, develop air transportation etc. If there are some other purposes, they must be stated as well.
- The comparison of the economic changes between having and not having the project such as the income, land prices, property prices, business, etc.
- The increase of economic circulation and the dispersion of income of the provincial and regional levels.
- The economic positive impact that the project can serve the industrial and agricultural sectors and the tendency for the expansion of industry and agriculture as the consequences of the development of the project.

3.4.3 Public Health and Safety

(1) At least, the information should be presented according to the following guidelines:

- The public health service such as, the amount of the centers that serve 10,000 people, amounts of doctors, nurses along with the maps and charts demonstrating the locations and sites of the centers.
- The data concerning with types of disease, amounts of patients, the cause of disease on site and nearby and conclude the health conditions of the people living near the site.
- Indicating the service capacity of the center incase the emergencies or on site accidents.
- Indicating the site accident prevention plans, such as, the design of the air security zones, the light of the buildings comparing with the standard of ICAO, the control units when the aircrafts take off and land, the aircrafts maintenance, the preparation for emergency cases, fire prevention.
- Indicating other provincial or district plans concerning with safety and the capacity to handle such incidents.

(2) The impact should be evaluated according to the following guidelines.

- The changes in health conditions of people in the nearby area resulting from the construction and the operation.
- The direct impact on health conditions of people and the needs to decrease or avoid the impact.

After evaluating the impact on the public health and security of people around the site, it's recommended to evaluate the same impacts on the project employees, officers and also the passengers, for instance, the noise pollution which can be dangerous to the workers on the runways, the site sanitary, i.e., drinking water, utilizing water, air, noise in the project, the personal hygienic preventious of the workers, the air circulation in the passenger lounge, etc.

3.4.4 Culture, Aesthetic Values and Landscape

(1) The information should at least be presented as follows:

- Specifying the important places and locations focused on cultural, historical, and aesthetic value such as historical places, temples, churches, public parks, etc. with maps and charts of the location.
- The present landscape of the site and nearby within at least 1 kilometer radius; the height of the buildings along with the photographs or sketches.
- The landscape which is the sequence of having the project, i.e. the buildings, roads, signs and other landscape architecture, etc.
- Surveying the public opinion about the changes caused by having the project.

(2) The impact should be evaluated according to the following guidelines:

- The impact on relocations of historical, cultural and aesthetic sites, the noise pollution and vibration caused by the project that effect the people using those places.
- The impact from the changes of the landscape since there are more buildings with the project development.

- The impact on the local people's feelings and the commuters about the new landscape.

4. THE ADAPTED GUIDELINES FOR SPECIFIC CASES

The environmental impact assessment guidelines for commercial airports proposed under section 3 is generally used for any airports which are not focused on any specific structures or locations. In case of the runway terminal expansion, the changes of power engine and sizes of the aircrafts, the airport construction which is close to bird sanctuary, for instance, conservation, swamps, national park, some point of the guidelines must be adapted to fit each specific activities and locations.

4.1 The Coastal Airbase Project

The coastal area has a significance importance to the ecological system. It's the linkage between land and sea and usually with nutrients for plants and aquatic creatures. The area should received high interests in terms of ecological system, just like, peat swamp, estuary, mangrove, wildlife conservation, national conservation, national parks, botarincal gardens, etc.

Coastal airport project is normally built on remote island or open bay which are famous for tourism. Some of the bays are crowded with people. Some are surrounded with mountains and are in the area of marine national park. Since such areas are valuable as natural tourist resources; beaches, sea, coral, and marine animals etc. Thus the impact analysis will be similar to from those of airport on land with some additional aspects as follows:

4.1.1 Physical Resources

The physical conditions of the site have to consider the coastal area and current, which is different from airports on land. Thus it's suggested to study about the oceanography and focus on the quality of sea water which might be effected by the operation. Besides, the impact about air quality and noise must be focused on the people in the coastal area

near the site which can be tourists, business people or tourist business and other services.

(1) Oceanography

- The data about the meteorological condition especially the wind, speed, direction, the possibility of having storms and monsoon season.
- The data about the condition of the sea bottom, the depth, slope, geology, along with profile and coastal condition.
- The data about the current, level and the current characteristics.
- Analysing the impact in 2 aspects, i.e., the project impact on the oceanography and the results of the oceanology towards the project.
- Comparing the different conditions of the oceanography with and without the project.

(2) Water Quality

- The data about the water quality of the whole bay which is the project location and describe the existing problems and causes on water quality.
- The maps of the sampling stations which should cover the whole bay area according to the depth to represent the water quality in the study area.

4.1.2 Biological Resources

Biological resources, such as, coral reefs, sea grass, sea weeds which are the habitats for living creatures. In addition, there's terrestrial ecology in the case of the national park that need to be investigated.

(1) Aquatic Ecology

- The data about the coral reefs, sea grasses, the fertility, density dominant species, the dispersion, the rare species, the common species along with the map of the location.
- The data about fish ecology and other important aquatic creatures on site.

- Analysis of the impact on the loss and destruction of the coral reefs, fish and other aquatic ecology directly and indirectly caused by the project construction and the operation.
- Analysis of the accumulating impact from the project operation on the coastal ecology such as the coastal erosion.

(2) Terrestrial Ecology

- The data on forest condition, other ecological systems and wildlife similar to what have been done on the aquatic ecology.
- Estimating the sequential impacts that the project increases the numbers of tourists and the service expansions to serve tourism which can adversely effect the land nature.

4.1.3 Human Use Values

The coastal airport project mostly serves the tourists which the amounts are sometimes greater than the local population. The project area normally is highly utilized. As a result, the tourists are the main target of the impact and the secondary impacts are on business people and residents of the area.

(1) Tourism and Recreation

- The data about the amount of tourists, the characteristics of tourism and recreation in the bay, islands, provinces according to the high and low seasons.
- Services related to the tourism activities, categorizing according to types and the information of the popularity among the tourists.
- The surveys given by the tourists about the attitude towards the project along with the opinion toward the pollution from the project.
- Estimating the project impact toward the tourism recreations, the tourist attitudes and the land utilization.

- Proving that the positive impacts from project development toward the tourism.

(2) Land Utilization

- Presenting the data on coastal land utilization in the study area and the relationship between the local and master plan for islands, districts and the province.
- Presenting the detailed maps and charts of the land utilization near the beach on site.
- Analysing the impact of the project mitigation on the following development and the changes of land utilization.

(3) Transportations and Communications

- Presenting the data about the land, air, and water transportations i.e., the routes, amounts of vehicles, amount of tourists and people who use the services according to types and vehicles.
- Presenting the data about the utilization of the bay area and activities.
- Concluding the rules and regulations related to the sea liners and the utilization of the area and nearby.
- Analysing the positive impact on the transportation and the negative ones which can occurs in terms of the increasing of the traffic volume, the repetition of the air dispatch, etc.
- Analysing the impact of the operation on the obstruction of navigation, fishing activities, recreations in the bay areas.

(4) Land Resource Management

- Describing the land resource management if the airport is in the national park, related plan, problems and obstructions at present.
- Presenting the data about the facilities such as, the lodging, food, water, electricity, communications and also the service limitations.
- Describing the present site coastal area managing plan.

- Estimating the direct and indirect impacts, with and without the operation, on the national park managing plans and the coastal area management.
- Estimating the impact on the limitations in the land resource management along with the present and future facilities.

4.1.4 Quality of Lifes

The data and the impacts on tourists and population should be presented and assessed as follows:

(1) Social Condition

- The general information about the local people on site according to types occupations, related activities along with the map of population and housing density near the project site.
- The general information about tourists in the bay according to sex, age, nationality and related activities.
- Surveying the public opinions from local residents and tourists, with and without project.
- Assess the impact from the project operation, on the changes of social, cultural conditions, attitudes, and satisfaction.

(2) Economic Condition

- The data about the tourist economic conditions especially on the beach in front of the site and in larger scales, i.e., islands, districts and provinces.
- Evaluating the economic changes effected by the changes of land and property prices, giving both positive and negative impacts which are the results of the business expansion, or noise pollution, traffic congestion, poor aesthetic quality as the consequence of the project.
- Comparing the economic outcomes of the operation and related activities which effects local, provincial and region levels.

4.2 Post Environmental Evaluation

If there was an airport construction and development without having the environmental impact assessment, post environmental evaluation must be carried out immediately for that specific project. In doing so, the present environmental and pollution conditions caused by the airport must be evaluated to set up the mitigation measures and decrease the environmental impacts before it has become very dangerous and the plan for monitoring program must be carried out in the future.

Important factors which should be focused on are the problem of noise pollution, waste treatment, water quality, safety, socio-economics. In case that the airport is located in the suburb with low density population and there's no significant ecological resources, the guidelines to estimate the impacts should be as follows:

4.2.1 Surface Water Quality

At least the detailed study should be as follows:

- Specifying the water sampling stations, water resources which might be effected by the wastewater discharge. The studies should covered at least 3 areas, upstream, downstream and on site in both dry and rainy season.
- Describing the environmental conditions of the sampling stations along with the maps.
- Sampling parameters as mentioned in 3.1.2.
- Estimating the amount of wastewater, the contamination caused by the activities at the airport.
- The mitigation measures in alleviation the wastewater treatment impact from the airport with the monitoring program on the water quality for the future.

4.2.2 Noise

At least the detailed study should be as follows:

- Specifying the sampling stations, time, according to the sensitivity receptors effected by noise pollution. The maps should also be presented.

- Describing the topographic conditions, community conditions, activities, the distance between the boundaries of the airport and the distance from the mid of runways.
- Propose the approach to assess the impact or attitudes and opinions of the people on noise pollution caused by the existing aircrafts and in the future.
- The mitigation measures in reducing the noise impact and the monitoring program to measure the noise levels in the future.

4.2.3 Waste Treatment

At least the detailed study should be as follows:

- The amount and types of waste on site and nearby along with the collection and treatment.
- Waste disposal of the nearby communities and other related problems that should be evaluated as follows:
  - Estimating the amount of waste, characteristics, types from several area of the project, for example, kitchens, passenger lounge, etc. for the next 10 years.
  - Recommend the waste disposal strategies according to types at least for the next 10 years.

4.2.4 Safety Problems

At least the detailed study should be as follows:

- The safety system on site and nearby area, for instance, the height of the buildings on site and nearby comparing with the ICAO standard.
- The environmental control while the aircrafts is taking off and landing and the aircraft maintenance.
- Assess the risk of the people, employees from accidents caused by the plane crashes, and other accidents on site.
- The mitigation measures to reduce the impact on safety systems.

4.2.5 Socio-Economic Problems

At least the detailed study should be as follows:

- Categorizing the areas and communities to be affected by the noise and safety impact, the survey on the attitudes of local people interms of pollution, the disappointment about housing, the changes in income and land utilization, the tendency in moving and the needed assistance when facing problems.
- The maps and charts of the above communities should be presented.
- Analysing the impact from the people's attitudes and establishing the measures to alleviate the impact.

4.3 Project Development Close to Bird Sanctuary

The project close to swamps, peat swamps, meadows, creeks which are suitable habitats of birds has tendency to have bird collision. Thus the study on environmental impact should be done on such problems once every two years and set up the mitigation measures according to the following guidelines (Reference 14).

4.3.1 The Accidents from the Bird Collisions

- Studying the data about air traffic, numbers of accidents caused by birds collision, number the killed birds on and near the runway. The annual and monthly records should be collected for the operation airport.
- Studying the ecological capacity in sustaining the development, for example, numbers types of birds, the migration pattern, the map showing the hatching, feeding areas, bird sanctuary, foods, focusing on the types of bird involved in the accidents.
- Studying the flying characteristics, flying level of birds in comparison with the aircrafts.
- Studying other animals, for examples, reptiles, invertebrate animals which may cause to the problems, e.g., grasshoppers, earth worms, insects which are birds' foods.
- Estimating the possible accidents which might occur in comparison with bird type, amounts of accidents occured at other airports which has been studied, for example, Bangkok International Airports, Chiang Mai Airport and Had Yai Airport.

- Presenting the measures to alleviate the impacts and the monitoring program to check the amount of birds, sanctuary and food sources.

5. GUIDELINES ON MITIGATION MEASURES

The mitigation measures to reduce the environmental impact from commercial airport projects consists of the measures on structures, compensation payment, evacuation plans and academical and technological measures.

In planning of mitigation measures, the consultants should submit the measures to the project owners for approval, appropriateness and suitability. After that, the mitigation measures will be finalized. However, it needs to be aware of the fact that the mitigation measures presented in the EIA is the responsibility of the project owners to implement the plan not only the suggestions of the consultants.

If the measures is related to other offices, for instance, provincial offices, Highway Division etc., it's suggested to coordination should be made between the offices before presenting the plans in the EIA.

In this case, the mitigation measures for essential factors should be presented as follows:

5.1 Noise Pollution

Since the noise pollution is always the major problem of airport operation, it should be considered both on site and around the airport.

5.1.1 It should be encouraged to decrease the noise emitted from the flight such as the measure of the flying control to produce the lowest noise level by accelerating the engine to reach the suitable altitude after passing the high density community, the flying route should avoid the communities, preferential runway should be far from the residential areas.

5.1.2 The runways should be properly maintained and it should be modified NEF level over 30 will cover the minimum number of communities.

5.1.3 The operating time and the flight frequency should be controlled for example, from 10 pm. to 7 am. is the flight-free time, the night flight should not exceed 2 flights daily.

5.1.4 For the area around the airport, the land utilization plan and the future development plan of the area affected by noise pollution should be presented by specifying the suitable utilization on site, specifying the regulations which limit the development in that region and a map showing the boundary in relation to the appropriate land utilization plans of the province should be presented.

5.1.5 The project operator should consider to buy the pieces of land which are effected by the noise pollution in order to design the appropriate land utilization. The project owners might utilize such areas as cargo, or others which can generate economical profits without any impacts on local residents.

5.1.6 Noise insulation plans for the residents, or for concerned receptors such as schools, hospital, in the affected area should be provided when there is an airport expansion. The project owner will be responsible for the cost.

5.1.7 The compensation plans for the affected people interms of television and communication signals should be facilitated.

5.2.1 During the runway construction, the paddy field and public waterways might be filled up, induce erosion and increase suspended solid which can effect the aquatic ecology in the waterways and nearby rivers. The measures to reduce the impact from the sedimentation and organic matter should be presented by construction of dikes and retention pond to trap sediment and organic matters. The design, size and the location of such ponds should be clearly presented. In addition, if there will be any waterway blockage during the construction, the method of river diversion has to be clearly stated.

5.2.2 Many airports might become international airport in the future. Other activities can increase the amount of wastewater, for example, passenger lounges, business centers, the employee's lodgings etc. The total amount of water used on site, the amount of wastewater in the future and BOD level should be estimated. The information will be used to design the wastewater treatment system for each building and activity. This can be alternatives for the project owners. In addition, the wastewater treatment system and the operation expenses should be presented to the project owner to solve such problem. The map demonstrating the locations of wastewater treatment system and the wastewater outfall must also be presented.

5.2.3 It should have the policy of not allowing the labor camps to be located close to the water resources to avoid the water contamination and the spreading of diseases.

5.2.4 The quality of underground water on and around the site especially during the rainy season might have amount of coliform bacteria higher than average level due to the contamination by surface water. Thus, the measure to maintain the quality of underground water is the treatment of wastewater to keep Fecal Coliform within The National Environmental Board Standard.

... should be presented.

5.3 Accidents from Birds

Accidents from birds often occur at the airports all over the world which can be dangerous to the passengers' life, increase the maintenance budget, therefore, it should be considered as follows:

5.3.1 The environmental planning on site to prevent accidents should include the planning on the following aspects:

(1) The soil and grass condition around the runways and other open areas should be properly maintained.

(2) The control of tree, lawns and others such as golf course on and nearby the site.

(3) Water resource management such as swamps, ponds on site or close to the site.

(4) The garbage disposal area on site and nearby communities.

5.3.2 The rules and regulations about the decreasing and preventing accidents from the birds which can be implemented by the project owners should be presented, e.g., the ways to chase away the birds. The record of bird population and the ecological changes on site and nearby should be made.

5.4 Evacuation, Social and Economical Problems

Since the project may cause the land acquisition, the evacuation, and the changes in socio-economic condition, thus it should be considered as follows:

5.4.1 The evacuation plan for the affected residents should consider and find provision of the new places close to the old communities so they don't loose touch with their own neighborhood.

5.4.2 The compensation for the affected property should be priced according to the market value to make people satisfy with the compensation payment.

5.4.3 The evacuation program should be planned for people exposed to high noise levels from the project.

5.5 Air Pollution

The impact from the airport, traffic and other activities may cause the dispersion of dust and increase of air pollution so it should be considered as follows:

5.5.1 At the airport, the air pollution problem is very serious so the employee prevention program such as the masks must be implemented and also all buildings must be air conditioned for passenger safety and the windows can be closed at all time.

5.5.2 Reducing the amount of vehicles parking within the airport and reducing the amounts of aircraft landing and takeing off at very close schedules.

5.5.3 Grasses should be planted to reduce the dust dispersion from the roads to and from the airport.

5.6 Land Utilization Problems

5.6.1 The land utilization plan for area outside the project should be considered according to the appropriate environmental condition such as noise pollution, soil property, drainage and safety. The specific plans in the land utilization at various distances from the project will help facilitate the good and balance environment in the future. The detailed planning should be presented to the project owners to put into action. The committee should be established among the concerned offices to take care of the implementation period.

5.6.2 The details of land utilization planning should at least considered: prohibit the residential areas at the beginning and the end of the runway where the noise level exceeds the standard and no garbage disposal area in 8 kilometers radius from the site.

5.7 Traffic Congestion Problems

5.7.1 The mitigation measures should be on the necessary road expansions along with year that the expansions should be done.

5.7.2 The plans to solve the problems about the parking areas and non-systematic parking at present and for future.

5.7.3 The airport entrance and exit should be properly maintained. The road control plan, and the controls of any construction activities away from the road will alleviate the traffic congestion and accidents.

5.8 Flood Problems

The mitigation plan to reduce the impact on flooded condition for the low-lying project areas which collect the rainfall and water from other areas. The land filling activities of the airport construction will obstruct and change the directions of natural water flows generally, the residential areas downstream from the project will be affected. In addition, in case that the site is higher than the nearby areas, the measures to prevent the flooding such as digging canals around the airport area to collect the rainfall from the project should be considered.

5.9 Waste Treatment Problems

5.9.1 The appropriate design of incinerators should be presented along with the locations and the basic information. Therefore, the Department of Aviation will use such information to build the incinerator, the necessary information include: the fuel for solid waste burning, wind direction, temperature, the building materials and disposal procedures, etc.

5.9.2 If some solid waste is collected and disposed by the municipality, the waste must be clearly divided by the treatment procedure, e.g., minicipality or incinerations.

5.9.3 Increasing the amount of containers and the solid waste dumping areas to serve the increasing needs. Temporary storage areas must be concealed to prevent the odor, insects and rodents. It must be located away from the passenger terminals or communities.

6. MONITORING PROGRAM

The monitoring program during construction and operation period will provide the benefit to the other projects with similar natures interms of alleviation of impacts. The general concerns should be on the following items:

- Monitoring Program During Construction
  - Water quality sampling program to detect any contaminants from construction activities and erosion.
  - Transportation survey along the local roads to identify any traffic blockages from construction activities.
  - Monitor the impact on relocation program of the evacuees.
- Monitoring Program During Operation
  - Noise Level Measurement
  - Air Quality Measurement
  - Water Quality Measurement
  - Socio-Economic Survey

- Drainage System Survey
- Water Treatment System
- Solid Waste Disposal System

The monitoring program has to be actually implemented by the project owner according to the recommendations in the EIA. The guideline for major monitoring programs are as follows:

6.1 Noise

6.1.1 Noise level should be measured according to the NEF contour and at the villages with exposure to high noise level. The measurement should be made at the sensitive receptors, i.e., hospital, school.

6.1.2 Noise monitoring program should be based on NNI (Noise Number Index) which identify the noise level within the concerned areas, e.g., highly populated area. In addition, the NEF around the project area or Leq (24) should also be considered to compare with the ISO Standard.

6.1.3 In case that the amount of airborne traffic exceeds the stated amount in EIA or the flights are scheduled during the nighttime, the additional study on noise level is necessary.

6.2 Water Pollution

6.2.1 During the construction period, the water quality of the water resources with potential to be contaminated from the project should be monitored especially for suspended solid.

6.2.2 Monitor the treated wastewater during operation at
- receiving water body upstream from wastewater outfall
- treated wastewater at the outfall
- receiving waterbody downstream from the outfall

The monitoring program at the 3 spots should be conducted at the same period every 3 months.

6.2.3 Major parameters to be analyzed for treated wastewater should include SS, BOD, pH, Fecal Coliform, Nitrate, Phosphate and etc.

6.2.4 Major parameters to be analyzed for receiving waterbody should include SS, Coliform bacteria, BOD, DO, Nitrate, Phosphate, and pH.

6.2.5 Groundwater quality around the project area should be monitored for : Turbidity, pH, color, Iron Hardness Nitrate E.Coli (standard plate count) Coliform Bacteria (MPN/100 ml) and should be sampled every 6 months after operation

6.2.6 The groundwater should be collected from the wells with potential to be contaminated by wastewater discharge from the site.

6.3 Bird Collision

6.3.1 The record should be made everytime the airplane hits bird. The information should include date, accident, location, flying level, meteorological condition, and type of bird. This records will be very useful to the project operators and other project with the same nature in the region.

6.3.2 The monitoring program on bird ecology should be conducted twice a year in different seasons to investigate bird species, population, flying level, food, community structure, habitat condition and land use condition around the airport.

6.4 Socio-Economics

The coordination should be made between the project operators and related governmental offices to set up a committee to monitor the alteration of life-style and socio-economic conditions of the local residents due to the project development. The socio-economic survey should be conducted annually.

6.5 Land Use

The monitoring program would be made on the changes of land use and urban expansion around the site, e.g., housing complex, high raised building which are not correspond with the project land use pattern and may obstruct the future project expansion.

6.6 Air Pollution

6.6.1 In case that the type and amount of airplanes are altered from the stated in EIA, CO around the project area and surrounding communities should be measured. The recommended method is by utilizing air bags with 1 hr air sample and analyzed by NDIR. In addition, HC and TSP levels should be measured by the NEB recommended methods and the air quality around terminals and working areas would also be monitored.

6.6.2 The air quality around the sensitive receptors, e.g., school, hospital, etc., around the site should be monitored during construction period and operation period (once every yar n dry season).

6.7 Flood Condition

6.7.1 The existing drainage channels should be maintained in good conditions, e.g., by dredging, remove aquatic weeds, and blackages, especially prior to rainy seasons.

6.7.2 The pumping stations should be properly maintained and ready to be operated during emergency situations.

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