Chapter 3
STUDY AREA

3.1. Location : Geography and Topography

The Mae Moh Power Plant (and Lignite Mine) is situated in Mae Moh Basin. It covers wide area and many Subdistricts in Mae Moh District, Lampang Province, northern Thailand. It is approximately 25 km from Lampang city and 650 km north of Bangkok. Geographically, the Mae Moh Basin is located in an intermontane basin at latitude 18°18' 21" N and longitude 99° 44' 02" E (Figure 3.3). The basin covers an area of approximately 135 km^2 with 8.8 km maximum width and 18.3 km maximum length. It is surrounded by Doi Kew-Lom quartzite mountain ridge in the north, Doi Chang limestone mountain in the east, Doi Luang mudrock mountain in the west and Doi Pha Hob basalt-limestone mountain on the southern boundary. The basin was formed during the Tertiery period and was filled mainly by semi-consolidated sediments. Sediments of fluvial origin such as clay, lateritic soils, and terraced gravel are dominant within the uppermost 10 m of the basin. Below this, sediments are dominated by mudstone and lignite deposits with an average thickness of 15-20 m. The depth of lignite deposits from the ground surface varies from very shallow along the marginal area of the basin to relatively deeper in the central part of the basin (> 300 m) (Institute of Environmental Research, 1981; EGAT, 1991; Department of Geological Sciences, 1996).

The topography of the Mae Moh Basin is generally flat and low lying terrain with ground elevation ranging between 300 and 350 m. However, a slightly rolling topography is found in some places among the flat lying ground of the basin (Institute

of Environmental Research, 1981; EGAT, 1991; Department of Geological Sciences, 1996). Figure 3.4 shows the geological map of the study area.

3.2. Climate

The climate of the Mae Moh Basin is influenced by two monsoons *viz.* southwest and the northeast and secondarily by cyclonic storms and intertropical fronts. During May to October, air masses move from the Indian Ocean and bring moisture creating the rainy season over the region. The dry season occurs during mid-October to mid-February when the cool air masses from the Arctic region moves southward across Siberia and mainland China to this region creating cool-dry weather. During mid-February to mid-May, the polar air mass is modified by tropical heat and moves into the area creating hot and dry weather. However, the duration of the season varies due to the effects of moonsons. Heavy rainfall can occur when the cool air mass from the north meets the southwest moonson or because of cyclonic storms from Pacific Ocean.

3.2.1. Rainfall

There are three types of rainfall in the Mae Moh basin area *viz.* oragraphic, convective, and cyclonic. Oragraphic and cyclonic rains prevail during the rainy season while covective rains occur during the hot season. The average monthly rainfall varies with a minimum amount of 0.6 mm in February to a maximum amount of 235 mm in September. During the observation period from July to October 1998 the rainfall was much higher than those of the previous years (Figure 3.1).

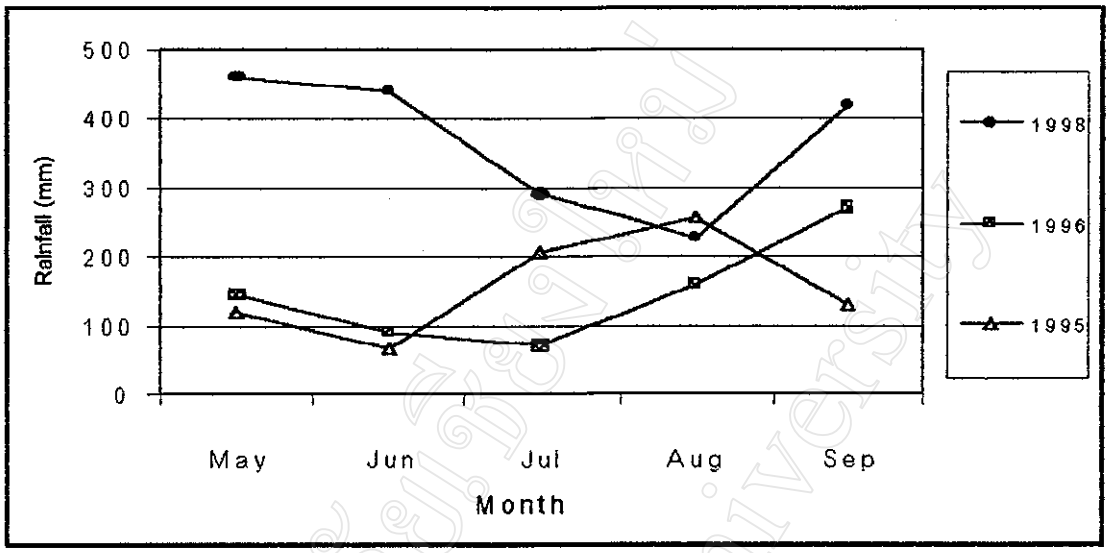

Figure 3.1. Average monthly rainfall in the Mae Moh Power Plant area
(Source : Environmental Division, Mae Moh Power Plant)

3.2.2. Temperature

The average monthly temperature of the area is variable. The maximum temperature (41°C)and minimum temperature (6.8 °C) were recorded at the Mae Moh station which occurs in April and January, respectively (Figure 3.2).

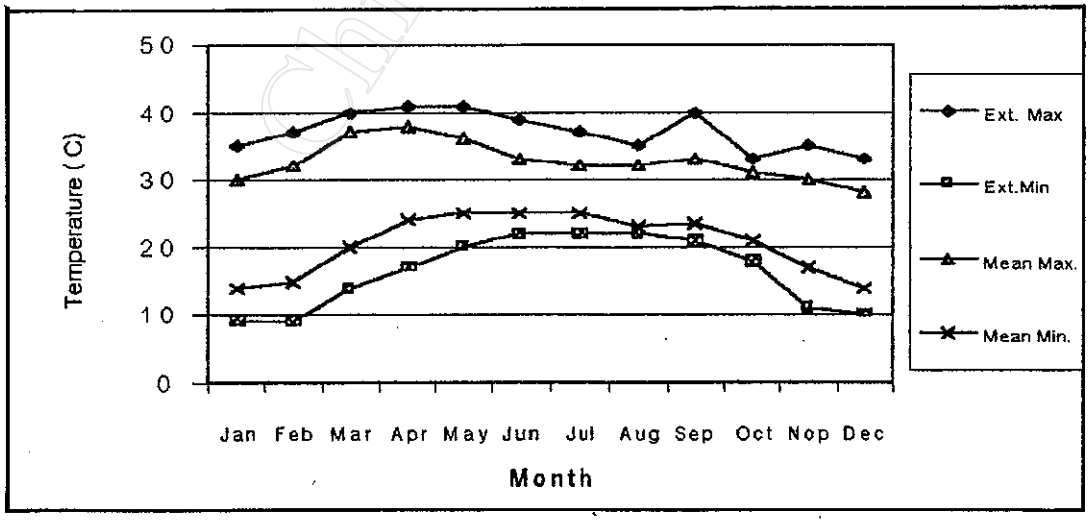

Figure 3.2. Average monthly temperature in the Mae Moh Power plant area
(Source : Environmental Division, Mae Moh Power Plant)

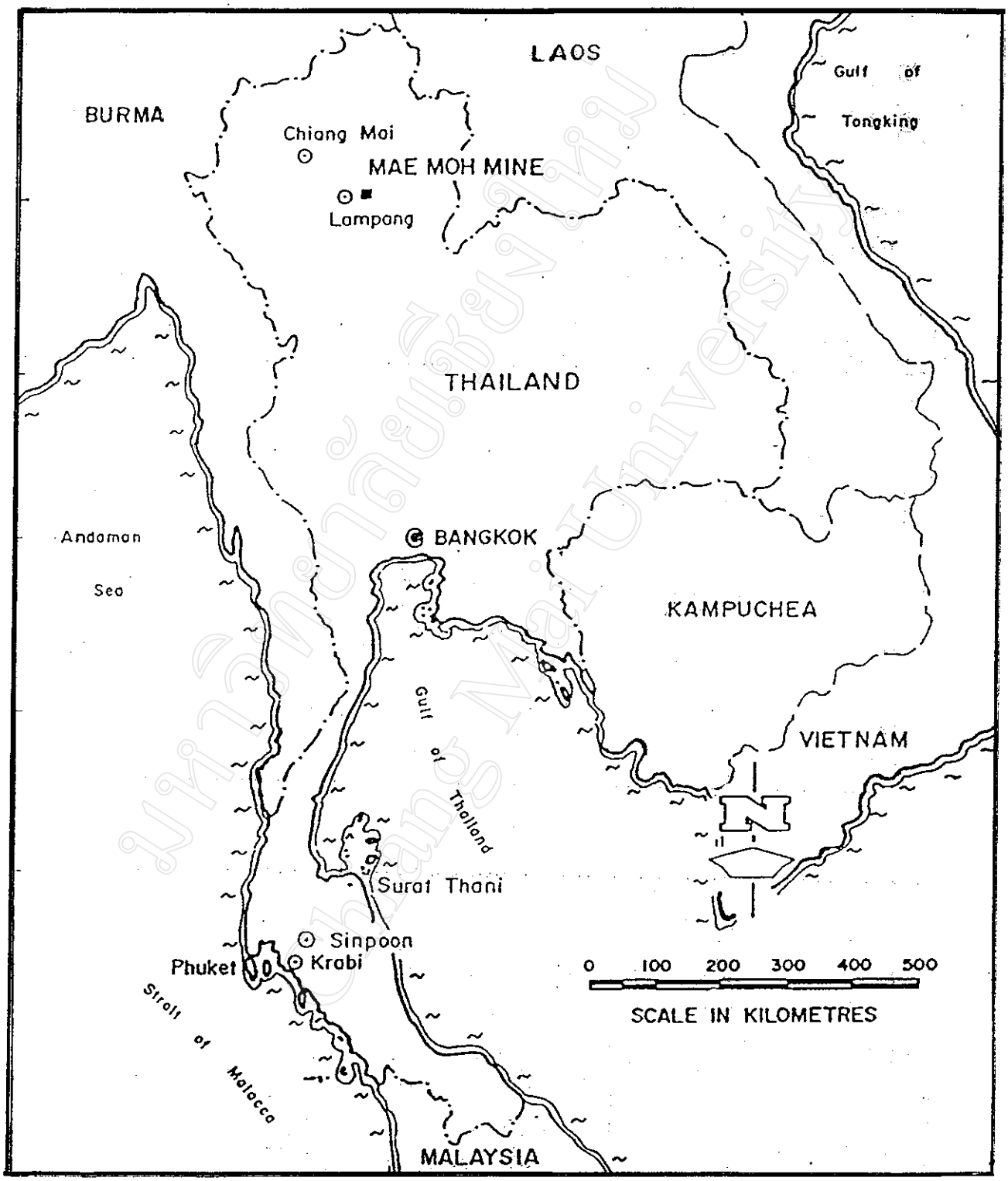

Figure 3.3. Map showing location of Mae Moh Power plant and Lignite Mine
(Source : Jitapunkul, 1985)

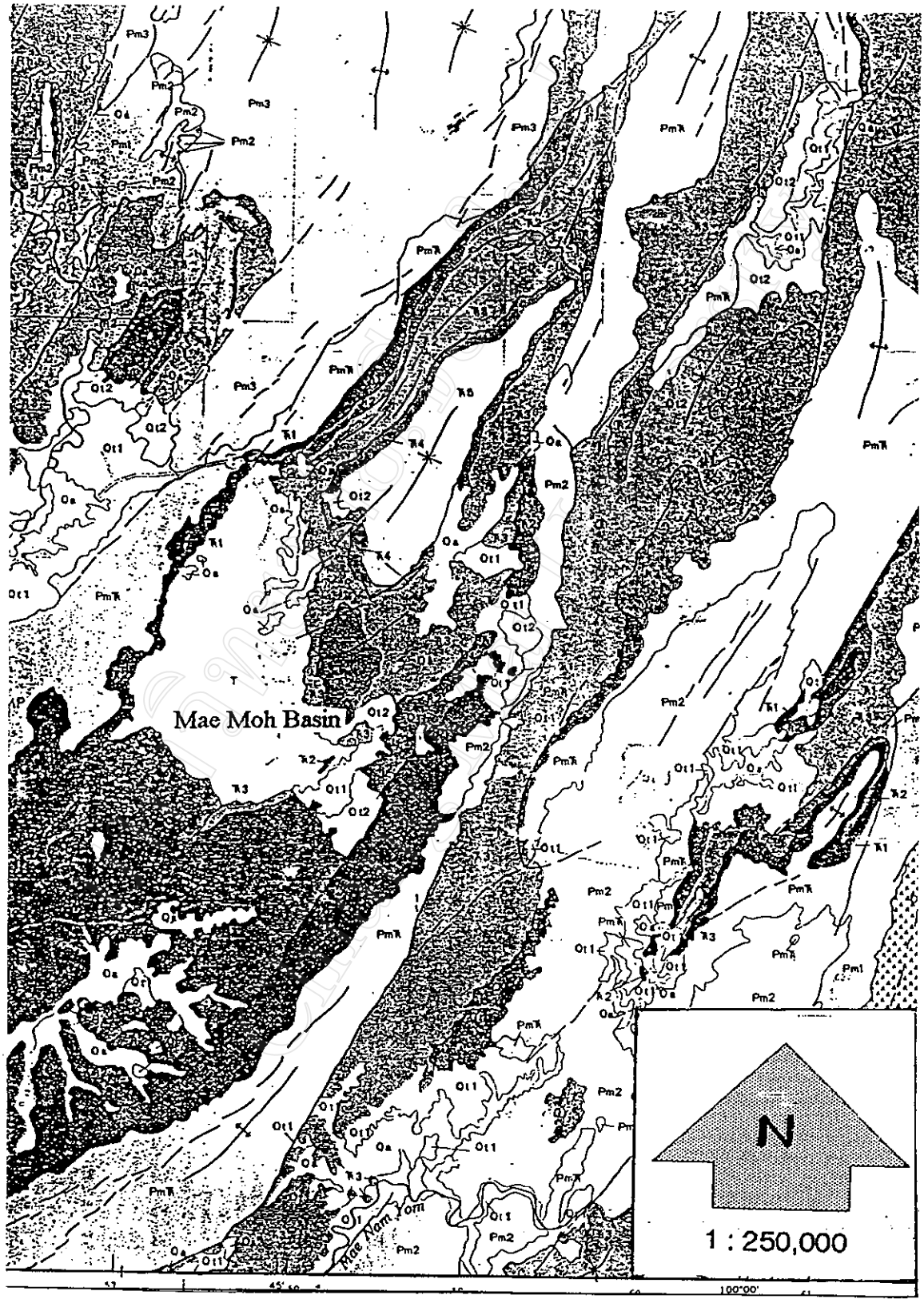

Figure 3.4. The geological map of the Mae Moh Basin area (Source: Department of Mineral Resources)

Explanation of Figure 3.4 :

Qa River gravel, sand, clay and mud

Qt1 Lower terraces, gravel, sand silt, clay

Qt2 Higher terraces, gravel, sand, silt, clay (Mae Teang Group)

T Fresh-water sandstone, shale, carbonaceous shale, limestone, viviparous beds, lignite (Mae Moh Group)

T5 Reddish-brown sandstone, shale, conglomerate, greenish-grey siltstone, shale, sandstone (Pha Daeng Formation, Lampang Group)

T4 Limestone, limestone conglomerate, medium grey to pinkish-grey with fossils of gastropods, brachiopods (Doi Chang Formation, Lampang Group)]

T3 Greenish-grey shale, sandstone, tuffaceous sanstone, laminated shale, conglomerate with fossils of *Halobia, Daonella, Posidonia, Trachyceras, Paratrachyceras, Joannites*, etc. (Hong Hoi Formation, Lampang Group)

T2 Limestone, massive or banded, dark grey to medium gray, shale, sandstone, calcareous, grey to greyish-brown, well stratified, with fossils of *Brachiopods, Claraia, Halobia, Daonella, Posidonia, Ammonites* (Pha Kan Formation, Lampang group)

T1 Basal conglomerate, redish-brown sandstone, shale, agglomerate, tuff

Pm3 Shale, calcareous shale, carbonaceous shale, tuffaceous shale and sandstone, laminated shale with fossils of *Dielasma, Leptodus, Orthotichia, Echinocus, Neospirifera, Schizopoira, Aviculopecten*, etc. (Huai Thak Formation, Ratburi Group)

Bs Basalt, vesicular, Amygdaloidal

3.2.3. Wind

The direction of the prevailing wind changes according to the season. From October to January, the prevailing wind is south because of the northeast monsoon. The prevailing wind varies in all directions during the transition period of the northeast monsoon to the southwest monsoon. Windrose diagram showing annual wind direction is presented in Figure 3.5. The average wind speed of 5-6 km/hr is relatively low throughout the year.

3.3. Study sites

The study sites were selected according to different distances from the power plant and oriented to the wind direction. A total of twelve study sites were established of which six were northern and up-wind (sites N1 to N6) and six southern and down-wind (sites S1 to S6). The locations of the study sites is shown in Figure 3.6 and detailed information is given in Table 3.1.

3.4. Vegetation

The forests in the study area can be classified into degraded deciduous and deciduous dipterocarp-oak forest often with bamboo and secondary growth. The forests are dominated by following tree species : *Tectona grandis, Xyliax kerii, Shorea obusta, Dipterocarpus tuberculatus* and *Dipetrocarpus obtusifolias,* Various bamboo species are distributed over the study area : *Dendrocalamus membranaceus, Dendrocalamus nudus, Bambusa tulda, Thyrsostachys siamensis, Oxytenanthera albociliata* and *Ceaphalostachum pergracile.* The forests have been repeatedly degraded by legal and illegal logging, forest fires, and settlements.

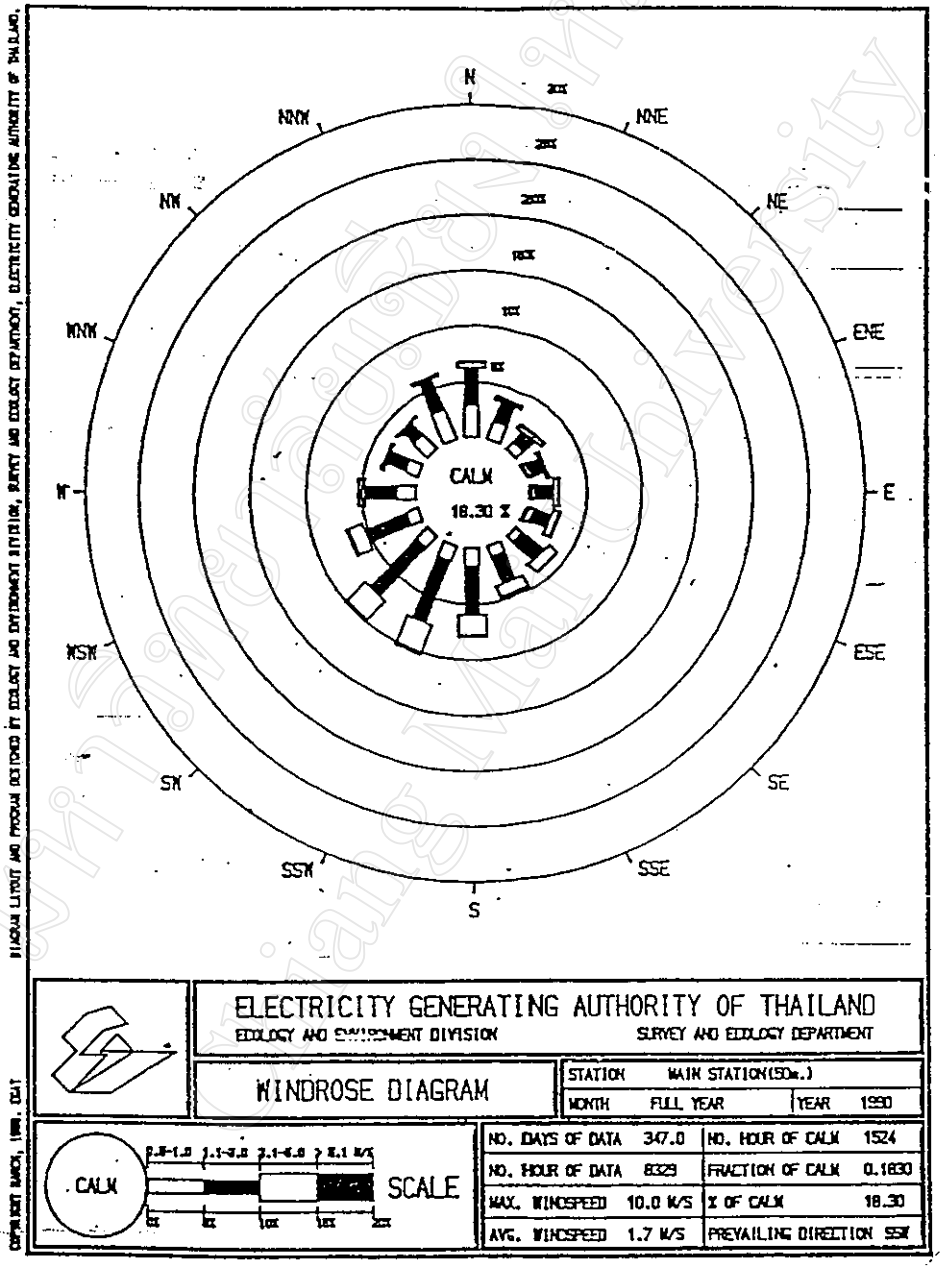

Figure 3.5. Windrose diagram showing annual wind directions in Mae Moh Basin Area (*Source* : Environmental Division, Mae Moh Power Plant)

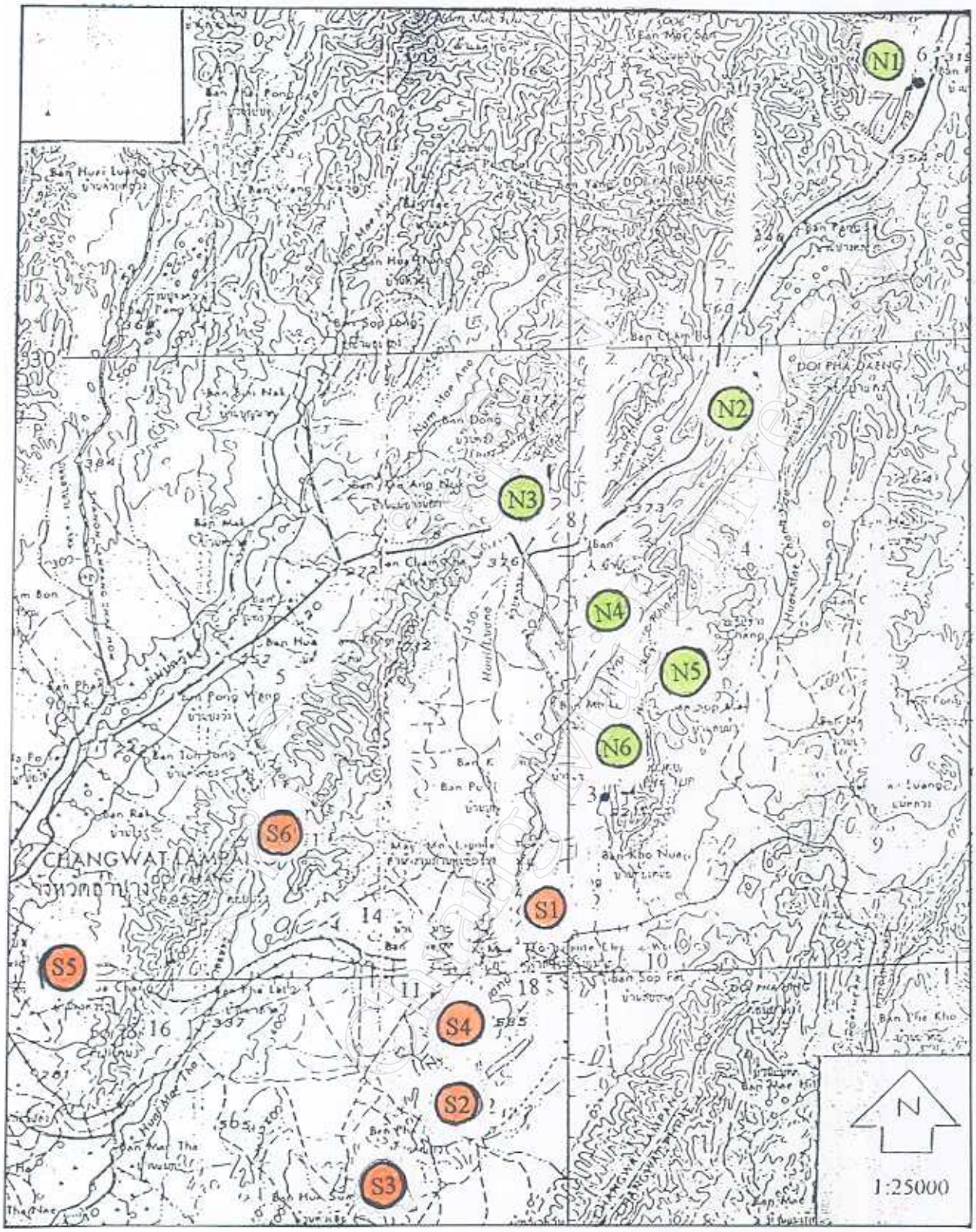

Figure 3.6. Map showing the study sites (Source: Royal Thai Survey Department, Bngkok, 1992)

Table 3.1. Details of the study sites

Site	Position (UTM unit)		Distance from the power plant	Direction	Elevation (m)	Soil profile (organic layer)	Land use pattern
	North	East					
N1 : Km. 644 (Lampang- Ngao)	2042050	0585261	19 km	N-NE	460	> 10 cm, freshly and decomposing litter	Bamboo forest
N2 : Km. 637 (Lampang-Ngao)	2037569	0580726	13 km	N	330	> 10 cm, less freshly fallen litter	Teak, bamboo, scrub
N3 : Nong Bom (Lampang-Ngao)	2036373	0577211	12 km	N	350	4-6 cm, freshly fallen litter	Teak plantation
N4 : Ban Dong	2034619	0578308	10.5 km	N	330	4-5 cm, freshly fallen litter	Deciduous dipterocarp, very degraded
N5 : Ban Tha Si 2 Bridge	2033088	0580551	9 km	N	340	8 cm, freshly fallen litter	Scrub, open, very degraded
N6 : Dumping Area	2029963	0580035	5 km	N	300	10-12 cm, decomposing litter	Deciduous secondary growth
S1 : C Road	2025575	0578682	1.5 km	N-E	300	> 10 cm, freshly and decomposing litter	Vegetation with much Leguminosae
S2 : Ban Hui Pet	2020822	0576493	4 km	S-SW	280	6 cm, decomposing litter	Bamboo, deciduous scrub forest
S3 : Sob Moh School	2018750	0575025	7 km	S-SW	290	10 cm, freshly fallen litter	Deciduous scrub, very degraded
S4 : Huai King Bridge	2022075	0576197	3.5 km	S-SW	360	8 cm, freshly fallen litter	Open, scrub forest
S5 : Mae Moh Police Station	2020654	0569315	11 km	SW	280	6-7 cm, decomposing litter	Deciduous dipterocarp-oak scrub
S6 : Monitoring Station	2024699	0577699	3.5 km	W	310	8 cm, freshly fallen litter	Vegetation with much Leguminosae

3.5. History of the Mae Moh Power Plant

Lignite was discovered in the Mae Moh Basin in 1917. Development of the power plant began in 1958 when two units of 6.25 kW each were constructed to power the Bhumibol Hydroelectric Project in Tak province. They were operated from 1960 to 1978 when this power service was terminated. In 1969, the Electricity Generating Authority of Thailand (EGAT) was established and launched a plan to increase lignite production and install a new Mae Moh Power Plant one year later. Three generating units rated at 75 MW capacity were approved for construction by the Government in 1972 and 1978. They were operational in 1978, 1979 and 1981, respectively. Units 4-7 of 150 MW each were completed during 1984-1985. With the proven lignite reserves of about 614 million tons, units 8-11 of 300 MW each were constructed in 1985 to fulfill a dramatic rise of power demand due to Thailand's economic boom. During 1988-1989, EGAT revised its power development plan and implemented the Mae Moh Power Expansion Project, which included the installation of units 12-13 rated at 300 MW each with desulphurising unit. By completion of the whole plan in 1995, capacity of the Mae Moh Power Plant now stands at 2,625 MW and becomes the biggest lignite-fired power plant in the Southeast Asian region.

Further exploration in 1987 discovered lignite reserves of more than 1,000 million tons. This will lead to the expansion of the power plant up to 14 units with a total capacity of 2,925 MW and lignite consumption of 75,800 tons per day. According to the EGAT power development plan, the ultimate capacity of 4,725 MW will be reached in the year 2001 with the completion of Lampang units 6 and the

lignite production will be increased to approximately 30 million tons per year (Electricity Generating Authority of Thailand, 1994; Electricity Generating Authority of Thailand, 1992; Electricity Generating Authority of Thailand, 1995). The plan, however, had to be discontinued due to the overload of bad air condition especially the problem of too high sulphur dioxide during the beginning of winter in Mae Moh Basin. It led to the health problem of people in the area.

Assuming that the Mae Moh lignite contains about 30% ash which after burning generates 80% fly ash and 20% wet or bottom ash (Ratanasthien *et al.*, (1990), a total of 22,740 tons of fly ash would be produced daily. Concentrations of some heavy metals in Mae Moh lignite fly ash are listed in Table 3.2.

Table 3.2 Concentrations of heavy metals in fly ash of the Mae Moh Power Plant

Heavy metal	Concentration (mg/kg)
Arsenic (As)	213
Cobalt (Co)	33.7
Chromium (Cr)	66.5
Manganese (Mn)	582
Molybdenum (Mo)	19.9
Nickel (Ni)	53.3

(Source: Ratanasthien et al., 1990)