

CHAPTER I

INTRODUCTION

Groundwater is an important source of water supply in many parts of the world. Groundwater resources, which are provided for irrigation, industries, water supply, mining, and household utilities, continue to increase. Due to the rapid growth of the world 's population increasing demand upon fresh water supplies, thus, the groundwater is becoming an essential natural source of water supply. Moreover, groundwaters are as good as, sometimes better than, surface water both in the quality and quantity.

1.1 Background Information

Bangkok Metropolis and its vicinity are rapidly; both economically and socially developed which resulted in land use development, population growth, increasing of number of industries, as well as real estate. These lead to higher demand of water supply for households and industries. The surface water, the main water supply in the Metropolis and its vicinity is inadequate. Thus, others sources of water supply is comprehensively investigated. Groundwater is then chosen to be an alternative and serve as a supplementary source of water supply. By nature, the groundwater is clean and the chance of water contamination is less in comparison with the surface water. Moreover, the most outstanding advantage is that it can be used all year round.

Since, the groundwater pumping is not controlled, it causes the excessive extraction of groundwater, which is greater amount than groundwater recharge. The groundwater system is not balance which will lead to groundwater depletion,

saltwater intrusion, wastes contamination and land subsidence. In addition, a lot of aquifers suffered from these phenomenons. The Nakhon Luang aquifer, one of the Bangkok aquifer systems is also affected. It is the third in descending order of the Bangkok aquifer system. It is approximately about 150 m. depth below the surface and it is the main groundwater aquifer that being pumped for the usage as it gives good water quality with sufficient quantity. The heavily overpumping, the more suffered of the Nakhon Luang aquifer. This problem approaches to the critical state as somepart of the Nakhon Luang aquifer become salty due to saltwater encroachment. Many groundwater wells are abandoned. These lead to the economically and socially loss as a whole.

Therefore, the comprehensively study of hydrogeology of the Nakhon Luang aquifer is urgently required to determine groundwater occurrence, groundwater storage, aquifer characteristic, water quality, distribution and extension of the aquifer as well as potentiometric surface data. The collection of all groundwater data is highly recommended, as it would be use as the database that can be used for planning, groundwater development and groundwater resource management in the area with great efficiency and effectiveness.

1.2 Description of the Study

1.2.1 Study Area

The study area consists of 7 administrative Provinces: Bangkok Metropolis, Nonthaburi, Samut Prakan, Pathum Thani, some parts of Samut Sakhon, Nakhon Pathom, and Phra Nakhon Si Ayutthaya, The total area comprises more than 5,600 square kilometers cover all 6 sheets of the 1:50,000 topographic maps, series L 7017: sheets 5037 I, 5036 I, 5036 II, 5137 III, 5137 IV, 5136 III, and half of each sheet 5137

II, 5136 I, 5136 II. The study area is extended to the east from Amphoe Muang, Nakhon Pathom Province to Amphoe Nong Chok , Bangkok Metropolis. The southern and northern boundaries are limited at the Gulf of Thailand and Amphoe Wang Noi, Phra Nakhon Si Ayutthaya Province respectively (Fig. 1.1)

1.2.2 Topography and Drainage

The topography of the study area is relatively flat and low lying plain which is typical of a flood plain and a delta of the Chao Phraya River Basin. The major drainage system of the study area is the Chao Phraya River and its tributaries, i.e. the Tha Chin. The Chao Phraya River drains from north through Pathum Thani, Nonthaburi Province and Bangkok Metropolis Provinces to south into the Gulf of Thailand at Samut Prakan Province. The Tha Chin River drains from the north through Nakhon Pathom Province to south at Samut Sakhon Province. The plain also receive the water from three other rivers, namely the Mae Klong River from the west, the Bang Pakong River from the east and the Pa Sak River from the northeast. Along the Chao Phraya River the ground levels of the levee vary between 1 and 2 m. above Mean Sea Level (MSL). The levels of the back swamp areas between the Chao Phraya and the Tha Chin, which river meanders about 30 kilometers, west of the Chao Phraya, are much lower. The network of spot heights surveyed by the DMR and the Royal Thai Survey Department reveal that ground levels on some locations reach sub-zero MSL such as Ramkhamhaeng University, Huamark. Within the study area its altitude ranges from 1-6 m. above MSL.

1.2.3 Climate and Land use

The climate of the study area is tropical, which affected by Southwestern and northeastern monsoons can be divided into three seasons as follows:

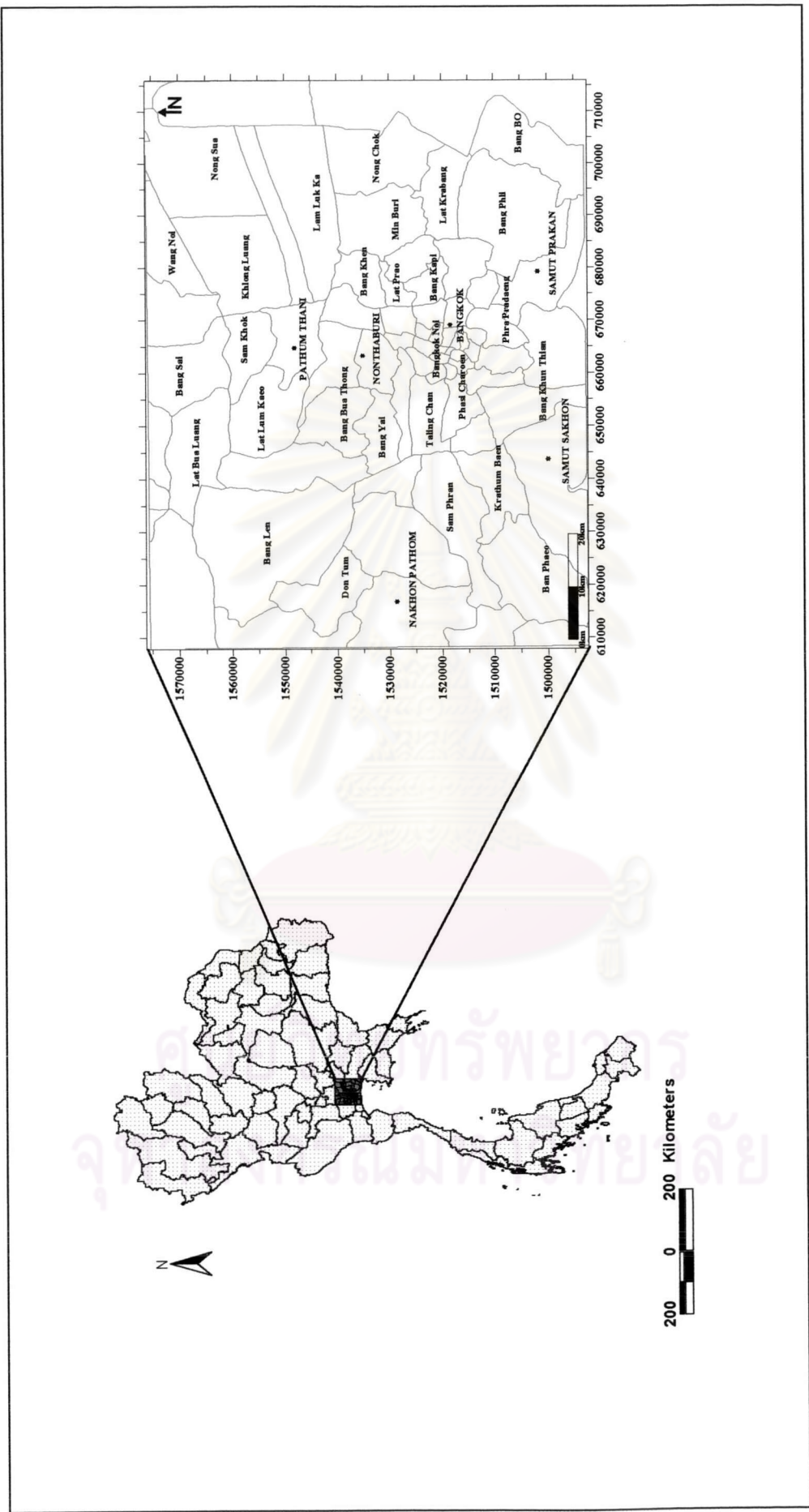


Figure 1.1 Location of the study area

1) Summer season started from middle February to middle May, 2) Rainy season started from middle May to October and, 3) Winter season started from November to middle February. Mean average temperature from 25-30 degree C. The relative humidity is ranging from 71-82 %. The mean annual rainfall in the lower Chao Phraya basin is approximately 1,500 mm. and the mean annual evaporation is about 1,800 mm. The estimated groundwater recharge from the hydrologic balanced study is only 3 % of the basin rainfall (AIT and DMR, 1982)

Areas of Bangkok Metropolis and its vicinity have been used for housing and industrial, whereas the outskirts have been used for agricultural activities.

1.2.4 Distribution of Groundwater Monitoring Wells

A network of 117 groundwater monitoring stations (304 wells) were constructed by the Mitigation of Groundwater crisis and Land subsidence in Bangkok Metropolis (the MGL Project) based on the critical zones in the Remedial Measures. A complete groundwater monitoring station consists of three monitoring wells penetrating three different aquifers Phra Pradaeng (PD: 100 - meter depth zone), Nakhon Luang (NL: 150 - meter depth zone), and Nonthaburi (NB: 200 – meter depth zone). Of the 117 monitoring stations, there are 78 complete stations, 12 stations for 2 wells and 27 stations for one well. The groundwater monitoring stations that were penetrated into the Nakhon Luang aquifer is **94 observation wells**. (Table 1.1)

Table 1.1 Groundwater monitoring well stations in the study area

Station number	UTM Grid		Observation Well			Province	Details	Location
	Easting	Northing	PD	NL	NB			
1	681000	1531800	8	62	5	Bangkok	Wat Khu Bon (Ban Khu Bon), Khwang Bang Chan	
2	680100	1519900	5	11	8	Bangkok	Bangkok Golf Course, Khwaeng Hua Mak	
3	683600	1515600	38	3	9	Samut Prakan	Wat Hua Khu Wanaram (Ban Hua Khu), Tambon Sisa Chorakhe Noi	
4	672100	1525500	7	-	-	Bangkok	Phibun Uppatham School, (Ban Lat Phrao) Mu Thi 9, Khwaeng Lat Phrao	
5	654109	1538551	55	-	4	Nonthaburi	Wat Lahan (Ban Sano Loi), Tambon Sano Loi	
6	683800	1509200	3	-	-	Samut Prakan	Wat Khlong Salut (Ban Khlong Salut), Mu Thi 4 Tambon Bang Phli Yai	
7	656174	1516845	6	-	1	Bangkok	Wat Chan Pradittharam, Khwaeng Bang Duan	
8	682500	1494700	2	-	49	Samut Prakan	Wat tamru, Sukhumvit-Khling Dan Rd., Tambon Bang Pu Mai	
9	673300	1509000	4	-	-	Samut Prakan	Wat Dan Samrong, Ban Samrong Nua, Tambon Samrong Nua	
10	666036	1500807	1	67	53	Samut Prakan	Wat Khu Sang, Ban Khu Sang Mu Thi 9, Tambon Nai Khlong Bang Pla Kot	
11	663884	1505820	77	4	76	Bangkok	Wat Thung Khru, Ban Thung Khru, Mu Thi 5, Khwaeng Thung Khru	
12	677700	1500700	39	50	41,10	Samut Prakan	Wat Phraek Sa, Ban Phraek Sa, Tambon Phraek Sa	
13	673100	1503900	22	10	30	Samut Prakan	Samut Prakan Provincial Hall, Tambon Pak Nam	
14	690600	1494900	78	1	77	Samut Prakan	Bang Pla Aeromautical Transmission Station, Tambon Bang Pu Mai	
15	669700	1538600	-	-	3	Bangkok	Wat Weru Wanaram, Ban Si Kan, Mu Thi 1, Khwaeng Thung Song Hong	
16	689100	1540700	51	7	7	Pathum Thani	Wat Nang Khan Chantri, Tambon Bung Kham Phroi	
17	671900	1531900	28	-	11	Bangkok	Wat Bang Bua, Khwaeng Anusawari	
18	688800	1505600	-	2	-	Samut Prakan	Phun Charoen Wittayakom School, Tambon Bang Chalong	
19	677789	1551413	42	8	6	Pathum Thani	Wat Kla Cha-um, Tambon Khlong Song	
20	665764	1543431	-	9	-	Pathum Thani	Wat Pa Klang Thung, Tambon Bang Khayaeng	
21	667300	1508500	46	-	2	Samut Prakan	Wat Bang Ya Phraek, Ban Bang Ya Phraek, Mu Thi 6, Tambon Bang Ya Phraek	
22	677700	1532800	26	6	36	Bangkok	Wat Siri Phong Thammimit, Ban Khlong Bua, Mu Thi 6, Khwaeng Tha Raeng	
23	664300	1511200	10	-	-	Samut Prakan	Wat Ruak, Tambon Bang Phuang	
24	649800	1504800	62	18	66	Bangkok	Wat Phromma Rangsi, Khwaeng Samae Dam	
25	653800	1552300	9	-	-	Bangkok	Wat Sakae Ngam, Bang Sakae Ngam, Mu Thi 1, Khwaeng Samae Dam	
26	684700	1504700	12	37	29	Samut Prakan	Wat Bang Phli Yai Klang, Ban Bang Phli Yai, Tambon Bang Phli Yai	
27	693800	1502900	11	43	18	Samut Prakan	Wat Mongkhon Nimit, Ban Khlong Samrong, Mu Thi 1, Tambon Bang Sao Thong	
28	679600	1540300	-	-	16	Pathum Thani	Wat Sai Mai, Tambon Khu Khot	
29	700500	1515000	14	81	78	Bangkok	Wat Ratcha Kosa, Khwaeng Khom Thong	

Table 1.1 Groundwater monitoring well stations in the study area (Continued)

Station number	UTM Grid		Observation Well		Province	Details	Location
	Easting	Northing	PD	NL			
30	695600	1526000	15	84	Bangkok	Wat Mai Lam Nok Khwaek, Ban Lam Nok Khwaek, Mu Thi 10, Khwaeng Sain Saep	
31	681900	1571400	75	13	Phra Nakhon Si A	Wat Lat Sai, Ban Lat Sai, Mu Thi 5, Tambon Lat Sai	
32	694950	1511600	13	-	Samut Prakan	Wat Sri Wari Noi, Mu Thi 6, Tambon Sisa Chorokhe Yai	
33	688700	1528000	40	16	Bangkok	Wat Saen Suk, Ban Suk, Mu Thi 2, Khwaeng Min Buri	
34	701400	1532300	85	15	Bangkok	Wat Phakdi Noraset, Ban Krathum Rai, Khwaeng Krathum Rai	
35	665126	1569478	68	12	Phra Nakhon Si A	Wat Bot Somphon Chai, Mu Thi 1, Ratcha Khram	
36	694082	1552844	72	14	Pathum Thani	Wat Aiyakaram, Ban Lam Phak Kut Khlong Paet, Mu Thi 4, Tambon Lam Phak Kut	
37	687270	1560760	67	76	Pathum Thani	Wat Phalahan, Mu Thi 9, Tambon Khlong Hok	
38	663979	1562311	74	78	Phra Nakhon Si A	Wat Pa Kha, Mu Thi 1, Tambon Khok Chang	
39	653800	1552800	59	71	Pathum Thani	Wat Bua Kaeo Keson, Ban Rahaeng, Mu Thi 4, Tambon Rahaeng	
40	665900	1550300	47	65	Pathum Thani	Pathum Thani Provincial Hall, Tambon Bang Prok	
41	690100	1519800	33	47	Bangkok	Wat Bamrung Run, Ban Khlong Sam, Khwaeng Khlong Sam Prawet	
42	671000	1517400	-	17	Bangkok	Bangkok Planetorium, Khwaeng Phara Khanong	
43	704200	1543500	64	22	Pathum Thani	Wat Phut Udom, Mu Thi 9, Tambon Phut Udom	
44	643300	1526500	53	68	Nakhon Pathom	Wat Salawan School, Mu Thi 5, Tambon Salaya	
45	636700	1513100	-	19	Nakhon Pathom	Wat Om Yai, Ban Khlong Om Yai, Mu Thi 5, Tambon Om Yai	
46	654800	1531600	-	20	Nonthaburi	Wat Sakae, Ban Bang Sakae, Tambon Bang Len	
47	670100	1523500	-	25	Bangkok	Wat Kunnathi Ruttharam, Khwaeng Huai Sakae	
48	639500	1503300	52	24	Bangkok	Wat Bang Ping, Ban Bang Ping, Mu Thi 2, Tambon Na Di	
49	675126	1562150	76	23	Pathum Thani	Wat Khun Ying Som Chin, Ban Chiang Rak Noi, Tambon Khlong Nung	
50	697100	1562800	-	21	Pathum Thani	Wat Bung Ba Praphasawat, Ban Khlong Sip, Tambon Bung Ba	
51	641900	1545400	58	72	Nonthaburi	Wat Sai Yai, Tambon Sai Noi	
52	673919	1543915	-	26	Pathum Thani	Wat Prayun Thammaram, Mu Thi 4 Phahonyothin Rd., Tambon Khu Khot	
53	670400	1509100	16	27	Samut Prakan	Pig Quarantine Station, Pu Chao Saming Phrai Rd., Tambon Samrong Tai	
54	671400	1509700	-	28	Samut Prakan	Wat Mahawong, Pu Chao Saming Phrai Rd., Tambon Samrong Tai	
55	672800	1515800	24	29	Bangkok	Phra Khanong Flood Control, Soi Sukhumvit 50, Khwaeng Phrakhanong	
56	673300	1524000	20	35	Bangkok	Wat Samakhi Tham, Soi Ketnut (64), Lat Phrao Rd.	
57	686100	1512200	29	30	Samut Prakan	Wat King Kaeo, Bangna-Trat Highway, Tambon Ratcha Thewa	
58	672200	1528900	-	31	Bangkok	Wat Srikammalawat, Mu Thi 4, Soi Chok Chai 4, Lat Phrao Rd., Khwaeng Lat Phrao	
59	666776	1536872	-	41	Nonthaburi	Khlong Klua School, Mu Thi 4 Chaeng Watthana Rd., Tambon Pak Kret	

Table 1.1 Groundwater monitoring well stations in the study area (Continued)

Station number	UTM Grid		Observation Well			Province	Details	Location
	Easting	Northing	PD	NL	NB			
60	637412	1510997	18	32	25	Samut Sakhon	Wat Nang Sao, Mu Thi 7, Soi Wat Nang Sao, Setthakit Rd.	
61	665400	1521800	17	34	27	Bangkok	Department of Mineral Resources, Rama Rd., Khwaeng Thung Phayathai	
62	638300	1497800	19	33	26	Samut Sakhon	Samut Sakhon Provincial Hall, Chetsadang Rd., Tambon Mahachai	
63	678800	1522700	21	36	28	Bangkok	National Housing Authority Flat No. 13, Khwaeng Khlong Chan	
64	664500	1525700	25	39	32	Bangkok	Wat Kao Fa Chula Mancee, Thahan Rd., Khwaeng Thanon Nakhon Chaisi	
65	665900	1514800	23	38	33	Bangkok	Mahamek Electrical Substation, Sathu Pradit Rd., Khwaeng Chong Nonsi	
66	674224	1548714	50	40	34	Pathum Thani	Bun Khum Rat Bamrung School, Soi Bun Khum, Tambon Khlong Nung	
67	677200	1513900	27	42	35	Bangkok	Wat Wachiratham Sathit, Soi Sukhumvit 101/1, Khwaeng Bang Chak	
68	682200	1512600	30	44	37	Bangkok	Wat Thung Lan Na, Mu Thi 11, Khwaeng Dokmai	
69	676800	1537900	32	45	38	Bangkok	Wat Ko Suwannaram, Khwaeng Khlong Thanon	
70	673300	1539400	31	46	40	Bangkok	Wat Don Muang, Khwaeng Talat Bang Khen	
71	668719	1527356	34	48	42	Bangkok	Chatuchak Rd., Kamphaeng Phet Rd., Khwaeng Lat Yao	
72	676700	1509700	35	49	43	Bangkok	Wat Phon Phloi, Khwaeng Bang Na	
73	685200	1526200	37	51	44	Bangkok	Wat Bamphen Nua, Khwaeng Bang Chan	
74	683800	1521200	36	52	45	Bangkok	Wat Lat Bua Khao (Ratchayatha), Khwaeng Prawet	
75	685800	1535400	84	54	47	Bangkok	Wat Paen Thong Sopharam, Mu Thi 13, Tambon Sam Wa Tawan Tok	
76	657655	1516264	-	53	-	Bangkok	Wat Kho Non, Phattanakan Rd., Khwaeng Khlong Kum	
77	679400	1525900	41	56	51	Bangkok	Praphat Witthaya School, Sukhaphiban Rd., Khwaeng Khlong Kum	
78	657600	1521400	82	57	50	Bangkok	Wat Chaiyathit, Soi Charan Sanitwong 37, Khwaeng Bang Khum Si	
79	662900	1507500	-	58	54	Bangkok	Itsalam Witthayalai School, Pracha Uthit Rd., Khwaeng Thung Khru	
80	671300	1519800	44	59	55	Bangkok	11th Channel Television Station, New Phetburi Rd., Khwaeng Bang Kapi	
81	676200	1496600	43	60	48	Samut Prakan	Wat Sip Song Thanwaram, Mu Thi 1, Tambon Bang Pu Mai	
82	682500	1499300	79	61	56	Samut Prakan	Wat Noi Suwannaram, Tambon Phraek Sa	
83	683700	1508500	-	63	57	Samut Prakan	Bang Phli Telephone Exchange Station, Bangna-Trat Highway	
84	661823	1531565	45	64	58	Nonthaburi	Wat Bang Phraek Nua, Tambon Suan Yai	
85	665601	1544298	48	-	59	Pathum Thani	Wat Chinwanaram Worawihan, Tambon Bang Khayang	
86	674763	1551464	65	66	67	Pathum Thani	Rangsit Switching Office, Phahonyothin Highway	
87	674755	1544995	49	-	-	Pathum Thani	Pathum Thani Agriculture College, Tambon Khu Khot	
88	638613	1519846	54	69	61	Nakhon Pathom	Wat Tha Phut, Mu Thi 19, Tambon Rai Khing	
89	654100	1531200	56	-	63	Nonthaburi	Wat Pikun Ngoen, Tambon Bang Muang	

Table 1.1 Groundwater monitoring well stations in the study area (Continued)

Station number	UTM Grid		Observation Well			Location		
	Easting	Northing	PD	NL	NB	District	Province	Details
90	652166	1511415	57	70	62	Bang Khun Thian	Bangkok	Wat Ninsukharam, Mu Thi 10, Khwaeng Bang Bon
91	660565	1547845	60	74	64	Muang	Pathum Thani	Wat Phrai Fa, Tambon Bang Dua
92	640500	1534700	61	73	65	Sai Noi	Nonthaburi	Limkun Watthana School
93	666789	1538216	63	-	-	Pak Kret	Nonthaburi	Wat Phasuk, Mu Thi 10, Tambon Pak Kret
94	645100	1559400	66	75	68	Sai Noi	Nonthaburi	Wat Lak Khon, Tambon Rat Niyom
95	705900	1500900	69	77	71	Bang Bo	Samut Prakan	Wat Bang Phli Noi, Mu Thi 1, Tambon Bang Phli Noi
96	704688	1556688	70	79	70	Thanya Buri	Pathum Thani	Wat Pichit Pitayaram, Khlong Sip Sam, Tambon Bung Nam Rak
97	641900	1545400	71	80	72	Thanya Buri	Pathum Thani	Wat Mun Chindaram, Mu Thi 3, Tambon Bung Yitho
98	697265	1563059	73	-	74	Nong Sua	Pathum Thani	Amphoe Nong Sua Office Compound, Tambon Bung Ba
99	658000	1512000	80	82	79	Bang Khun Thian	Bangkok	Wat Kok, Tambon Chom Thong
100	653500	1508800	-	86	80	Bang Khun Thian	Bangkok Abandon	National Housing Authority No. 3, Thon Buri-Pak Tho Rd.
101	657900	1523400	83	83	81	Taling Chan	Bangkok	Wat Taling Chan
102	704600	1521200	86	85	84	Nong Chok	Bangkok	Wat Lam Toiting, Khwaeng Lam Toiting
103	646100	1520200	81	87	85	Taling Chan	Bangkok Abandon	Thawi Watthana School, Khwaeng Thawi Wattana
104	666000	1507000	-	-	-	Phra Pradaeng	Samut Prakan	Rat Pracha Samasai School, Tambon Bang Phung
105	648300	1507800	-	-	-	Bang Khun Thian	Bangkok	Technic Ratchasit College, Bang Bon
106	661300	1507800	-	-	-	Lat Lum Kaeo	Pathum Thani	Provincial Electric Authority, Lat Lum Kaeo
107	688400	1522000	-	-	-	Lat Krabang	Bangkok	Rom Klao National Housing Authority, Khwaeng Khlong Song Ton Nun
108	674600	1556800	-	-	-	Khlong Luang	Pathum Thani	A.I.T. Phahon Yothin Rd., Tambon Khlong Nung
109	638100	1500700	-	-	-	Muang	Samut Sakhon	Wat Khlong Khru School, Ekachai-Bang Bon Rd., Tambon Mahachai
110	632900	1524800	87	88	86	Nakhon Chaisi	Nakhon Pathom	Wat Thaiyawat, Mu Thi 4, Tambon Thaiyawat
111	626100	1515900	89	89	87	Sam Phran	Nakhon Pathom	Wat Wang Nam Khao, Mu Thi 5, Tambon Khlong Chinda
112	615200	1543100	88	91	88	Don Tum	Nakhon Pathom	Wat Thung Si Long, Don Tum-Nong Pla Lai Rd., Km. 2, Tambon Lam Hoei
113	629200	1534700	90	90	89	Nakhon Chaisi	Nakhon Pathom	Wat Lamut, Nakhon Chaisa-Dontum Rd., Tambon Wat Lamut
114	618400	1528100	91	92	90	Muang	Nakhon Pathom	Wat Rai Ko Ton Sam Rong, Tambon Phra Prathone
115	607600	1524900	92	93	91	Muang	Nakhon Pathom	Wat Nong Din Daeng, Mu Thi 3, Phet Kasem Rd., Tambon Nong Din Daeng
116	626100	1550100	93	94	92	Banglen	Nakhon Pathom	Banglen Office Compound, Tambon Banglen
117	641000	1500000	-	-	-	Muang	Samut Sakhon	Wat Panthai Norasing, Tambon Bang Nam Jud

1.3 Geology of the Lower Central Plain

1.3.1 Geographic Settings

The study area is situated in the southern part of the Lower Chao Phraya River Basin. It is located at the latitudes of 13° 30 ' 0'' N to 14° 13 ' 22.2'' N, and longitudes 100° 15 ' 0'' E to 100° 53 ' 30.6'' E. Its altitude ranges from one to six meters above mean sea level. It is composed of Bangkok Metropolis, Samut Prakan, Pathum Thani, Nonthaburi and some parts of Samut Sakhon, Pra Nakhon Si Ayutthaya and Nakhon Pathom Provinces covering 5,600 km². Geomorphology of the area is a combination of deltas and flood plains of the Chao Phraya River which traversing along the Lower Central Plain of Thailand (Fig.1.2). The area, known as the Lower Chao Phraya Basin, is approximately 250 km. from north to south and 175 km. from east to west. It is bounded on the east and the west by mountain ranges as well as by a series of small hills. At Bangkok, the general altitude of the area is 1.5 m. whereas at Nakhon Sawan is 15 m above MSL.

1.3.2 Geologic Settings

The Lower Central Plain is a geologically depressed area filled with clastic sediments. Aeromagnetic data and borehole data indicated that the fault/flexure depression is underlain by various types of bedrock, such as quartzite and gneiss, at depth from 400 m. to 3,500 m below ground surface. The basin floor generally slopes toward the central axis, which is located more or less along the Chao Phraya River course and declines southward to the Gulf of Thailand (Achalabuti,1975). Overlying the basement complex are unconsolidated and semi-consolidated sediments aged from the Tertiary to the Quaternary. During these periods the sediments are fluvial and deltaic deposits with occasional shallow marine. The total thickness of this rock

sequence ranges from 400 m. to more than 1,800 m (Piancharoen and Chuamthaisong, 1976).

1.4 The Aquifer System

Piancharoen and Chuamthaisong (1976) classified of the aquifer system according to the geological, hydrological, and geophysical studies. A number of borehole logs and electric logs were used in identifying the aquifer system. It is generally assumed that each aquifer is fairly uniform in thickness and extends a long way out to the recharge area. The system of Bangkok aquifer in the study area can be differentiated into at least 8 aquifers (Fig. 1.3). The brief description of the aquifer system, in descending order, as follow:

1.4.1 The Bangkok Aquifer

The Bangkok aquifer is the topmost of aquifers which is overlain by the Bangkok clay. It consists of a sequence of thin to thick layers of sand and gravel with many clay lenses. Depth of the aquifer is about 15 to 30 m. from existing ground surface. The thickness of aquifer ranges from 20 to 60 m. This aquifer is unused due to brackish to salty water.

1.4.2 The Phra Pradaeng Aquifer

The aquifer is separated from the Bangkok Aquifer by 10-15 m. clay bed. The average depth is 60-90 m. from the surface and the thickness varies from 20 to 50 m. The aquifer consists of white, coarse-grained sands and gravels with occasional clay lenses and carbonized wood. The deposits were laid in the mouth of the river or the very shallow sea on an erosion surface overlying hard and compacted older clay. Thickness of the aquifer decreases to the north. Groundwater in this aquifer is generally high yield but contains mostly brackish to salty water.

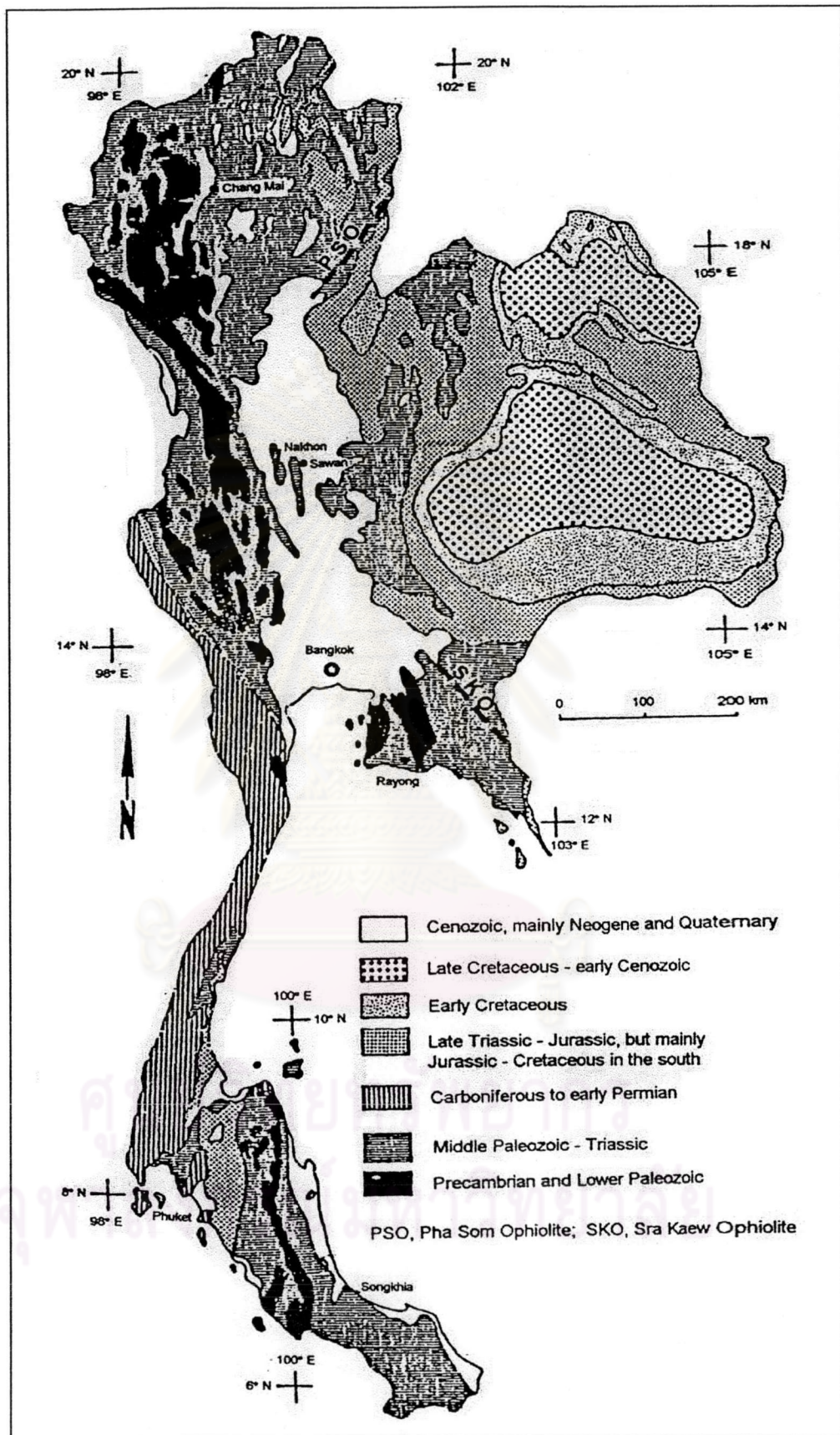


Figure 1.2 Geology of Thailand (Bunopas, 1981, quoted by JICA, 1995)

1.4.3 The Nakhon Luang Aquifer

The aquifer thickens towards the west and thins out towards the east of the study area. It consists of permeable sands and gravels with some clay lenses and leaky clay beds. Depth from surface to the aquifer is about 120-150 m. and the average thickness is 50 m. Thickness is slightly decreases to the south. The aquifer is very permeable and gives good quality water in the area, east of the Chao Phraya River

1.4.4 The Nonthaburi Aquifer

The aquifer is, geologically, similar and conforms to the Nakhon Luang aquifer. It is composed of sands and gravels with minor clay lenses. The aquifer can be divided into at least 3 sub aquifers separated by leaky clay beds. Depth to the aquifer ranges from 170 to 200 m. and the thickness is about 30 to 70 m. The groundwater conditions are quite similar to those of the Nakhon Luang Aquifer's. Groundwater development of this aquifer has increased rapidly since the Nakhon Luang aquifer has suffered from heavily pumpage and also caused some deterioration of water quality.

1.4.5 The Sam Khok Aquifer

The aquifer is found at a depth of about 300 m. Thickness ranges from 10 m. to 55 m. It consists of alternating layers of sands or gravels and clays. Clays are generally brown to yellow and moderately to highly compacted. Sands and gravels are generally medium to well sorted with clay lenses intercalated. The aquifer yields good quality water in the north, east and southeast of Bangkok with a slightly lesser amount than those of the Nakhon Luang and Nonthaburi Aquifer's.

1.4.6 The Phaya Thai Aquifer

The aquifer is underlain the Sam Khok aquifer and is separated by a hard and compacted clay bed 5 to 10 m. thick. It consists of thin sand and gravel layers

intercalated with clay lenses. Sand and gravels are dirty brown, angular, medium-grained and poorly to fairly well sorted. The depth of the aquifer is 275 to 350 m. and the thickness is 40 to 66 m. The water bearing properties of the aquifer are similar to those of the Sam Khok Aquifer s. Good quality water is found in the north, east and southeast of Bangkok. The Aquifer is generally not much developed due to its depth.

1.4.7 The Thonburi Aquifer

The aquifer is underlain a clay bed of 1 m. to 10 m. thick. It consists of thick sands and gravels interbedded with thin layers of clay. Sands are coarse-grained, rounded and well sorted. Clays are generally pinkish to brown, compacted and sandy. The aquifer is 350 m. to 400 m. deep and 50 m. to 100 m. thick. Good quality water is found in the north, east and southeast of Bangkok but the aquifer is not as productive as other aquifers due to the presence of clay in many horizons.

1.4.8 The Pak Nam Aquifer

The aquifer is separated from the Thonburi aquifer by leaky clay to sandy clay layer. It consists of at least 3 thick sand and gravel beds with clay lenses. Sands and gravels are white to gray and well sorted. Clay layers are generally very compacted, olive gray to dark gray, and associated with some carbonaceous matters. The depth of the aquifer is about 550 m. and the thickness is about 30 m. Groundwater from this aquifer is considerably good both in terms of quality and quantity. The temperature of the water can be as high as 50 degrees C.

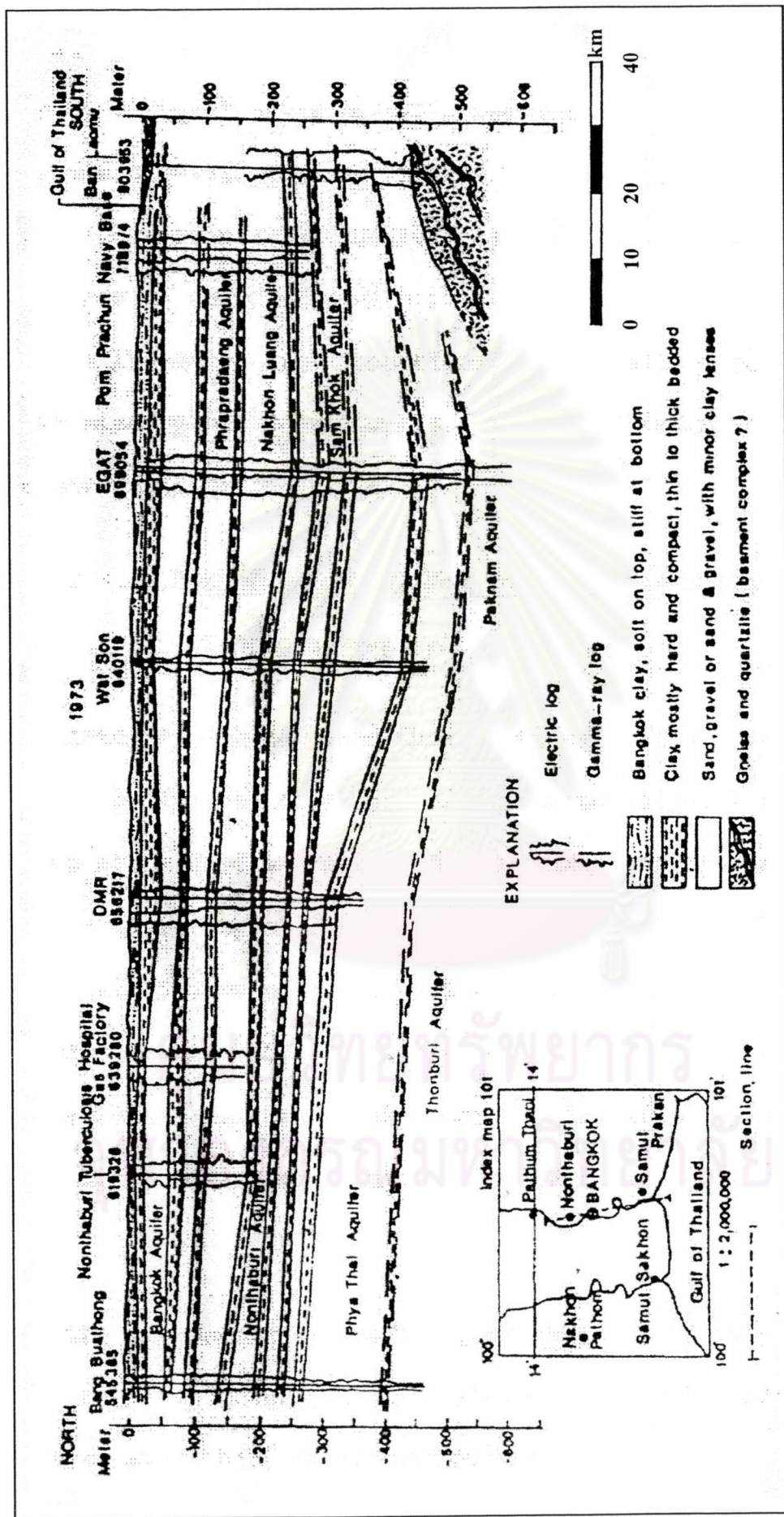


Figure 1.3 Hydrogeologic North-South section of the Lower Chao Phraya Delta showing principal aquifers of Bangkok Metropolitan [correlated by Electric and Gamma-ray Logs] (Piancharoen and Chuanthaisong, 1976)

1.5 Objectives and Scope of the Study

1.5.1 Objectives of the Study

The purpose of this study is stated as follows:

1. To study characteristics of the Nakhon Luang aquifer in terms of groundwater occurrence, groundwater storage, groundwater quality and quantity as well as extension and distribution of the Nakhon Luang aquifer.
2. To correlate the available data so as to indicate the potential of the quality and quantity of the Nakhon Luang aquifer within the studied area.

1.5.2 Scope of the Study

The study is concentrated in the Nakhon Luang aquifer, the third aquifer of Bangkok Aquifer System. The data is collected mainly from the Mitigation of Groundwater Crisis and Land Subsidence in Bangkok Metropolis area and its vicinity Project; MGL Project, The Study on Management of Groundwater and Land Subsidence in the Bangkok Metropolis area and its vicinity Project; JICA, and the Consultants Reports since 1978 up to the present. Moreover, the data namely; Lithologic logs; Spontaneous Potential (SP) and Resistivity (R), Cuttings, Groundwater quality, Hydraulic properties and potentiometric surface from 94 observation wells of 117 groundwater monitoring stations, both monitoring wells within the study area and productive wells will be analyzed and correlated. Moreover, the ideal hydrogeologic cross sections of the study area will be pursued.

1.5.3 Output Expectation

1. To be able to recognize hydrogeology and groundwater potential in terms of quantity and quality of the Nakhon Luang aquifer.

2. To be able to evaluate the critical situation of groundwater of the Nakhon Luang aquifer which affected to the underlying and / or overlying layers of the aquifer in Bangkok aquifer system.



ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย