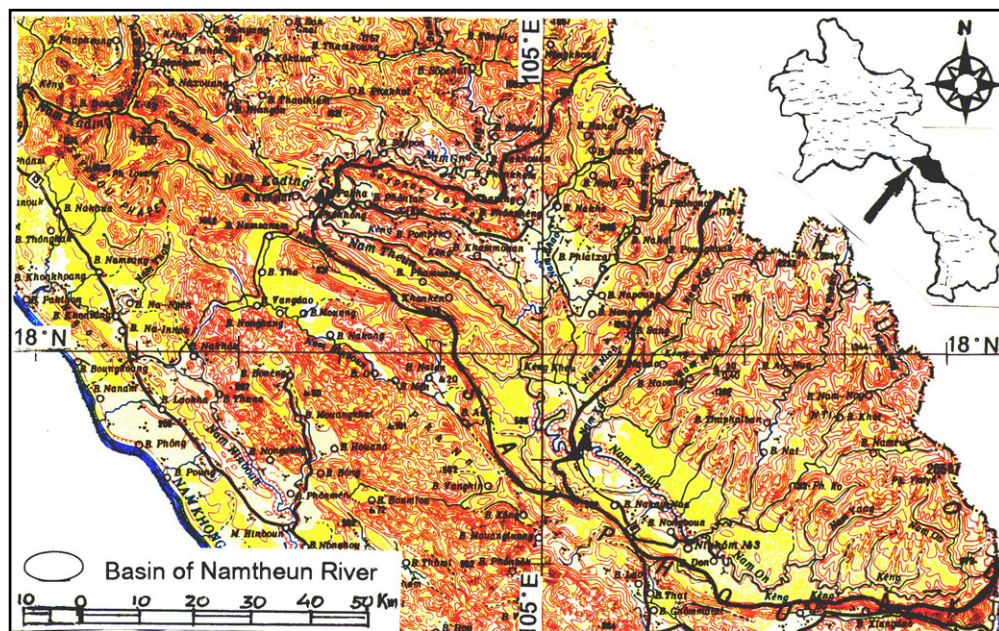


## Nam Theun/Cading

### Map of River



### Table of Basic Data

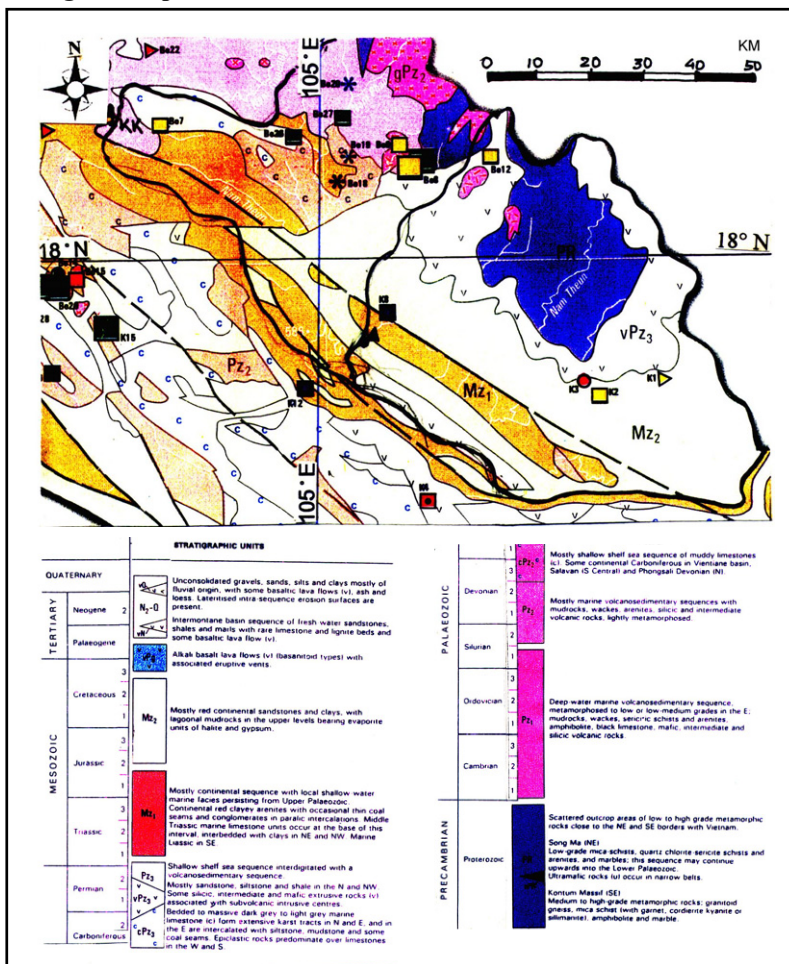
<b>Name:</b> Nam Theun/Cading (at Signo)		<b>Serial No:</b> Lao - 4
<b>Location:</b> Barikhamxay Province	N: 17° 50'42"	E: 105° 03'06"
<b>Basin Area:</b> 3 370 km <sup>2</sup> (at Signo)	<b>Length of main stream:</b> 138 km	
<b>Origin:</b> Sayphoulouang (2 200 m)	<b>Highest Pt. :</b> 2 288 m	
<b>Outlet :</b> Pakading	<b>Lowest Pt. :</b> 155 m	
<b>Main geological features :</b> Mesozoic, Cretaceous, Permian and Proterozoic, Precambrian.		
<b>Main tributaries:</b> Nam One, Nam Noy, Nam Xot, Nam Kata		
<b>Main Lakes :</b> Nam Theun II project (on going) 450 km <sup>2</sup>		
<b>Main reservoirs :</b> Nam Theun II (project)		
<b>Mean annual precipitation:</b> 2 500 mm (1986~1998)		
<b>Mean annual runoff:</b> 222.83 m <sup>3</sup> /s at Signo (3 370 km <sup>2</sup> ) (1985~1998)		
<b>Population :</b> 103 000 (1998)	<b>Main cities:</b> Nakai, Khamkeut	
<b>Lands use:</b> Forest (60 %), Agriculture (25 %), Urban (1.5 %), Wetland (0.48 %), River (8 %), Others (12.22 %) (1998)		

# 1. General Description

Nam Theun/Cading is the fourth largest tributary of the Mekong river. It flows from the Siaphou Louang (Lao- Vietnam border) at an elevation of 2 200 m to the Nakai plateau, 500 ~ 580 m in a north-northeast to south-southwest direction. From Nikhom 03 to Khamkeut (Kengkuang), the river flows in a southeast-northwest direction with an underground river system more than 300 m long. The Nam Theun leaves the plateau at its north-western end, turns to the west and joins the Mekong River as the Nam Cading through an elevation lower than 200 m. The total catchment area at the confluence point with the Mekong is 14 810 km<sup>2</sup> and the total length including tributaries is 2 047 km. The average annual precipitation is 2 500 mm with a little more than 3 000 mm along the mountain range. The annual discharge at Signo (3 370 km<sup>2</sup>) is 223 m<sup>3</sup>/s (1985~1998). At Ban Phoney in the lower reach (14 200 km<sup>2</sup>), the annual discharge is 478 m<sup>3</sup>/s (1984~1986). The total population in the basin was estimated at 103 000 people in 1998. As the topography of the basin relates closely to the geology, the Nam Theun biogeographical sub-unit is Annam Trung Sun mountain chain with watershed highlands of granites and metamorphics, draining down to Jurassic and cretaceous Indonesian sandstones and shales, and most fertile area is in the lower Nam Cading.

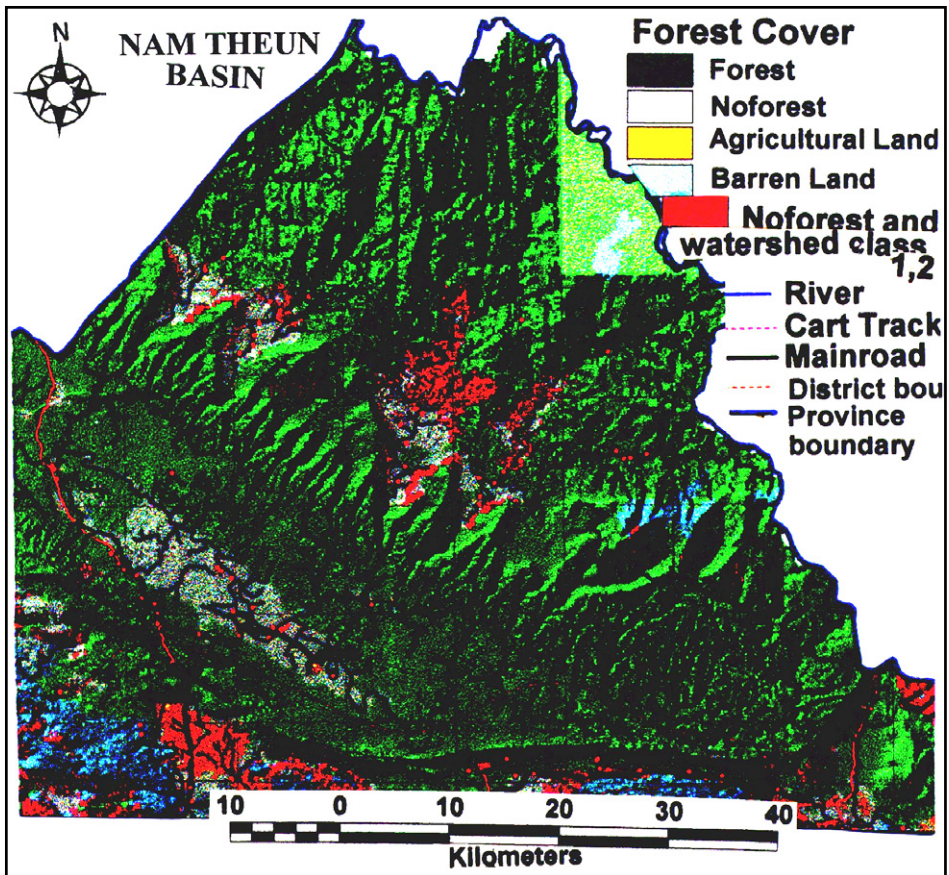
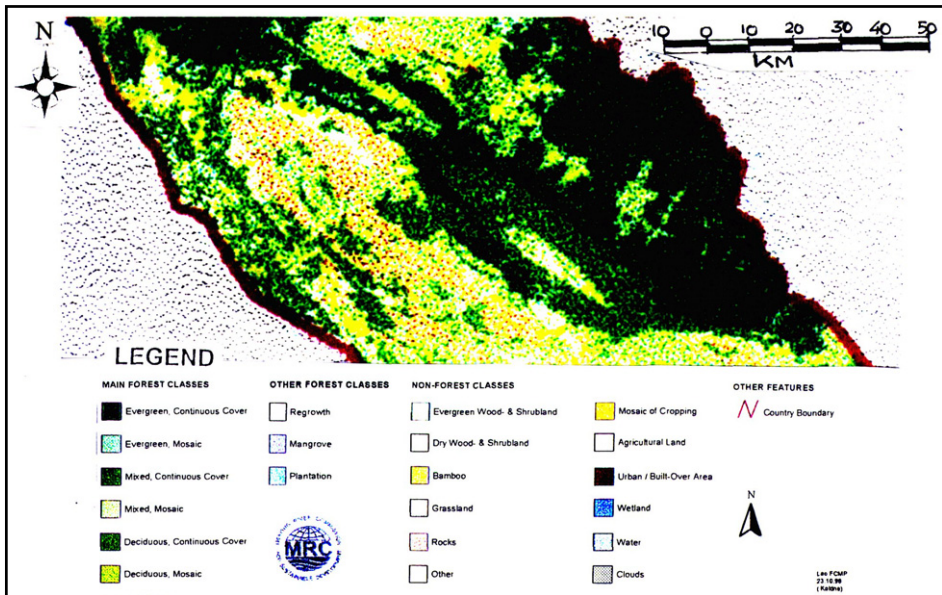
# 2. Geographical Information

## 2.1. Geological Map





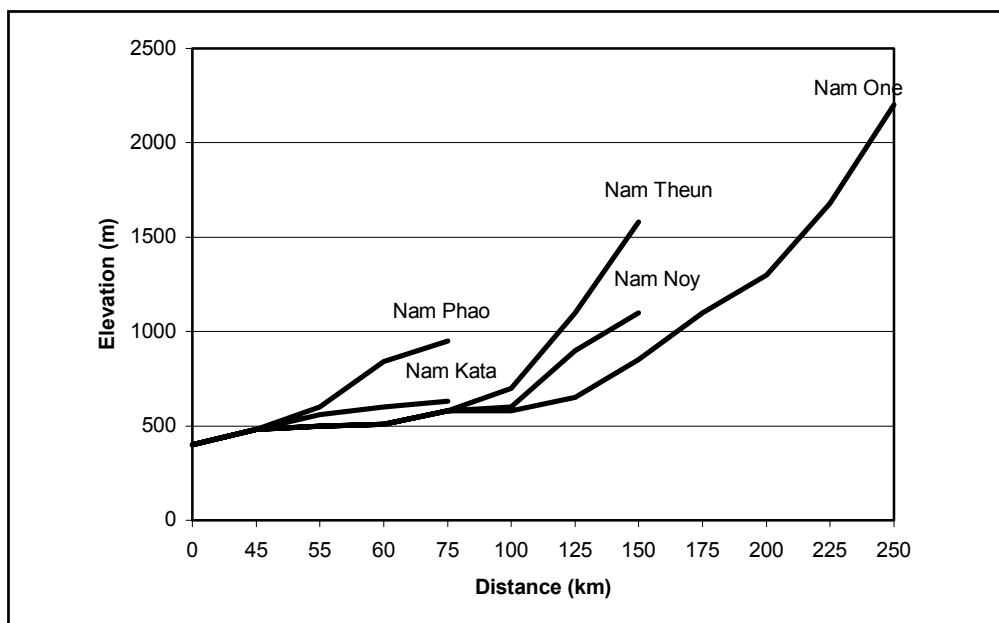
2.2. Land Use Map



### 2.3. Characteristics of the River and the Main Tributaries

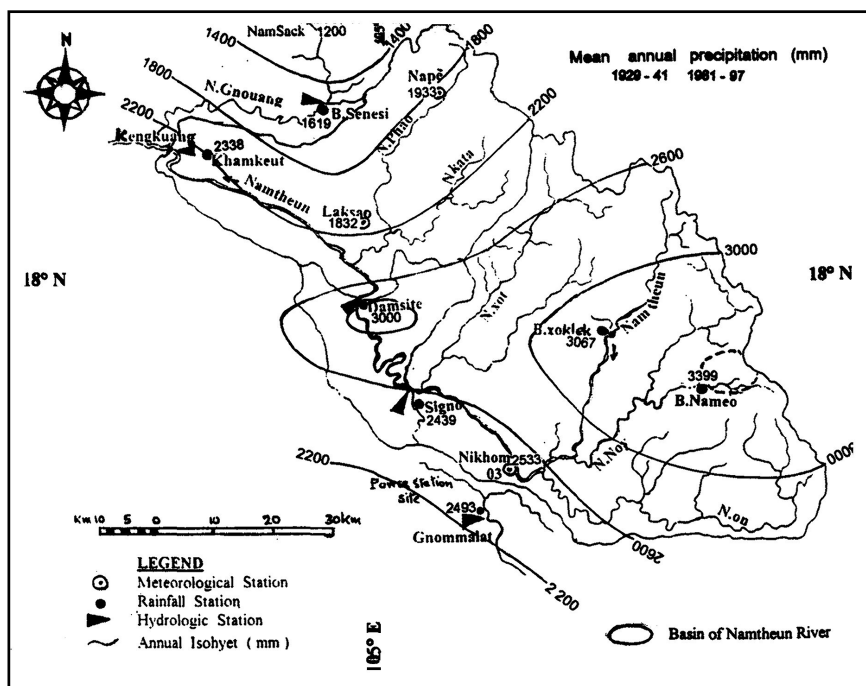
No.	Name of River	Length [km] Catchment area [km <sup>2</sup> ]	Highest peak [m] Lowest point [m]	Cities population (1998)	Land use [%]
1	Nam Theun/ Cading	138 14 810	2 280 157	Pakcading 25 000	Forest (64)
2	Nam One	912	2 058 530	Nakay 15 000	Forest (60)
3	Nam Noy	618	1 058 508		
4	Nam Xot	823	2 288 508		
5	Nam Kata	38	1 724 500		
6	Nam Phao	35 1 190	1 821 480	Lak Sao (KK) 20 000	Forest (65)
7	Nam Gnung	111 2 830	1 689 470		

### 2.4. Longitudinal Profiles



### 3. Climatological Information

#### 3.1. Annual Isohyetal Map and Observation stations



#### 3.2. List of Meteorological Observation Stations

No	Station	Elevation [m]	Location	Observation period	Mean annual precipitation [mm]	Mean annual evaporation [mm]	Observation items <sup>1)</sup>
224*	Khongsedone	122	N 15°34' E 105°48'	1965~94 1929~90	1 658 1 716		P,E
225*	Pakse	101.5		1951~96	1 942	1 550~ 2 000	P,E,SR,DS
226*	Paksong	1 200		1965~94	3 403	Piche 550	
227*	Salavane	168		1960~94	1 999	Pan'A' 2 073	P(TB),E,SR, DS
242*	Selabam	117		1972~94	1 929		P
270*	LaoNgam	451		1991~95 1989~93	1 760 1 780		P
	Vangkaman	302		May~Dec 1995			P (TB)
260	Nonghine	1 280		1980~94	2 844		P
	Thateng	800		1993~95	2 123		P
	MuangVapi	160		1991~96	1 704		P
	KengSin	180		1993~96	2 416		P

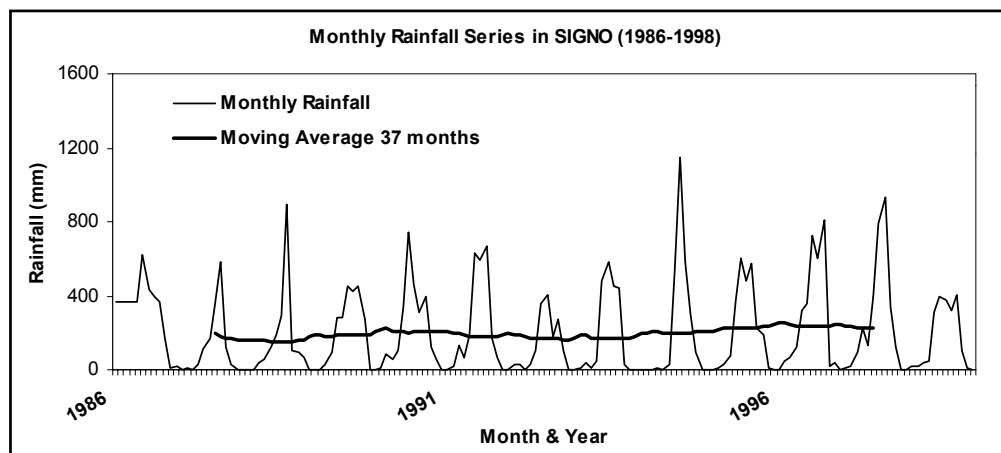
1) P: precipitation; E: evaporation; SR: solar radiation; DS: Duration of sunshine; P(TB): tipping bucket raingage

### 3.3. Monthly Climate Data

#### Station: Paksan

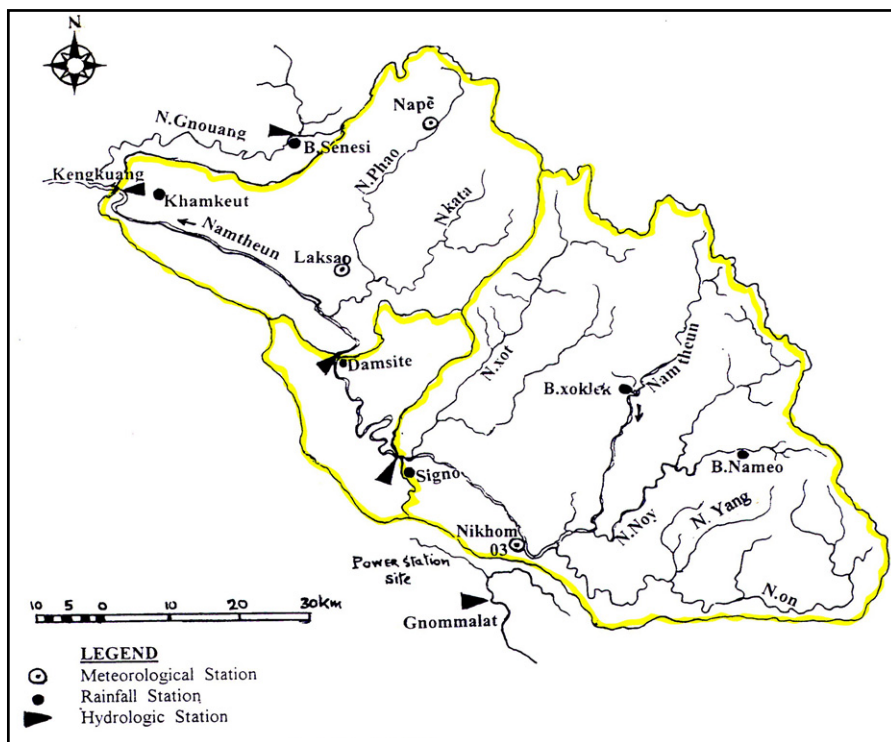
Observation item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	20.6	22.8	25.2	26.9	26.9	26.8	26.1	26.3	26.3	25.2	23.4	21.1	24.8	1933~44
Precipitation [mm]	3.8	30.8	75.9	120.9	431.2	599.2	674.1	479.3	389.3	146.8	31.7	2.8	2 986	1933~44
Evaporation [mm]	15.8	18.3	21.0	24.2	26.3	28.2	27.5	26.8	26	22.8	18.2	16.5	21.5	1933~44
Duration of sunshine [hr]	221.6	192.7	240.4	205.9	157.3	96.7	78.5	84.2	141.3	202.5	231.2	218.5		1938~44

### 3.4. Longterm Variation of Monthly Precipitation Series



## 4. Hydrological Information

### 4.1. Map of Streamflow Observation Stations



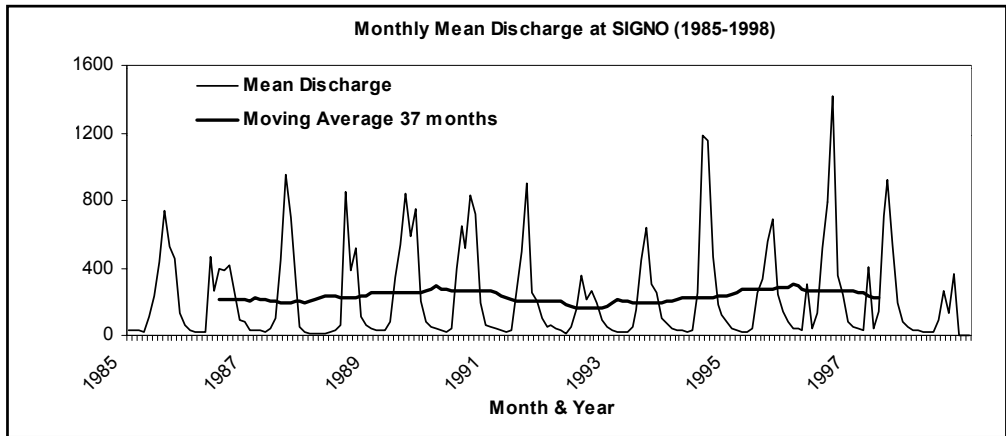
### 4.2. List of Hydrological Observation Stations

No.	Station	Location	Elevation [m]	Catchment area (A) [km <sup>2</sup> ]	Observation period	Observation items <sup>1)</sup> (frequency)
1.	Singo	N 17° 50' 7" E 105° 03' 1"	500	3 370	1985~1998	H2
2.	Kengkuang	N 18° 14' 1" E 104° 39' 7"	470	5 560	1985~96 1992~92	Q(d)
3.	Phonsi	N 18° 18' 1" E 104° 05' 9"	157	14 200	1960, 1967~71 78~80, 86~93	Q(d)

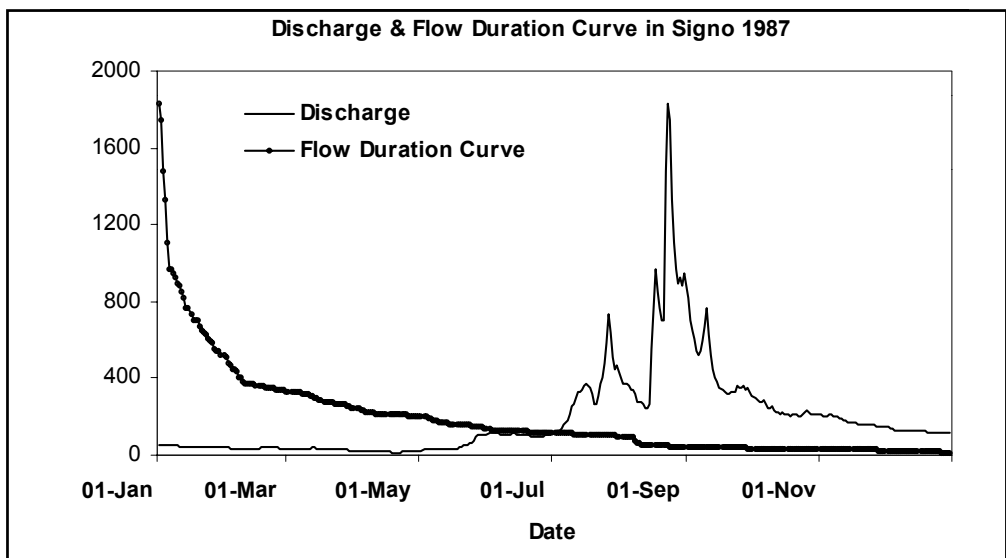
No.	Q <sup>2)</sup> [m <sup>3</sup> /s]	Q max <sup>3)</sup> [m <sup>3</sup> /s]	Q max <sup>4)</sup> [m <sup>3</sup> /s]	Q min <sup>5)</sup> [m <sup>3</sup> /s/100 km <sup>2</sup> ]	Q/A [m <sup>3</sup> /s/ 100 km <sup>2</sup> ]	Qmax/A [m <sup>3</sup> /s/ 100 km <sup>2</sup> ]	Period of statistic
1	222.83	3 040	1 775	20.42	6.612	90.208	1986~98
2	385.0	2 490	3 172	16.80	5.044	56.142	1986,90~93
3	478.0	6 000	4 910	59.95	3.366	34.577	1986, 91~93

- 1) H2 (d): water level reading twice daily; Q(d): daily discharge;  
 2) Mean annual discharge;  
 3) Annual maximum discharge;  
 4) Mean annual maximum discharge;  
 5) Mean annual minimum discharge

### 4.3. Longterm Variation of Monthly Discharge Series

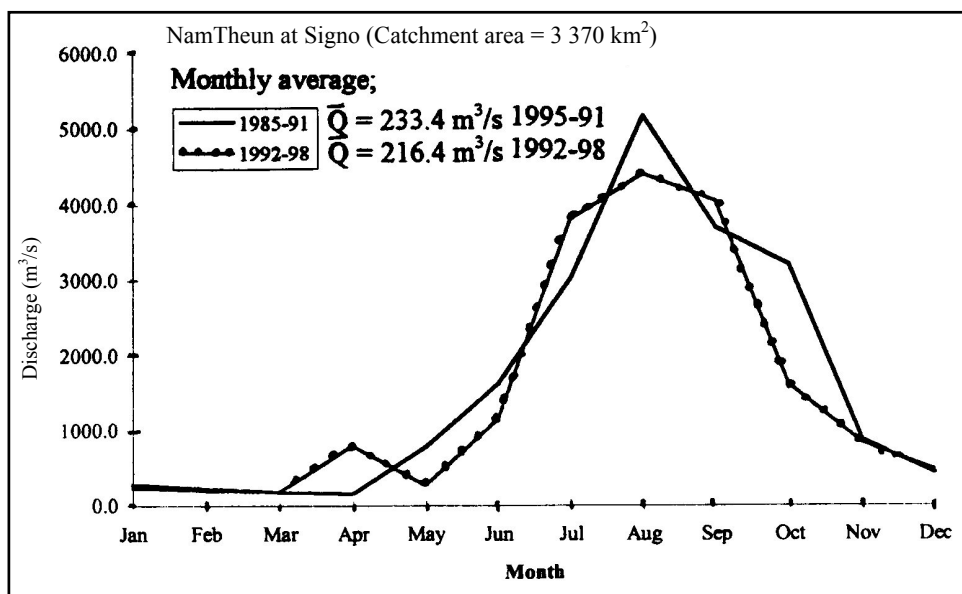


### 4.4. Annual Pattern of Discharge Series





#### 4.5. Unique Hydrological Features



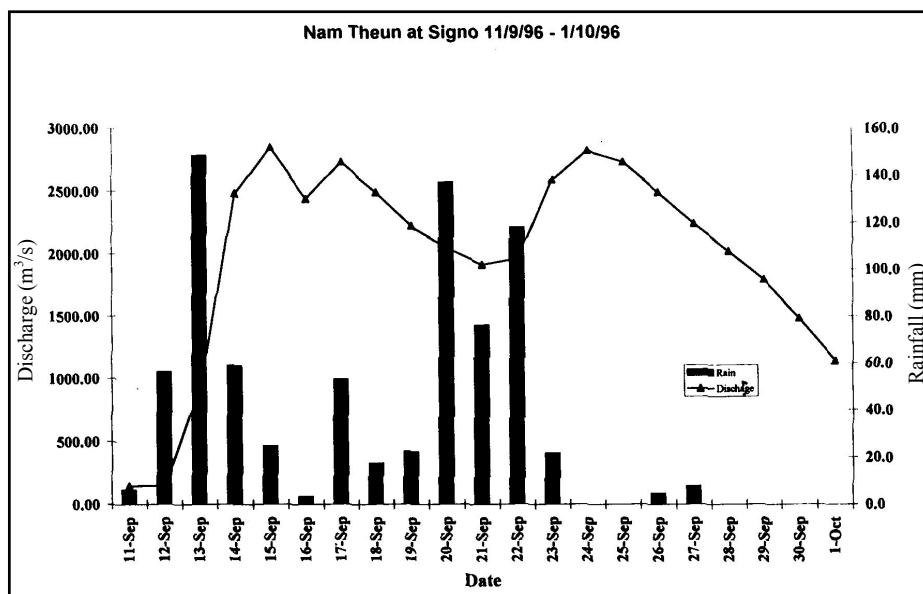
#### 4.6. Annual Maximum and Minimum Discharges

Station: At Ban Signo

Catchment Area: 3 370 km<sup>2</sup>

Year	Maximum		Minimum	
	Date	Discharge <sup>1)</sup> [m <sup>3</sup> /s]	Month	Discharge <sup>2)</sup> [m <sup>3</sup> /s]
1986	9.8	1 280	-	-
1987	8.22	1 890	4	14.4
1988	8.11	1 270	3	15.0
1989	7.25	1 770	4	38.4
1990	8.3	1 930	4	16.0
1991	8.2	2 060	6	14.0
1992	6.3	1 520	5	7.38
1993	7.14	1 480	3	16.4
1994	8.1	2 330	4	17.7
1995	9.2	1 696	5	16.6
1996	9.16	3 040	4	48.4
1997	8.17	1 787	4	23.6
1998	7.4	1 011	3	17.1
<b>Sum</b>		23 064		244.98
<b>Mean</b>		1 774.16		20.42

#### 4.7. Hyetographs and Hydrographs of Major Floods



## 5. Water Resources

### 5.1. General Description

The Nam Theun / Cading, where the upper part is in Khammouane Province while the middle and the lower areas are in Bolikhamxay Province in Central Lao, has several tributaries: as illustrated on map of streamflow, the upper reaches in the plateau consist of Nam One, Nam Noy and Nam Theun that have total length of 138 km; the middle tributaries consist of Nam Xot, Nam Kata and Nam Phao with 38 km and 35 km long than they join the Nam Theun; and the lower tributary is Nam Gnoang of 111 km long and drainage area 2 800 km<sup>2</sup> joins the NamTheun downstream of KengKuang gauging station. In the middle reach of Nam Cading there is an important tributary (Nam Mouan), still an ungauged river.

The floods of more than 2 000 m<sup>3</sup>/s at Signo (3 370 km<sup>2</sup>) were frequently observed. On the 12<sup>th</sup> of September 1996, the water stage was 1.95 m than beginning the 14<sup>th</sup> September rise to 14.27 m as resulted from a tropical cyclone which corresponded to an increase in river discharge from 130 to 3 040 m<sup>3</sup>/s. These peak stage and discharge were the highest in the 10-year period of stream gauge operation. The second tropical storm on the 22<sup>nd</sup> of September caused a peak of 15.78 m water level (2 850 m<sup>3</sup>/s) on the 24<sup>th</sup> that same month. It was concluded that the 1996 was the wettest year in ten years. However, the interannual variability is of importance. During the EL NINO years, with less rainfall in 1987 (1 427 mm) or much rainfall in 1997 (3 050 mm) – the NamTheun and its tributaries have many promising projects for flood control and hydropower. The Nam Phao mini hydro is operational and supplies 2 MW to Laksao city, NamTheun 3 Power project (Nam Gnouang or Nam Nhoang) is under study, and NamTheun 0 - Hinboun Power project is a 210 MW Trans-basin run off river hydropower is already operational.

The NamTheun 2 Hydropower project involves the development of a hydroelectric scheme in Central Lao PDR (see Map of water resource systems in 5.2). The scheme involves constructing a dam on the



## 5.4. Water quality

Parameters	Unit	N.Theun Signo 30/06/95	N.Theun Damsite 30/06/95	N.Theun Signo 30/07/95	N.Theun Damsite 31/07/95	N.Theun Signo 30/08/95	N.Theun Damsite 31/08/95	N.Theun Signo 7/94	N.Theun Damsite 7/94	N.Theun Signo 30/09/94	N.Theun Damsite 30/09/94
Date		6.65	6.78	6.44	6.54	6.51	6.34	7/94	6.28	6.31	7.59
pH											
Conductivity	ms/m	2.7	2.6	1.9	1.7	1.39	1.32	1.3	1.4	2.2	27.1
Ca	meg/l	0.139	0.119	0.093	0.087	0.063	0.059	0.063	0.046	0.088	2.302
Mg	meg/l	0.071	0.079	0.076	0.061	0.068	0.068	0.071	0.055	0.058	0.679
Na	meg/l	0.048	0.027	0.047	0.031	0.028	0.029	0.045	0.013	0.055	0.022
K	meg/l	0.005	0.003	0.005	0.007	0.016	0.015	0.030	0.033	0.013	0.008
NH4-N	mg/l	0.105	0.041	0.042	0.046	0.088	0.070	0.024	0.023	0.011	0.005
Cl	meg/l	0.022	0.018	0.008	0.024	0.015	0.016	0.182	0.104	0.139	0.128
SO4	meg/l	0.070	0.223	0.006	0.043	0.079	0.055	0.056	0.060	0.110	2.950
Alkalinity	meg/l	0.143	0.121	0.098	0.085	0.078	0.099	0.126	0.063	0.051	0.035
NO3-N	mg/l	0.025	0.131	0.074	0.086	0.208	0.165	0.123	0.156	0.186	0.277
Total P	mg/l	0.179	0.020	0.034	0.049	0.121	0.107	0.047	0.156	0.052	0.035
Total Fe	mg/l	6.261	0.501	0.825	0.652	0.405	0.205	0.103	0.081	0.175	0.368
COD Mn		38.0	2.145	3.079	2.799	6.588	2.827	114	73	45	241
TSS	mg/l	0.001	19.0	67	79	14.8	92.4	0.783	0.930	1.593	0.458
Mn	mg/l		0.001	0.001	0.001	0.001	0.001	0.001	0.001	0	0

## 6. Socio-Cultural characteristics

The Ethno-economic context of the watershed is characterized by human population of the Nakai - Nam Theun conservation area and adjacent peripheries that can be grouped according to ethnolinguistic classes which, although not equivalent, represent useful anthropological categories for planning and management. The vietic branch of Mon Khmer (Austro Asiatic) Brou is a single language, Hmong, refers to a single language belonging to the Hmong-Mien family. Nevertheless, within the Nam Theun catchment there is a fascinating variety of people who still preserve distinct cultural traditions to a remarkable degree. In 1995 a UNESCO representative visited the Nakai Nam Theun Khammouane area and recommended that the Lao government seeks technical assistance available through World Heritage Fund to assess the suitability of the area for Natural Heritage nomination.

## 7. References, Databooks and Bibliography

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