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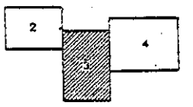
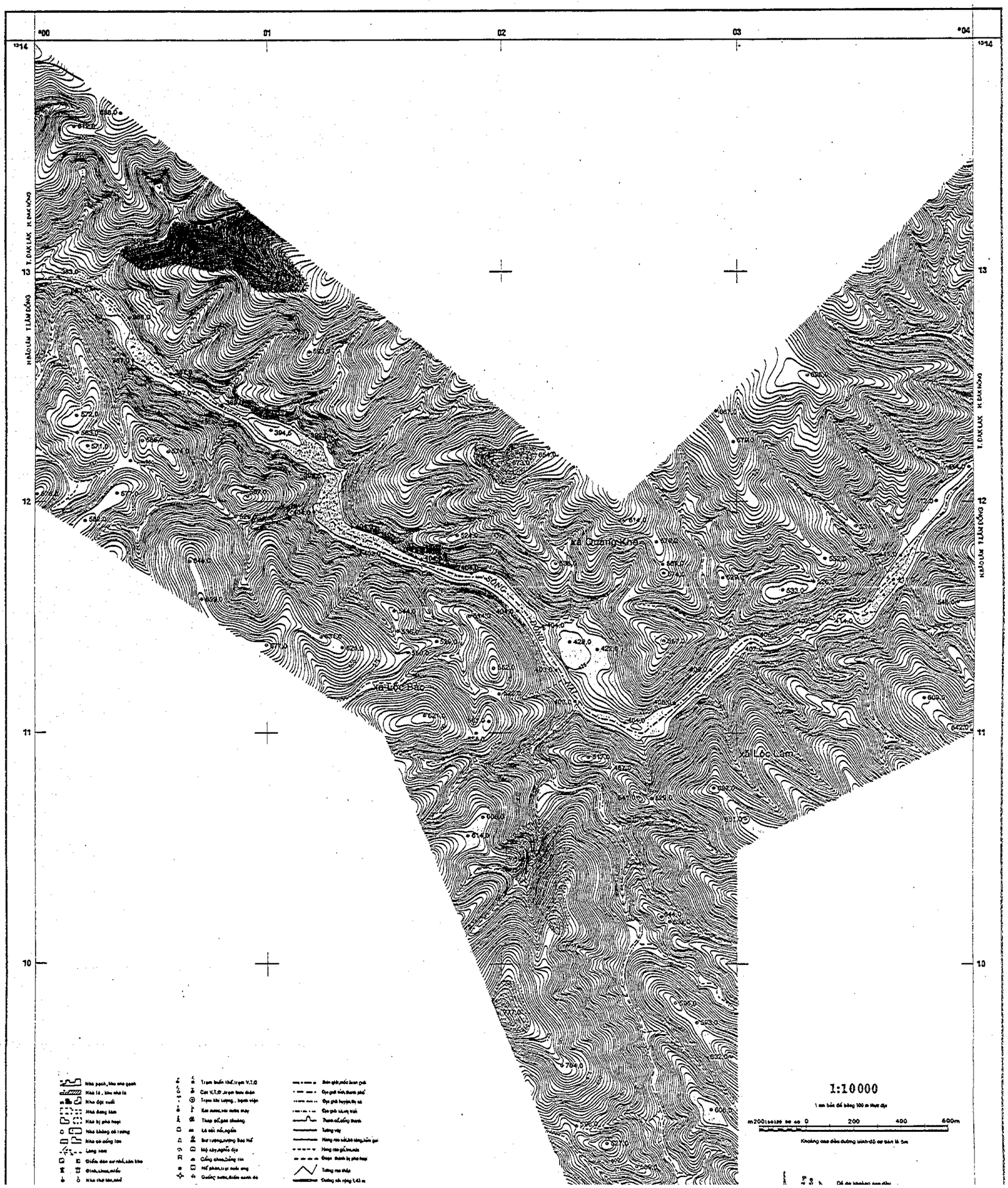
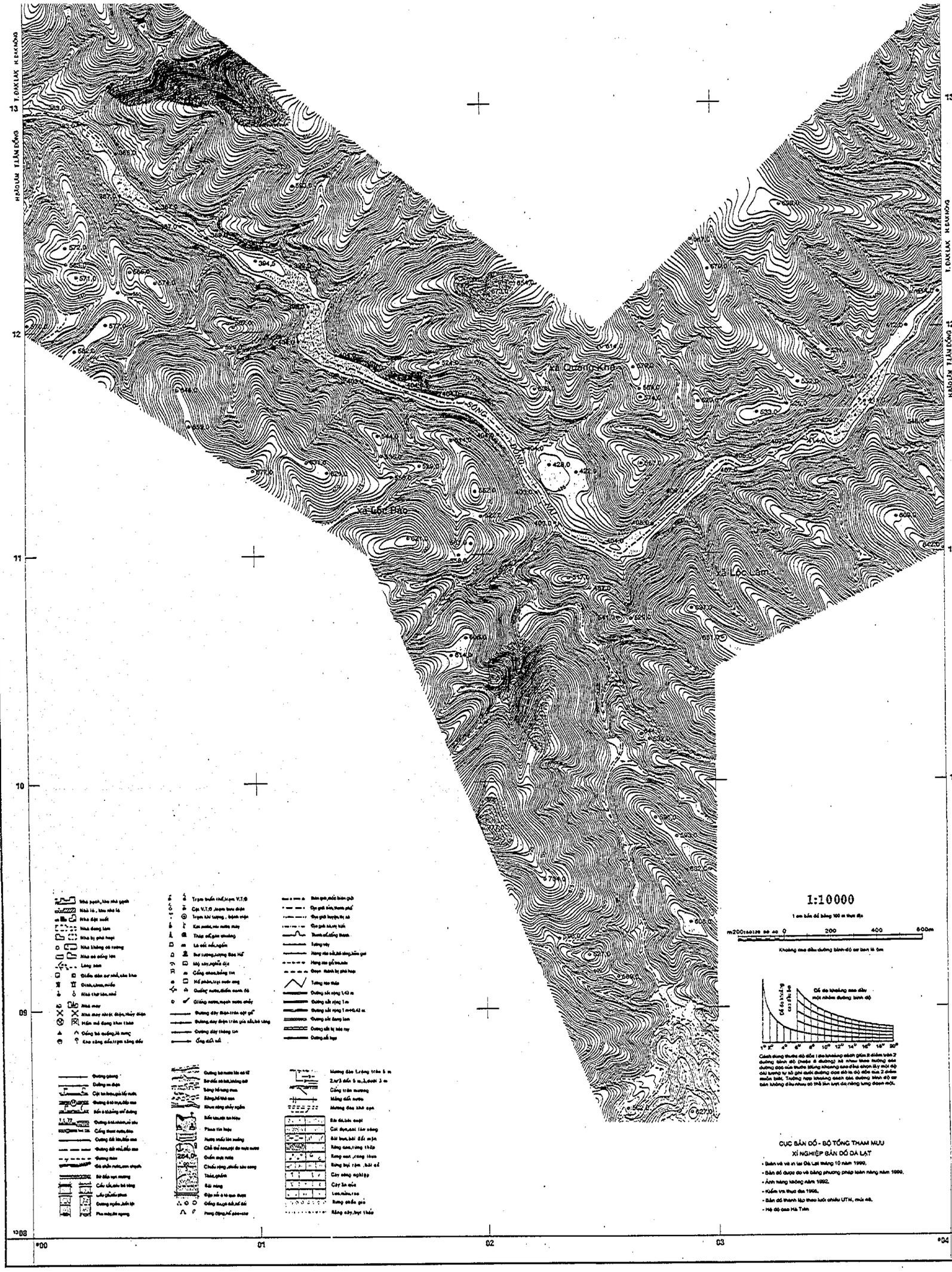
THỦY ĐIỆN ĐỒNG NAI 4

TỜ SỐ 3



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XÍ NGHIỆP BẢN ĐỒ ĐÀ LẠT
- Biên vẽ và in tại Đà Lạt tháng 10 năm 1990.
- Bản đồ được đo vẽ bằng phương pháp toàn năng năm 1990.
- Ảnh hàng không năm 1992.
- Kiểm tra thực địa 1998.
- Bản đồ thành lập theo lưới chiếu UTM, múi 48.
- Hệ độ cao Hà Tiên

THỦY ĐIỆN ĐỒNG NAI 4

TỜ SỐ 4

ĐAK LAK _ ĐAK NÔNG
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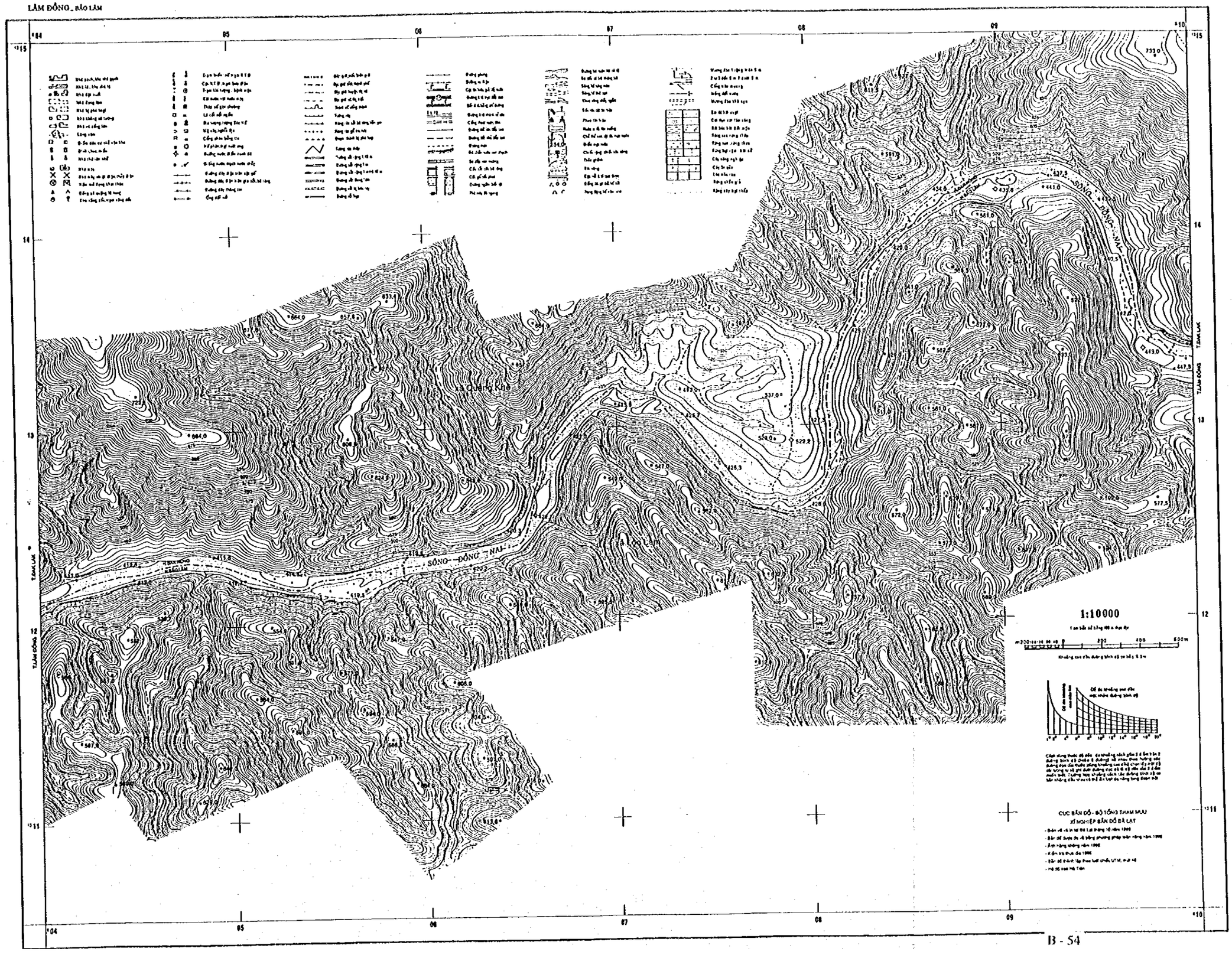

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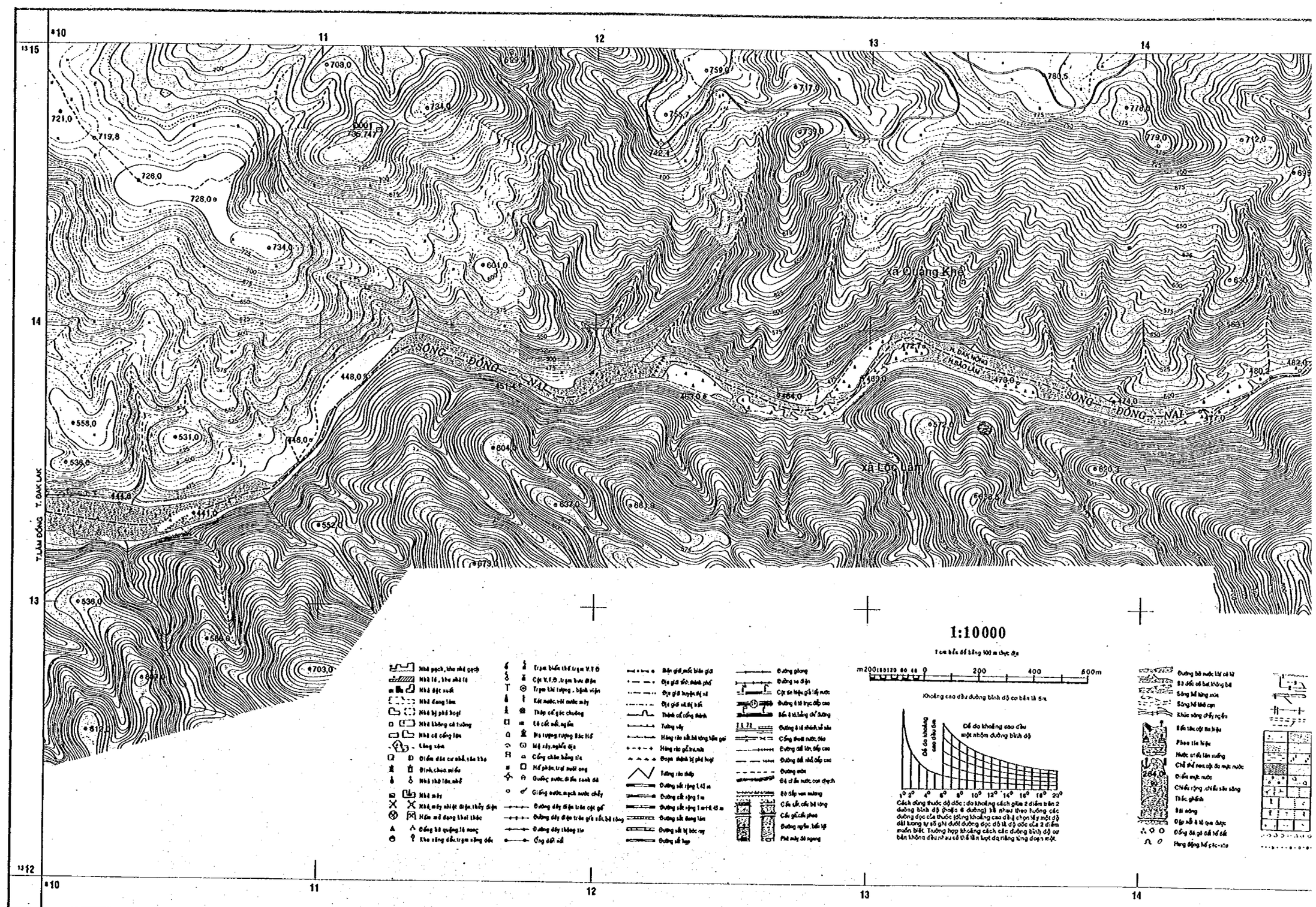
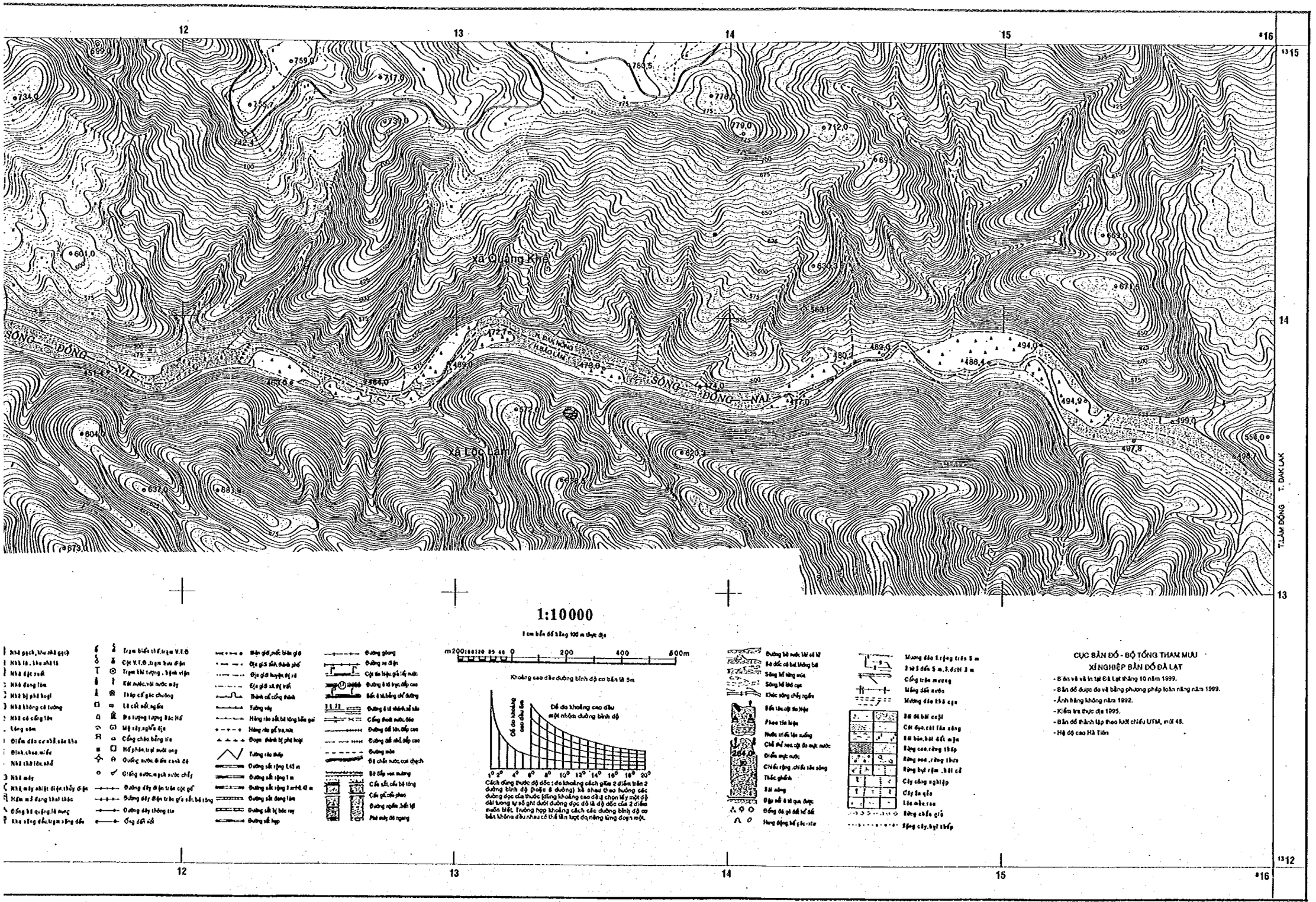
THỦY ĐIỆN ĐỒNG NAI 4





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Cách dựng thước độ dốc : đo khoảng cách giữa 2 điểm trên 2 đường bình độ (hoặc 6 đường) kề nhau theo hướng các đường dọc của thước (dùng khoảng cao đều chọn lấy một độ dài tương ứng số ghi dưới đường dọc đó là độ dốc của 2 điểm muốn biết. Trường hợp khoảng cách các đường bình độ cơ bản không đều nhau có thể lần lượt dọ riêng từng đoạn một.

CỤC BẢN ĐỒ - BỘ TỔNG THAM MƯU
XÍ NGHIỆP BẢN ĐỒ ĐÀ LẠT

- Bản vẽ và in tại Đà Lạt tháng 10 năm 1999.
- Bản đồ được đo vẽ bằng phương pháp toàn năng năm 1999.
- Ảnh hàng không năm 1992.
- Kiểm tra thực địa 1995.
- Bản đồ thành lập theo lưới chiếu UTM, múi 48.
- Hệ độ cao Hà Tiên

Appendix C :

Hydrological Investigation

Appendix C : Hydrological Investigation

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Appendix C : Hydrological Investigation

C1 INTRODUCTION

The hydrological field investigation for the Dong Nai No.3 and No.4 Combined Hydropower Project was initially carried out in the first field investigation lasting about two months from the middle of January to the middle of March 1999. In the First Field Investigation, the meteor-hydrological data required for the preliminary optimization to select the optimum Project layout plan were collected. Besides, it was determined through the field reconnaissance that a new streamflow gauging station be installed at the location adjacent to the proposed Dong Nai No.3 dam site.

It was resumed in the second field investigation that lasted about one month from the middle of May to the middle of June 1999. During the Second field Investigation, the preparatory works for installation of a new streamflow gauging station at the Dong Nai No.3 dam site and the hydrological observation and measurements were performed. The hydrological field works performed in the third Field Investigation performed for 22 days from the end of September to the middle of October include the supervision of the installation works for new streamflow and rainfall gauges undertaken by the local contractor as well as the hydrological measurements and observations undertaken by EVN.

Substantially, the hydrological field investigations were executed over the said three field investigation stages, namely the First, Second and Third Field Investigations. During these hydrological field investigations, a focus was placed on collection of meteo-hydrological data and information related to the Project. The field investigation was performed in collaboration with the counterpart personnel of EVN to gather the meteo-hydrological data and information as much as possible from the concerned governmental organizations of Vietnam. After then, the consistency of those meteo-hydrological data were carefully checked in the subsequent home office works to finally determine those to be applied to the hydrological analysis at a level of feasibility study.

In the present hydrological analysis, the lowflow analysis for estimating the long-term streamflow data and flood frequency analysis at the planned Dong Nai No.3 and No.4 dam sites were carried out based on runoff records at Ta Lai, since runoff data in the vicinity of the Dong Nai No.3 and No.4 dam sites were hardly available. Concerning the lowflow analysis, the series runoff data at Ta Lai streamflow gauging station were transposed to the Dong Nai No.3 dam site in proportion to ratios of their catchment areas and average annual rainfalls. While, the two different methods, namely unitgraph method and storage function model, were applied to estimate the probable floods of various return periods at the Dong Nai No.3 and No.4 dam sites.

The hydrological analysis carried out in the present feasibility study comprises the following:

- Runoff analysis for estimating the long-term daily discharges at the proposed Dong Nai No.3 and No.4 dam sites,

- Flood analysis for estimating the probable floods of different return periods at the proposed Dong Nai No.3 and No.4 dam sites by means of the unitgraph method and storage function model
- Sedimentation study for estimating the long-term sediment transport at the Dong Nai No.3 and No.4 dam sites applying the suspended load rating curves, which show a relation between the mean daily discharge and daily suspended load yield

This Appendix C compiles all the results of the hydrological investigation performed in the present feasibility study for the Dong Nai No.3 and No.4 Combined Hydropower Project.

C2 DATA AVAILABILITY AND GENERAL CLIMATE

C2.1 Data Availability

C2.1.1 General

A wide range of meteo-hydrological data related to the Dong Nai River basin are presented in the M/P study reports completed in August 1996 that were in hand of the JICA Study Team at the time commencement of this feasibility study. The meteo-hydrological data presented in the reports were utilized for this feasibility study and have been supplemented through collection of the latest data in the first and second field investigations.

C2.1.1 Runoff Data

There has existed no streamflow gauging station on the Dong Nai mainstream in the vicinity of the proposed Dong nai No.3 and No.4 dam sites, until a new streamflow gauging station has been installed at the Dong Nai No.3 dam site. However, the available period of water level records observed at the new streamflow gauging station is as short-term as about a half year.

Taking into account the limited availability of runoff data to be applied to the runoff analysis for this feasibility study, the JICA Study Team attempted to collect the runoff data from the concerned governmental organizations as much as possible. The runoff data available at streamflow gauging stations in upper and middle reach of Dong Nai River are shown in Figure C2.1. These data were collected in cooperation with counterpart personnel of EVN, who is in charge of hydrology. The collected data were comprehensibly checked by the JICA Study Team for the whole data period to assess their reliability. Especially, runoff data at Ta Lai SGS were carefully checked, since those play very important role for hydrological analysis in this feasibility study because of only SGS which was placed in mainstream of the Dong Nai River downstream of the Dong Nai No.3 and No.4 dam sites. The available periods of runoff data at those streamflow gauging stations are shown in Figure C2.2.

C2.1.2 Rainfall Data

The daily rainfall data at rainfall stations located in and around the project were collected and arranged by JICA Study Team during the field investigation to supplement those collected in the said M/P study. Consequently, the daily rainfall data related to the project have been made available through the field investigation as shown in Figure C2.2.

C2.2 Hydrological Observations and Measurement Carried out

C2.2.1 Installation of New Streamflow Gauging Station and Rainfall Station

In the Second Field Investigation, new streamflow gauging station and rainfall station were installed near the Dong Nai No.3 dam site, whose locations were selected through the filed reconnaissance during the first field investigation stage, as shown in Figure C2.3.

Installation works of these stations, which consist of installation of automatic water level

recorder, staff gauges and some accessory facilities at streamflow gauging station and automatic rainfall gauge, recorder and some accessory facilities at rainfall station, were completed in the end of June 1999 and immediately thereafter the observation was commenced by EVN, who is in charge of permanent observation thereat from now on. The exterior of newly installed streamflow gauging station and rainfall station is shown in Figures C2.4 and C2.5.

C2.2.2 Hydrological Observation at New Streamflow Gauging Station and Rainfall Station

EVN, who is in charge of permanent observation at newly installed stations, had established a system for hydrological observation with and maintenance of the installed equipment and facilities. The system is now put into operation with the established arrangement that three staff are mobilized to keep the streamflow gauging station while one staff to keep the rainfall gauging station, to be exclusively in service for the observation with and maintenance of the equipment and facilities.

To assist the EVN's activities, the JICA Study Team prepared the "Instruction Manual for Hydrological Observation (the Manual)" and handed it over to personnel concerned of EVN. The Manual which was also prepared with an intention of the transfer of technology, includes the measurement methodology and data processing technology and the specifications/O&M manual supplied by the equipment manufacturers in addition to sample sheets for hydrological observation and data arrangement.

The daily water level records observed at the new streamflow gauging station is shown in Table C2.1, while daily rainfall records at the new rainfall station in Table C2.2. The records of suspended load measurements performed at the new streamflow gauging station is tabulated in Table C2.3.

C2.3 General Climate and Estimate of Evaporation from Reservoir Surface

C2.3.1 General Climate

The project catchment belongs to tropical monsoon climate area where two distinct different climate seasons take place during a year, namely dry season and wet season lasting between November and April and between May and October, respectively. Besides, the seasonal climatic features of the Project catchment are characterized in more detail as follows:

- Jan. to Mar. : Dry and cool season under continental winter monsoon
- Apr. and May : Thunderstorm season with the highest temperature in all seasons
- June to Aug. : Summer season with west wind, accompanied by long rain
- Sep. to Dec. : Changeable weather, sometimes struck by typhoon with heavy rainfalls resulting in flood

Of the climatic stations located in and around the Project site, the Bao Loc station with an altitude of 800 m is indicative of the climatic features of hilly areas extending near the Project site. The air temperature at Bao Loc is comparatively constant throughout a year with the minimum mean monthly value of 19.9°C in January and the maximum one of

23.2℃ in May. The average relative humidity at Bao Loc is about 86 %, while the mean monthly value varies from 77 % in February to 93% in August. The recorded maximum wind velocity at Bao Loc is 22.0 m/sec in 1978.

The annual rainfalls observed at rainfall stations in and around the project catchment are listed in Table C2.4. On the basis of the mean annual rainfalls, an isohyetal map for the Project catchment is illustrated as shown in Figure C2.6. Although the annual rainfall in the middle reach of the Dong Nai River including the Dong Nai No.3 and No.4 dam sites increases to about 2,600 mm from 1,400 mm in downstream reach, it again decreases to 1,400 mm in the upper reach as seen in Figure C2.6. The annual basin average rainfall for the Project catchment is approximated at 1,950 mm based on the Thiessen's Polygon method (see Figure C4.2). In the project catchment, 80 % to 90 % of the annual rainfall takes place between May and October.

C2.3.2 Estimate of Evaporation from Reservoir Surface

The evaporation from reservoir surface is one of the important factors in carrying out the reservoir operation study to estimate the project outputs such as dependable peak power and energy. To estimate the monthly evaporation depths at the Dong Nai No.3 and No.4 dam sites, the evaporation records observed at climate stations were used to derive a typical relationship between ground elevation and annual evaporation depth in the Dong Nai River basin as shown in Figure C2.7.

The annual evaporation at the Dong Nai No.3 dam site (FSL-590 m) is estimated at 1070 mm/year as shown in Table C2.5. The monthly evaporation depths thereat are determined based on the ratios of monthly evaporation to annual one at Bao Loc climate station. These evaporation data are used for the reservoir operation study of the Dong Nai No.3 and No.4.

C3 RUNOFF ANALYSIS

C3.1 General

A wide range of meteor-hydrological data related to the Dong Nai River basin are presented in the M/P study reports completed in August 1996 that are kept by the JICA Study Team. Prior to the data collection, the JICA Study Team issued a letter to EVN, which states the meteor-hydrological data to be collected by the JICA Study Team. In the first field investigation stage, the meteor-hydrological data collection was made mainly through contacting with the staff of the PECC2 office who were in charge of the hydrological analysis works in the pre-feasibility study, in order to supplement those in hand of the JICA Study Team. In parallel to the data collection, the JICA Study Team discussed with the in-charge consecutively so as to fully grasp the methodologies and procedures adopted for the hydrological analysis in pre-feasibility study. On the basis of the data and information collected, the hydrological analysis results of the pre-feasibility study were reviewed in detail in the First Field Investigation. The results of the review on the previous studies are discussed in the Progress Report No.1 submitted to EVN in March 1999.

Based on the result of review of the previous studies discussed above and data and information newly collected during this first field investigation, the lowflow analysis was carried as explained below.

C3.2 Present River System and Effective Catchment Area of Dong Nai No.3 and No.4 Schemes

C3.2.1 Present River System

The mainstream of the Dong Nai River originates from the high hilly areas with elevations of 1,000 m to 2,000 m in the northern part of Lam Dong Province where the city Da Lat is situated. The Dong Nai River originating from the northern hills joins three large tributaries till it finally debouches into the South China Sea. These are the La Nga River, Be River and Saigon River in the order from upstream to downstream, of which the La Nga River flowing down from east meets the Dong Nai mainstream in existing Tri An reservoir. The Saigon River joins the Dong Nai mainstream near Ho Chi Minh City located about 30 km upstream of its estuary. The gross catchment area of the Dong Nai River including those of the three major tributaries is about 31,000 km^2. The river system of the Dong Nai is shown in Figure C3.1 and the river profile up to the middle reach is depicted in Figure C3.2.

The Dong Nai mainstream takes generally the southwestern flow direction in its uppermost reach, flowing into existing Dran reservoir created under Da Nhim hydropower project (HPP) after it flows down about 50 km from the watershed. The Da Nhim HPP was completed and started power generation in 1964. The streamflow of the Dong Nai mainstream regulated by Dran reservoir is diverted to the neighboring eastern basin, the Phan Rang River basin, through a waterway of the project. Thus, most of the river flow at existing Dran Dam is not discharged downstream except for the event of

occurrence of large-scale flood when the reservoir water is released to the downstream reach through opening of spillway.

After joining the Da Queyon River, a tributary of the Dong Nai River flowing from east, the Dong Nai mainstream changes the flow direction to west. Two storage type dams are proposed to be constructed under the on-going Dai Ninh HPP, one on each of the Dong Nai mainstream and Da Queyon River just upstream of their confluence. The Dai Ninh hydropower project also contemplates to divert streamflow of the Dong Nai to the neighboring eastern basin through a waterway. The construction of the project is going to start in the year 2000. After completion of the Project, the downstream reach of the confluence is to loose most of runoff, which comes from catchment above the confluence.

The Dong Nai River reaches the proposed Dong Nai No.3 dam after flowing for a river course of about 80 km downstream of the Dai Ninh project site generally in the west or northwest direction. The Dong Nai No.4 dam site is selected at the location of about 20 km downstream of the Dong Nai No.3 dam site.

The Dong Nai River takes the southern flow direction after making a large loop downstream of the Dong Nai No.4 dam site. Thereafter, it pours into existing Tri An reservoir through the Cat Tien National park. In a broad sense, the middle reach of the Dong Nai River is defined to be the reach up to the Tri An reservoir with a total catchment area of 14,979 km^2 including that of the La Nga River.

C3.2.2 Effective Catchment Areas of Dong Nai No.3 and No.4 Schemes

The existing Da Nhim HPP has been put into operation since its completion in 1964 to generate power by diverting inflow discharges to the Dran dam/reservoir to the Phan Ran River basin which drains the eastern part of the Dong Nai River basin. The diverted water of upper reach of the Dong Nai for the power generation has flowed down to the Vietnamese Sea without returning to the Dong Nai River. Except for the large-scale flood in the upper reach of the Dong Nai, no water has been spilled out from spillway of the Dran dam as lon as the reservoir operation records of the Dran dam show. Thus, the river water of the Dong Nai upper reach has been effectively used for hydropower generation so far.

The water level observation at Ta Lai SGS on the middle reach of the Dong Nai mainstream was commenced in 1979 when the hydropower plants of Da Nhim HPP were in the regular operation. Thus, it is noted that the discharges observed at Ta Lai SGS correspond to those yielded from a catchment area which excluds the catchment area of existing Dran dam from a gross catchment area of the Ta Lai SGS. Thus, the effective catchment area of the Ta Lai SGS is defined to be 8,850 km^2.

The Dai Ninh HPP is planning to be constructed in the middle reach between the Dran dam site and Dong Nai No.3 dam site. The Dai Ninh HPP also contemplates to divert the Don Nai River water to the eastern basin as well as the case in existing Da Nhim HPP. The Dai Nhin HPP covers an effective catchment area of 1,158 km^2 excluding that of the Darn dam. Accordingly, the present river flow at Dong Nai No.3 dam site will be reduced after the commencement of operation of the Dai Ninh HPP. Taking into the present and future water trans-basin for hydropower generation in the middle and upper reachs of the Dong Nai River basin, the effective catchment areas of the Dong Nai No.3

and No.4 schemes are defined based on the catchemnt areas measured by planimeter on 1 to 50,000 scaled topographic maps:

Location	Gross Catchment Area (km^2)	Effective Catchment Area (km^2)
- Da Nhim HPP (Dran Dam Site)	775	775
- Dai Ninh HPP	1,933	1,158
- Dong Nai No.3 Dam Site	4,374	2,441
- Dong Nai No.4 Dam Site	4,533	149*

Notes * ; residual catchment area intervening between the Dong Nai No.3 and No.4 dam sites.

C3.3 Estimate of Long-Term Discharge at Dong Nai No.3 and No.4 Dam Sites

C3.3.1 Crosscheck of reliability of observed discharge data at Ta Lai SGS

The monthly runoff data at Ta Lai SGS for the period from 1979 to 1998 are summarized in Table C3.1. It was foreseen that the runoff data observed at Ta Lai SGS would play an important role in the hydrological analysis of the present feasibility study, although the available period of runoff data observed at a new stream gauging station which has been installed near the Dong Nai No.3 dam site is as short-term as about a half year for the time being. First of all, therefore, the reliability of the runoff data observed at Ta Lai SGS were cross-checked through the comparison with the following meteo-hydrologic data using the double curve method:

- Runoff data observed at Ta Pao SGS
- Basin average rainfall

(1) Comparison with discharge data observed at Ta Pao SGS

The existing Ta Pao SGS is located on the La Nga River, a tributary of the Dong Nai River, about 45 km distant from Ta Lai SGS to the west. In view of their proximity in location, the runoff characteristics of these two SGSs are considered to be similar. Furthermore, the runoff data at Ta Pao SGS were utilized for the detail design of Ham Thuan-Da Mi hydropower project that is under construction. Hence, it is considered that the reliability of the runoff data had been verified to confirm whether or not those data applicable to the runoff analysis in the present feasibility study. The mean monthly discharges observed at Ta Pao SGS are tabulated in Table C3.2.

To check the reliability of runoff data at Ta Lai SGS, a double mass curve for annual runoff depths at Ta Lai SGS and Ta Pao SGS were constructed as shown in Figure C3.3. As seen in the Figure, a relationship between these two values is represented almost by a straight line. Thus, the runoff data observed at Ta Lai SGS is judged to be reliable in relation to the runoff data at Ta Pao SGS.

(2) Verification by the comparison with the annual average basin rainfall at Ta Lai SGS

During the first field investigation, it was informed to the JICA Study Team that no discharge measurements at Ta Lai SGS were available for the period from 1979 to 1984

so that the water levels thereat observed before 1984 were converted into mean dialy discharges using a stage-discharge constructed based on discharge measurements in 1985. Thus, there was a fear that runoff data at Ta Lai before 1985 might be inaccurate as compared with those for the latter period.

To check the reliability of runoff data observed at Ta Lai SGS from the basin rainfall, annual average rainfalls for a catchment of Ta Lai SGS were calculated by means of the Thiessen Polygon method based on annual rainfall records at rainfall stations in and around the catchment. A double mass curve is made to represent a relationship between these two annual values as shown in Figure C3.4. The Figure shows that the relationship is represented almost by a straight line. This means that the runoff data at Ta Lai SGS gives a comparatively constant annual runoff coefficients throughout the observation period of 1979 to 1998, implying that there is no significant difference between runoff coefficients derived from the data before 1985 and after 1985.

From the examinations above, it is assessed that the runoff data observed at Ta Lai SGS are applicable to the lowflow analysis to estimate the long-term discharges at the proposed Dong Nai No.3 and No.4 dams.

C3.3.2 Estimate of long-term-runoff at Dong Nai 3 and 4 dam sites

The long-term runoff at the Dong Nai No.3 and No.4 dam sites are estimated through transposition of the observed runoff data at Ta Lai SGS thereto. The present study used the similar formula to that used in the previous M/P for the purpose of transposition of the runoff data at Ta Lai SGS, but only the observed data at Ta Lai SGS are applied following the review results discussed above.

The detailed design for the Dai Ninh hydropower project has been completed before the start of the first field investigation in January 1999. Some of the hydrologic data on the project were provided by EVN to the JICA Study Team during this period. In the detailed design, the runoff data were estimated by transposing those at existing Dran dam site to the project site, in consideration of their catchment areas as well as runoff depths. The mean monthly discharges for the effective catchment area of the Dai Ninh HPP (1,158 km^2) which were estimated and finally adopted in detailed design stage of the Dai Ninh HPP are shown in Table C3.3. On the other hand, it appears that the inflow records of existing Dran reservoir are characterized by the stable runoff condition even in the dry periods. Hence, it is considered that the further analysis would be necessary to verify the Dran inflow records are applicable to the downstream basins.

As long as the results of reservoir operation study for the project are concerned, besides, almost all of streamflow at the Dai Ninh dam sites are to be diverted to the other basin where a powerhouse is to be constructed. Thus, the assumption made in the runoff analysis is that the runoff from the upstream catchment of Dai Ninh project is completely diverted to the other basin. Thus, it is assumed that no flow from the upstream catchment including that of the Dai Ninh HPP will enter into the Dong Nai No.3 reservoir, taking into consideration the conservative estimate of runoff at the Dong Nai No.3 and No.4 dams. To estimate the inflow discharges to the Dong Nai No.3 and No.4 reservoirs, the following formula was used to transpose to the Ta Lai SGS discharge data to effective

catchment areas of the Dong Nai No.3 and No.4 schemes:

$$Q_{DN3,4}=Q_{Ta\ Lai} \times F_t$$

$$F_t = R_{rain} \times R_{catch}:$$

Where,

F_t : Transposition factor of effective catchment areas of Dong Nai No.3 or Dong Nai No.4 dam sites for discharge data at Ta Lai SGS

$Q_{DN3,4}$: Mean monthly discharges at Dong Nai No.3 or No.4 dam sites (m^3/sec)

$Q_{Ta\ Lai}$: Observed mean monthly discharge for effective catchment area of 8,850 km^2 at Ta Lai SGS (m^3/sec)

R_{rain} : Ratio of annual basin average rainfall for effective catchment of the Dong Nai No.3 or No.4 dam site to that for effective catchment of Ta Lai SGS

R_{catch} : Ratio of effective catchment area at Dong Nai No.3 or No.4 dam site to that at Ta Lai SGS

The factors forming the above formula are derived as follows:

Location	Effective Catchment Area (km^2)	Annual Basin Average Rainfall (mm/year)
Ta Lai SGS	8,850	2,318
Dong Nai No.3 Dam site	2,441	1,950
Dong Nai No.4 Dam site	149*	2,657

Notes * : residual catchment area intervening between the Dong Nai No.3 and No.4 dam sites.

The transposition factors (F_t) for the Dong Nai No.3 and No.4 schemes are derived to be 0.23 and 0.02, respectively. As a result, mean discharges at Dong Nai No.3 and for residual area intervening between the Dong Nai No.3 and No.4 dam sites are estimated at 75.2 m^3/sec and 6.54 m^3/sec for the period from 1979 to 1998 as shown in Tables C3.4 and C3.5, respectively. The mean discharge of 75.2 m^3/sec at the Dong Nai No.3 dam site falls in the intermediate rang of those estimated in the previous M/P study (81 m^3/sec) and Pre-F/S (57 m^3/sec). These discharge data are used as the basic hydrologic data for reservoir operation study to estimate the project outputs of alternative development plans for the Dong Nai No.3 and No.4 Combined Hydropower project.

C3.3.3 Cross-check of Estimated Long-Term Discharge at Dong Nai No.3 and No.4 Dam Sites

The consistency of the estimated discharges for the Dong Nai No.3 and No.4 dam sites were further cross-checked through the following comparisons:

- Comparison with neighboring SGS in terms of hydrologic values such as specific runoff and runoff depth,
- Comparison with the observed runoff at the new streamflow station near the Dong Nai No.3 dam site, and
- Comparison with Annual Average Basin Rainfalls

(1) Comparison with neighboring SGS in the Dong Nai River basin in terms of hydrologic values

On the basis of runoff data in Table C3.3, annual specific discharge and runoff depth and runoff coefficient for a net catchment area of the Dong Nai No.3 (2,441 km^2) are derived as follows:

No.	Item of Hydrologic Value	Values derived for Dong Nai No.3 dam site
1.	Annual specific discharge	0.03 (m^3/sec/km^2)
2.	Annual runoff depth	972 (mm/year)
3.	Annual runoff coefficient	0.50

To check the adequacy of the above hydrologic values for the Dong Nai No.3 dam site, those for the neighboring 4 existing SGS and Da Nhim dam site are estimated based on their runoff data. The results are presented in Figure C2.6. As seen from the Figure, the hydrologic values are in their adequate ranges in comparison with those for the neighboring basins.

(2) Comparison with the observed discharges at new streamflow gauging station near the Dong Nai No.3 dam site

In January 2000, the JICA Study Team received from EVN the following hydrological data at the new streamflow gauging station, which has been installed at the nearby location of the proposed Dong Nai No.3 dam site in June 1999:

- Mean daily stage water levels observed between June and December 1999
- Results of discharge measurements performed in 1999

In this final stage of the feasibility study, an attempt was made to reflect the above hydrological data into the present runoff analysis. The mean daily stage water levels observed at the new stream flow gauging station are listed in Table C2.2 and the results of discharge measurement performed during the field investigation are shown in Table C3.6. As the first step, a new stage-discharge rating curve was constructed based on the results of the discharge measurement as shown in Figure C3.5. The observed mean daily stage water levels were converted into mean daily discharges with the stage-discharge rating curve as shown in Table C3.7.

To clarify a relationship between runoff observed at Ta Lai SGS and the new SGS near the Dong Nai No.3 dam site, the concurrent 5-day mean discharges in the year 1999 were plotted in Figure C3.6. Consequently, the following relationship between those concurrent discharges was attempted to be represented:

$$Q_{DN3}=Q_{Ta\ Lai} \times F_c$$

Where,

F_c : Ratio of discharges observed at the new SGS (Dong Nai No.3 dam site) to those at Ta Lai SGS

Q_{DN3} : Observed mean 5-day discharge observed at the new SGS (Dong Nai No.3

dam site) (m^3/sec)

$Q_{Ta\ Lai}$: Observed mean 5-day discharge observed at the new SGS (Dong Nai No.3 dam site) (m^3/sec)

Since some of the mean discharges at the new SGS, shown in Table C3.7, include the discharges released from spillway of the upstream Dran dam, the factor (Fc) was estimated using only the discharge data which were not affected by the release from the Dran dam. In such a manner, the factor (Fc) was estimated at 0.346. On the other hand, the observed discharges at the new SGS is a sum of the discharge from the effective catchment of the Dong Nai No.3 scheme (2,441 km^2) and that from the Dai Ninh HPP (1,158 km^2). Dividing the observed discharges at the new SGS into those for the effective catchment area of Dong Nai No.3 scheme and that of the Dai Ninh HPP in proportion to their catchment areas, the transposition factor for the effective catchment of Dong Nai No.3 comes to 0.23, which is almost coincident with that derived from the ratios of catchemnt areas and basin average rainfalls, that is estimated above. Therefore, the discharge data at the Dong Nai No.3 that were estimated above are consistent in comparison with the observed discharges at the new SGS near the Dong Nai No.3 dam site.

On the other hand, the annual basin average rainfall for the effective catchment area of Dong Nai No.3 scheme is obviously larger than that of the Dai Ninh HPP as seen in the isohyetal map shown in Figure C3.6. Thus, there is a possibility that the transposition factor for the Dong Nai No.3 scheme becomes larger in case the ratio of annual rainfalls for the two catchment areas is taken into consideration in dividing the observed discharges at the new SGS into those for the effective catchment area of Dong Nai No.3 scheme and that of the Dai Ninh HPP. In view of the limited available period of discharge data at the new SGS, however, it is recommended that the analysis with the observed data at the new SGS should be used only for the purpose of cross-checking the reliability of the runoff analysis.

(3) Comparison with Annual Average Basin Rainfalls

To check the reliability of the estimated runoff data at the Dong Nai dam site, the annual basin average rainfalls are calculated by the Thiessen's Polygon method based on rainfall records at stations in and around the catchemnt. The accumulated annual runoff depths and rainfalls are graphically plotted to confirm the relationship between these two values as shown in Figure C3.7. As seen in the Figure, the relationship can be represented by a straight line. Therefore, there is no inconsistency on the estimated runoff data in relation to the basin average rainfall.