MANAGEMENT LINES AND LAND USES FOR THE NILE RIVER BETWEEN ASSIUT AND DELTA BARRAGES

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ABSTRACT

In the late 1940's and early 1950's, the Ministry of Water Resources and Irrigation has developed the concept of "training lines" since the ministry has the responsibility to control all development within the area between these lines. These lines are two parallel curvilinear lines set about 700m apart to pass 11,000 m^3/s peak discharges.

Since the 1950's many things have happened to the river including channel shifting, however the most important was the construction of the High Aswan Dam (HAD) in the 1960's that has been completely controlled the downstream flooding. The peak annual release of about 3000 m^3/s can now regarded as bankfull discharge along the length of the river. Therefore, it was deemed necessary to bring up to date the old concept of training lines. The Nile Research Institute together with a Canadian panel of expertise achieved this task in 1992 by replacing the old training lines by morphological lines called the Management Lines which consists of Terrace Lines, Channel Lines and Flood Lines. The new concept takes into account the needs of the river itself, river planners and managers as well as the river users.

This paper outlines the criteria used to delimitate the new concept. The new lines are computed and plotted in about 300 km reach between Assiut barrage and Delta barrage. Mathematical model is used to compute the flood line. The paper recommended that in order to finalize these lines, they should be verified and the situation in the field should be defined. Also national commission should be asserted to monitor and control these lines.

Key Words: Nile River, Training Lines, Management Lines, Assiut to Delta Barrages Reach, Terraces Lines, Channel Lines, Water Levels, Discharges, Backwater, and Morphological Criteria.

1. INTRODUCTION

The "Training lines" are two lines defining a meandering corridor, about 700m wide. They do not seem to reflect land usage, topography, or acual river training works (see Figure 1 for part of the reach under study at Beni Maza), However, they may define the riverbank defenses to create a stable channel capable of conveying a discharge of 11000 m^3/s. The highest flood for the 100 year period from 1870 to 1970 was reported to have a peak discharge of 13500 m^3/s (Sogreah, 1986). The permanent development was prohibited between these lines in order to insure that the entire land between is belonged and available to the ministry for the construction of defensive works. It would serve also for preventing encroachments such as roads or railways embankments from restricting the river and reducing its flood passing capabilities.

The High Aswan Dam (HAD) has completely controlled the flow in 1968 and the river flow pattern can easily be predictable. The bankfull discharge can now be designated as 3000 m^3/s. Therefore it is deemed important to revise and update these lines to be compatible with the new situation. The Nile Research Institute together with a panel of Canadian expertise achieved this task in 1992. The new lines are morphological lines according to the land features defined by the Nile valley and mainly based on short-term integrated management. The new lines are labeled "the management lines".

2. CONCEPT AND DESIGN CRITERIA

Since management lines are tool for managing the development along the river, their assessment should be based on integrated management for river development including hydraulic structures, navigation facilities, bank protection and training works, land reclamation, fishery and recreation, tourism development, road, railways and building.

The land features defined by the valley of the Nile are representing basic tool and criteria for setting the general definitions of these lines. The first feature is the old flood plain that extends beyond the old banks of the river. In general the development including land cultivation, towns and roads was built in these lands. Since the construction of the HAD, this flood plain is no longer flooded and now represents a terrace. Therefore, this land was used to define the border of the first management line, which nominated the terrace lines.

The second feature is the active channel abundant from secondary channel, sand bars and seasonal islands*. This active channel is land that the river has taken for its own use. This land used to define the second manging lines called channel lines.

The third feature is to check that the management lines provide the conveyance capacity needed to handle the maximum annual and future expected releases from HAD. Therefore flood lines will be considered the third line of the management set.

* Seasonal islands are that covered with water during high seasons. They are also named submerged islands

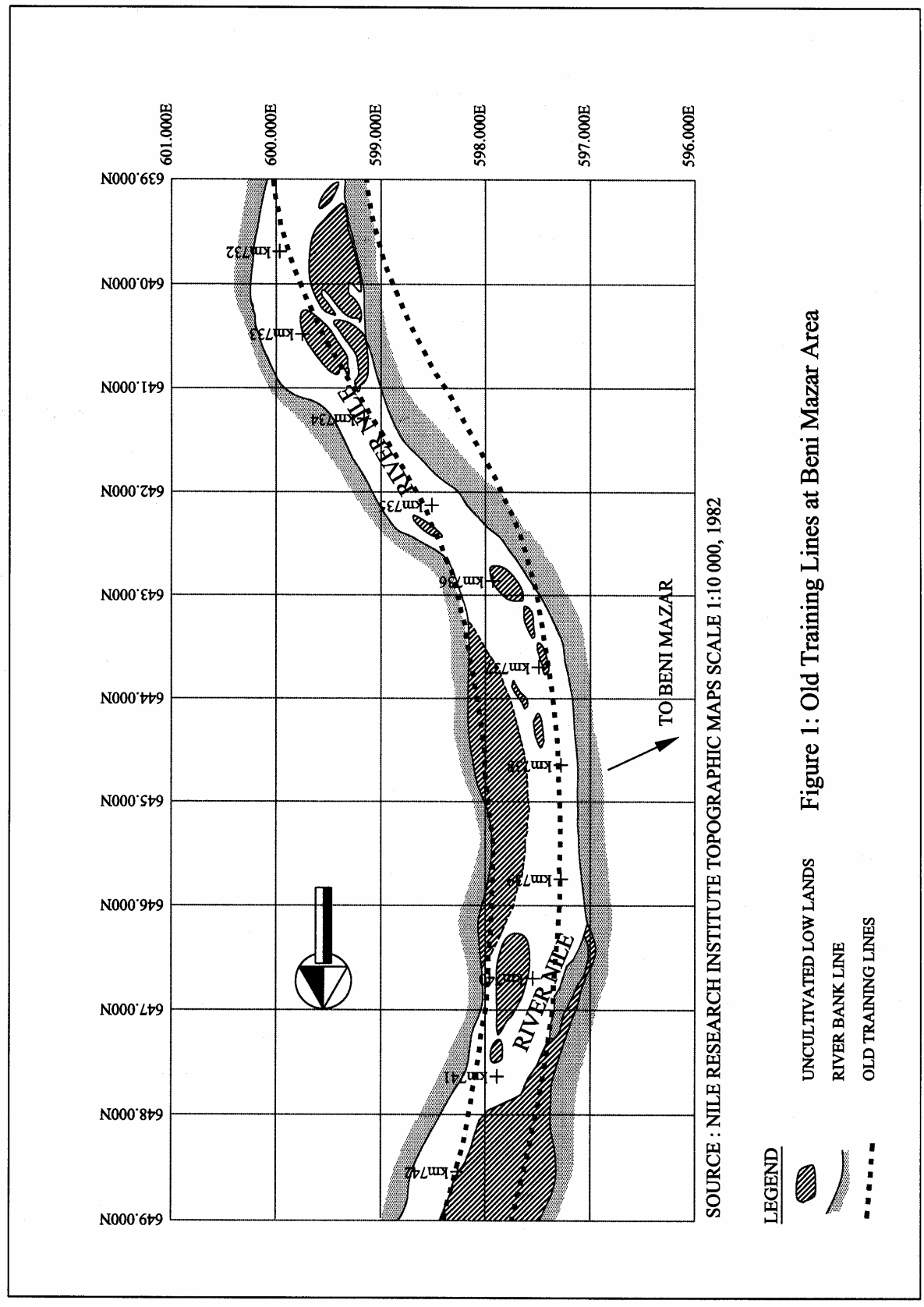

Figure 1: Old Training Lines at Beni Mazar Area

They define the way required by the river to convey release of 350 mm^3/day (4050 m^3/sec). This flow is considered by the Nile Research Institute to be the expected future release.

3. MANAGEMENT LINES AND LAND USES

The area of lands outside the terrace lines will consider available for public use and permanent structures and development and these area are outside the control of the ministry of water resources and irrigation. These lines can define in the field by the top of the old river banks and they defined easily on the 1:10000 map as they follow the contour lines of high ground near the river bank (the starting contour of the agriculture lands) and may separate between flat and steep slopes if the cross section is considered. Some islands (the permanent ones)* contain land that rise to the level of the flood plain terrace and this land is included in the terrace lands. These lines are more or less fixed and need to be updated every ten years.

The area between channel lines is reserved for the river needs and belongs to the ministry of water resources and irrigation. These lines are changeable due to some factors related to river process such as maximum discharge, erosion and deposition. Therefore, they need to be updated and checked every five years or less. Any development in the area between these lines is prohibited unless it is absolutely necessary. This is including pump intakes, ferry landing facilities, bridge abutments and piers, roadway encroachments, and pipeline crossing under the river or tunnel. This development should be decided upon engineering studies approved by the ministry.

The areas between channel and terrace lines can be used for temporal activities such as parks and recreation activities, seasonal agriculture, temporary farm building, fish farming, temporary storage without solid walls, wildlife refuges, access to water, ferry facilities, and borrow pits (gravel/sand) with the ministry approval (Mercer et al., 1990 and working paper 720-1, 1991). These lands may be returned to the ministry on demand.

4. THE MORPHOLOGICAL CHARACTERISTICS OF THE REACH UNDER STUDY

The area under study is reach no. 4 between Assiut and Delta Barrages (see Figure 2 for location). The selection of this reach for assessing the new concept is attributed to its experience of different types of problems including human interventions, bank erosion, navigation, and channel purifications. This reach is characterized by relatively straight channel, as the sinuosity is amount to 1.1. The channel pattern is straight with gentle meandering. Valley walls, towns on the right and bank protection works on the left in general confine the channel movement. Flow direction downstream Assiut barrage is diverted by human intervention since the construction of HAD.

* The permanent island is that has permanent vegetation and is distinct from sand bars

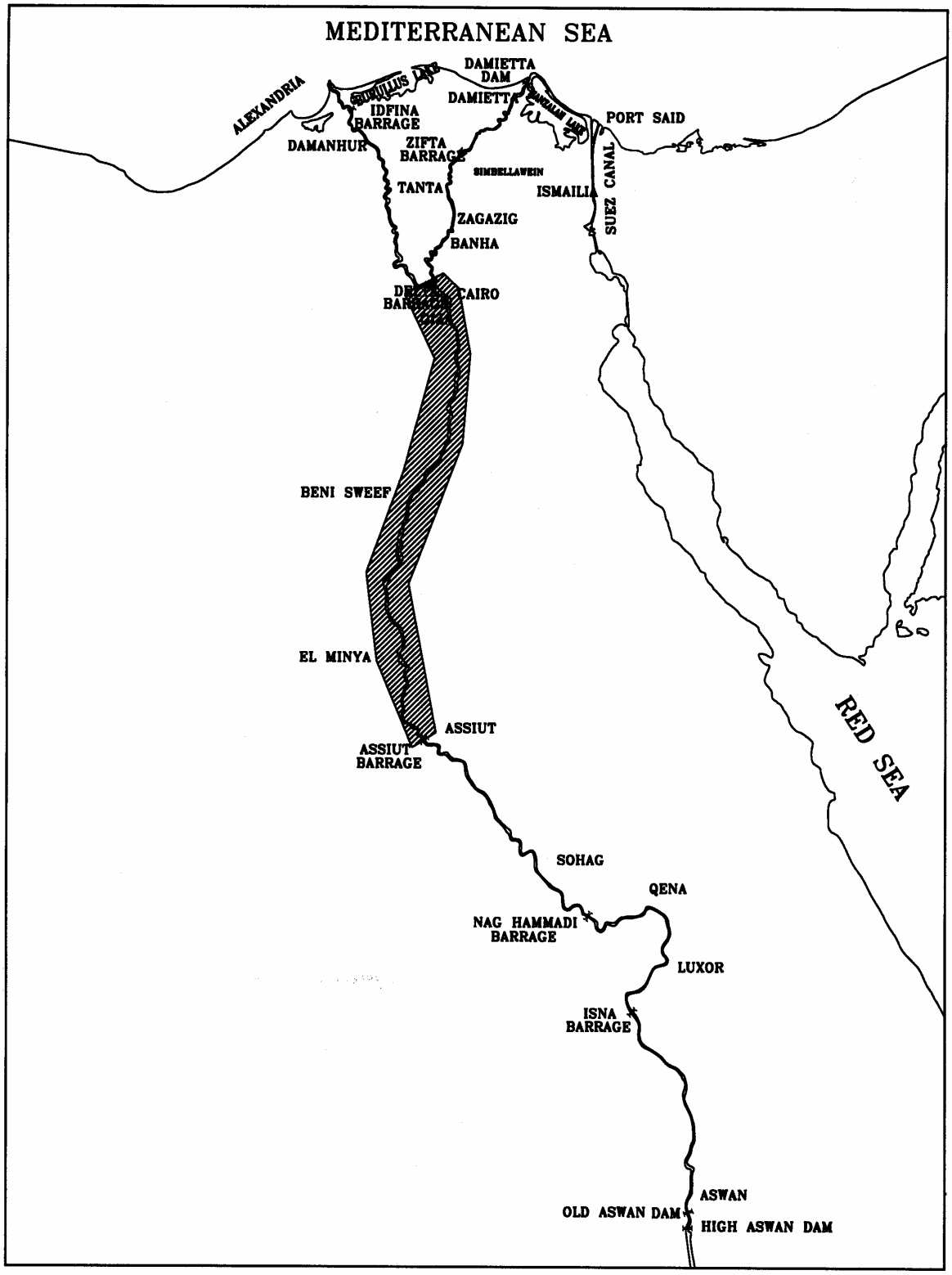

Figure 2: Location Map for the Reach between Assiut and Delta Barrage

Figure 3 indicates the range of flow variation downstream of Assiut Barrage since dam construction. This data is taken from actual measurements recorded by NRI. The minimum discharge regarded as 32.4mm^3/day recorded in 1992 however,

166 mm^3/day recorded as maximum values in 1995 if the period 1968 to 1995 is considered (NRI database sheets). The average slope of the reach is amounted to 9 cm/km.

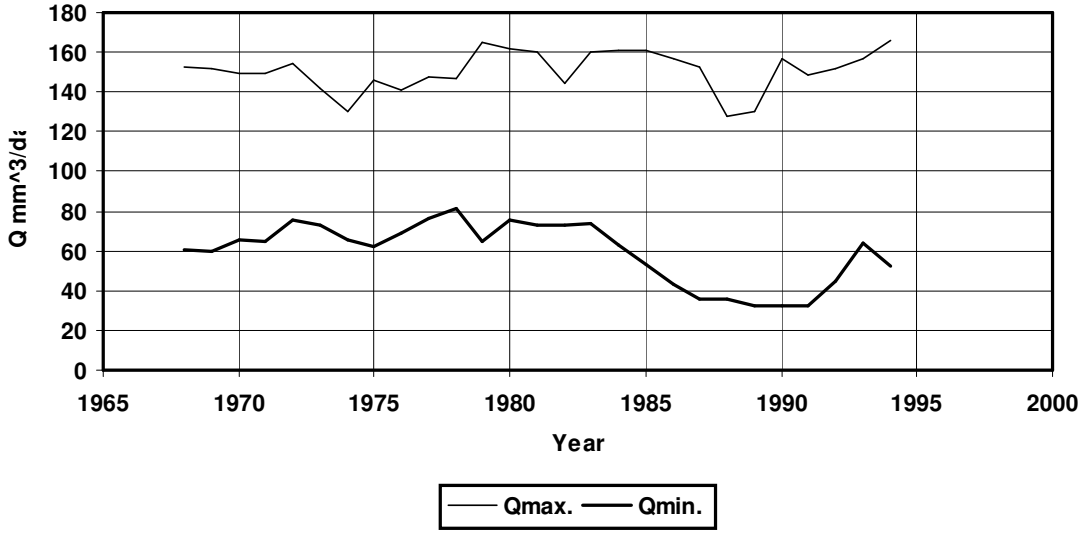

Figure 3: Variation of Discharges Downstream Assiut Barrage Since Dam Construction

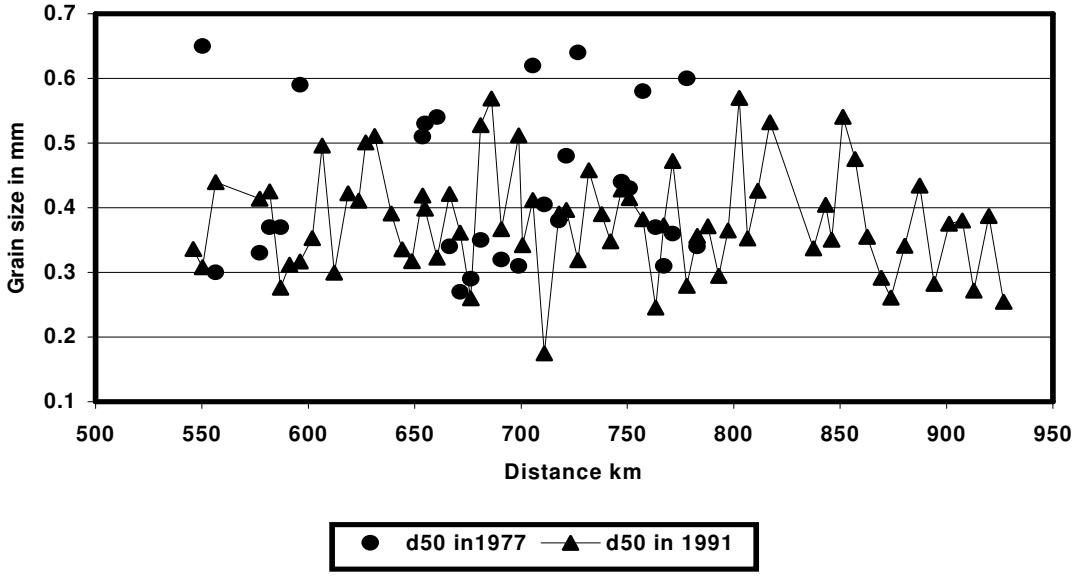

Figure 4: Median Grain Size

The d_{50} for about 44 cross sections (the plotted value is the average of three samples collected from east, west and middle parts of the cross section) collected in 1991 by NRI is shown in Figure 4 (DR 200-1-2, 1992). The length of the river banks (the main bank length plus the island length) has increased within this reach due to the development of new islands. However, the river bank lengths undergoing erosion is

decreased from 130 km in 1981 to 90 km in 1988. This is mainly attributed to the increase of artificial bank protection works (Abdelbary et al., 1990).

5. DATA BASE AND PREPARING THE LINES

In order to prepare the management lines for the entire reach the following most recent and available data sources were used:

1- 1:10000 scale topographic maps which were based on 1978-1979 ariel photography conducted by Kenting Earth Science Ltd. Canada. These maps reflect the 1979 ground conditions. These maps were used to provide the left and right bank extention which used to define the terrace line levels. Air mosiac to assis the secondary channel and sand bars which helps to define the channel lines.

2- Cross sections data (34 cross sections) surveyed in 1997 by the Nile Reseach Institute. The distance interval between these cross sections varied from 7 to 13 km apart.

3- River bank cross section surveyed by the Nile directorate along the reach. The distance intervel is 1 km apart.
The entire cross section data used to define the terrace and channel lines. They also used as an input data for the model.

4- The rating curve data of 1964 (discharges and water levels). These data were used to define the starting level (boundary conditions) for the mathematical model. Water level and discharge data of years 1995 and 1996. These data used to detremine the current release and also to calibrate the model and to define the channel line levels in the same times. Figure 5 shows the computed profiles of the management and flood lines. Also, the thalweg profile of 1997 is shown in the same figure.

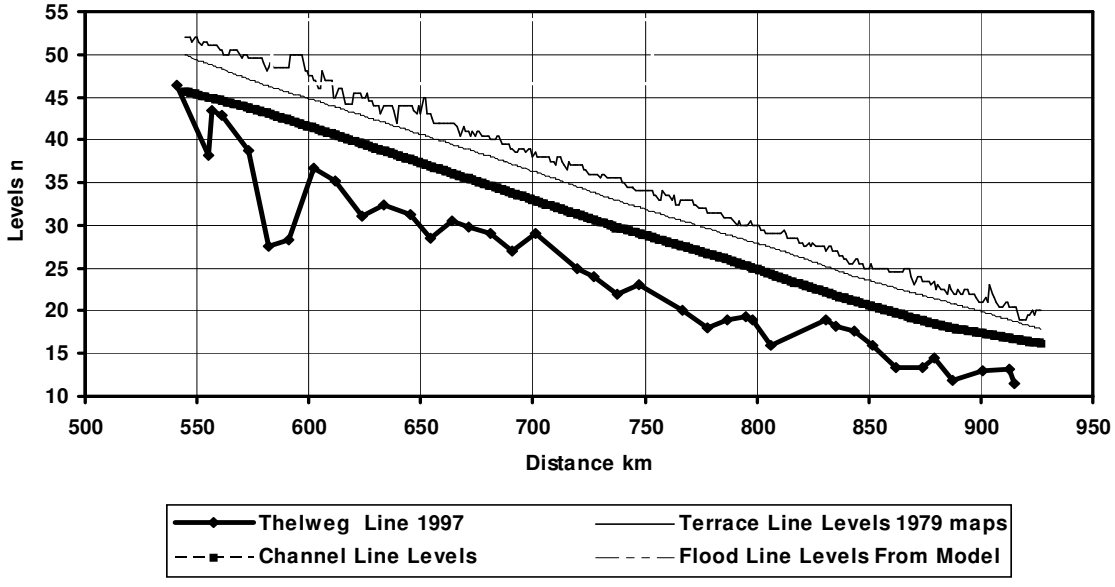

Figure 5: Computed Profiles of the Management Lines

6. MATHEMATICAL MODEL

The water surface profiles for two flows within the reach were computed using HEC-2 computer simulation program. The data required for running the model are discharges, flow regime (subcritical- supercritical), starting water level, roughness and other loss coefficient if found and geometric data such as cross section and reach length. The simulated flows are:

1- 173 mm^3/day, which corresponds to the nowadays bankful discharge in the reach. The downstream starting level at Ekhsas station was taken as 18.88 m
2- 350 mm^3/day, which corresponds to the future expected release. The downstream starting level at Ekhsas was taken as 20.82 m

The cross section data used for the model were 34 cross surveyed in 1997. In each of the backwater calculation, the Manning's roughness is adjusted to obtain fair calibration between the computed and measured water levels. The adjustement of n values was done according to reach discription and land use within the reach. This roughness values is within the range of "n" values of 0.024 and 0.041 (see Abdelbary et al., 1999 for calibration results).

7. PLOTTING CRITERIA AND VERIFICATION

The management lines have been drawn on 119 maps scale 1:10000 comprising the reach from Assiut to Delta barrage. It should be mentioned here that the corresponding ground contours were used to trace continuous terrace lines. In case of high islands, the terrace lines surround the island; however on the river side they were in general parallel to the river course. The demarcation of continuous channel lines was done in a similar manner as described for the terrace lines. From the results of the mathematical model, the levels of the flood line corresponding to 350 mm^3/day were also computed and plotted on the maps of 1:10000 scale. The line plot on 1:10000 maps (see Figure 6 for Beni Mazar area) is considered as a first step then these lines should be verified in the field because there are permanent structures that were perhaps legally built between terrace and channel lines. This situation is a result of the new concept of management lines. These structures were built to satisfy the channel requirements to pass peak discharges of 11,000 m^3/s. The ownership of lands in these zones may require special attention regarding land use because these zones now fall under the control of the ministry since they lie between a terrace line and channel lines. Also, expecting morphological changes and in addition to these morphological changes there are most likely, changes in landownership and land use, therefore, the entire set of maps representing the study area would still require to be verified against to current field situation. This verification is necessary to determine the new land uses, new built structures and land ownerships. Comments must be taken during the verifications to be taken into account when finalizing and updating the draft maps prior to final asserting. The final plotting of the lines should define continuous lines that provide the most appropriate alignment. This alignment should not position the channel outside the bank lines (the bank lines represent the level of the terrace lines in most cases). The channel should have the conveyance capacity to pass the future peak irrigation releases. They

should coincide with the river existing training and protection works. It is permissible that the channel divided to two channels according to the availability of the permanent islands.

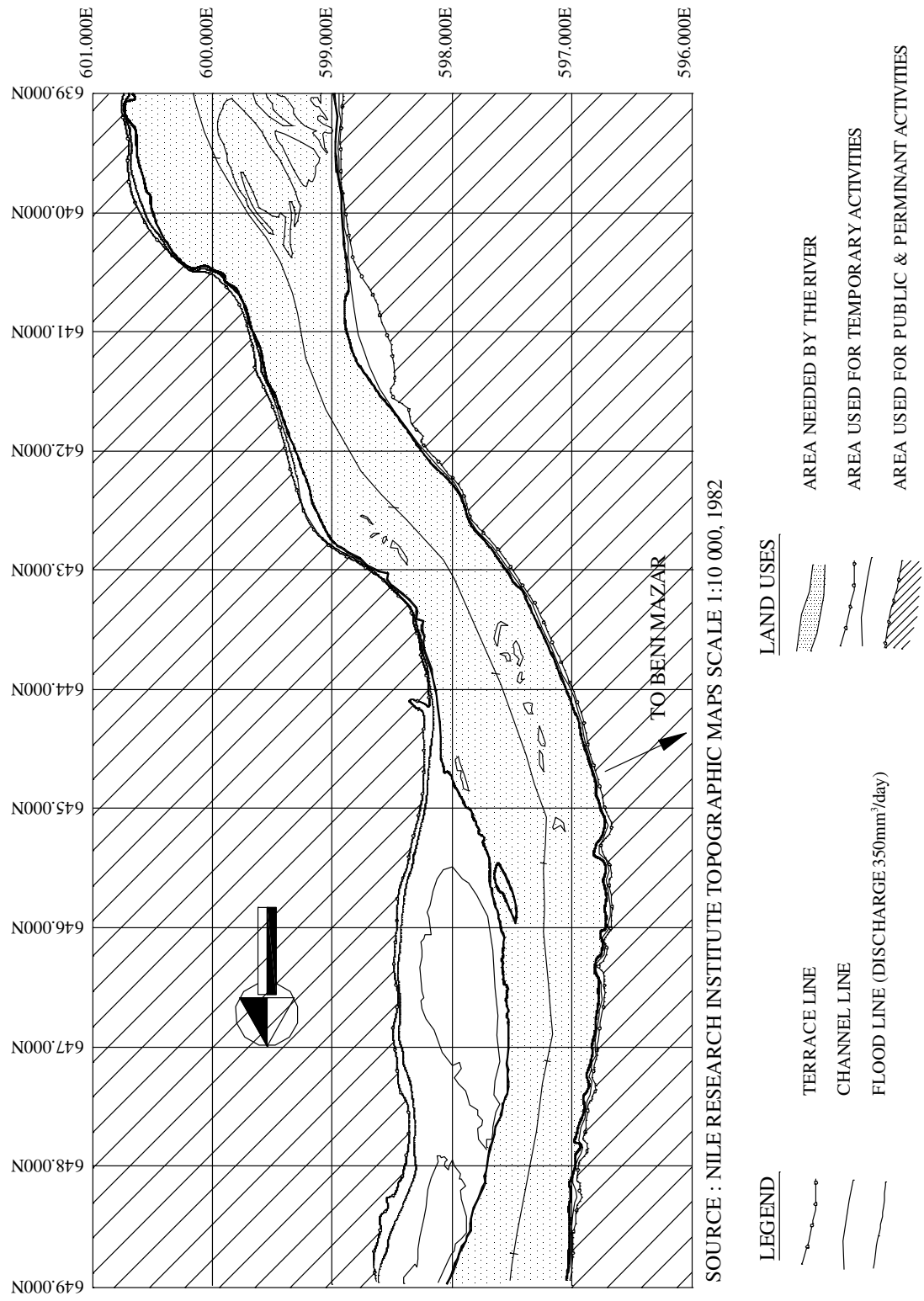

Figure 6: New Management Lines

8. DIFFICULTIES

Many difficulties are asserted during the determination of the management line levels. Some of these difficulties can be summarized as follows:

1- Since the management line levels are determined in a space of 1 km apart, therefore, the drawing of continuous line arises. To overcome this problem the corresponding ground contours of 1:10000 maps were used as a guide to trace the lines between the cross section locations.
2- Sometimes there are difficulties to determine the level of the channel lines as they are points of marked change of direction of channel section in the vicinity of the average water level. This change was clear on only one bank while a uniform slope was found on the other bank. In this case, a horizontal line originating from the identifiable point was taken to the opposite bank to locate the second channel point.
3- Sometimes the two side of the cross indicate uniform slope and the identification of the channel line point is impossible. Using the aerial mosaic or satellite images if available can solve this problem. Also the average water level on ordinary year (normal annual flood) can be utilized.
4- Sometimes the terrace and channel line points are coincident. In this case the land between terrace and channel lines do not exist. Some examples of these difficulties are shown in Figure 7.

9. CONCLUSIONS AND RECOMMENDATION

1) The new concept of the management lines should be verified. The current situation in the field should be addressed and the ownership of the permanent structure between the terrace line and channel lines should informed about the special uses in these areas and may be special legislation should be issued.
2) Integrated development for the entire river is required to avoid land disputes of the channel to be put to optimum use in the future
3) Different association should be involved to achieve various land uses
4) Compensations should be arranged for the damage that could be happened to permanent structure now lying between terrace and channel lines
5) Protection and consolidation of high terrace land suffering from bank erosion should be considered and the landowners could share in that
6) The use of the back channel should be given priorities according to economic income
7) A new commission or organization comprising representatives of the various ministries or agencies should be formulated

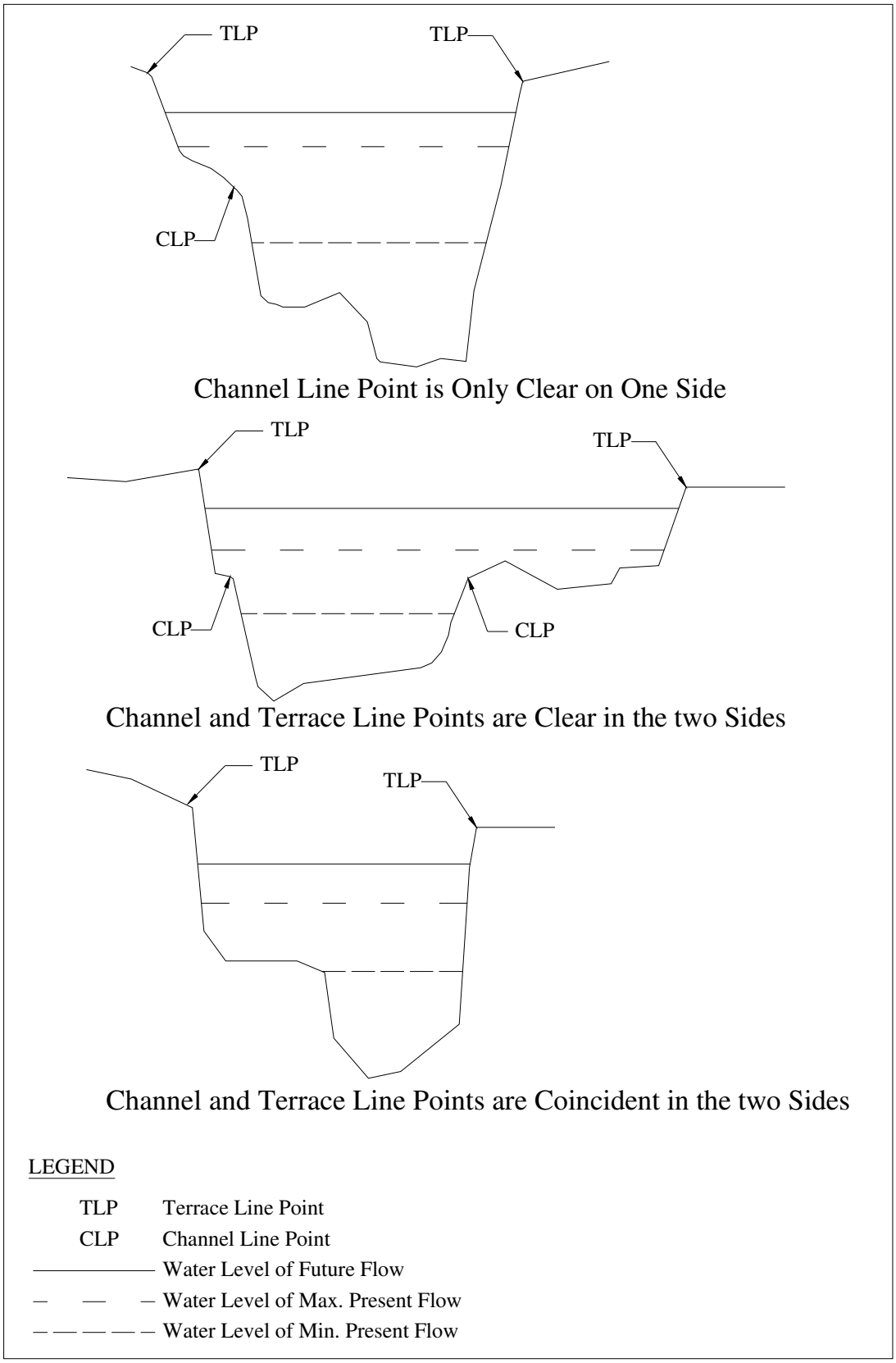

Figure 7: Some Difficulties Asserted in Determining Management Line Levels

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