EFFECT OF DIFFERENT FLOODS ON NILE RIVER

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ABSTRACT

The purpose of this research is to study the effect of the different floods on Nile River. For the reaches down stream Esna and Naga Hammadi Barrages, the different flood water levels were predicted to evaluate the problems with navigation for low floods and the overtopped areas for high floods. The mathematical model GSTARS 2.000, which was developed by U.S. Bureau of Reclamation (1998) was used for the analysis. The calibration results showed close relationship between the predicted and the measured parameters. Different floods were considered for this analysis. The output results were illustrated at the end of the study.

Morphological changes for the reaches down stream hydraulic structures:

Flow in natural or artificial channels is considered in equilibrium under many factors. For the case of any interference with the river, such as the existence of hydraulic structures, the river responses for this interference. In the following section, the reaches down stream the hydraulic structures were simulated and the different floods were analyzed for both the reaches.

Selected simulated reaches:

Two cases were selected for this analysis;
Reach No. 2: which is located from Esna to Naga-Hammadi Barrage and it has a length of 192 km., i.e. from km. 167.000 to km. 359.000,

Reach No. 3: which is located from Naga-Hammadi to Assiut Barrage and it has a length of 186 km, i.e. from km. 359.000 to km. 545.000.

SIMULATION MATHEMATICAL MODEL

To study the effect of high floods on the two reaches, These flood conditions, geometrical configurations, and bed grain size distribution were simulated using the same mathematical model. GSTARS 2.000. This model simulates the reach responses using different sediment motion approaches for the calibration analysis.

CALIBRATION ANALYSIS

The mathematical model was first calibrated for the two reaches to determine the suitable sediment movement concept and the relationship between the predicted and the actual parameters.

Reach 2 calibration

The model was calibrated using actual measured data for the flow of 1160 cubic meters per second (100 million cubic meters per day) during the period 1-10, March, 1988. Figure 1 shows the relationship between the predicted and the measured water levels. Figure 2 illustrates the relationship between the predicted water levels for 1000 cubic meters per second (1982 data) and the computed, by Nile Research Institute (NRI) water levels for the same conditions. While Figure 3 shows the relationship between the predicted water levels for 2500 cubic meters per second (1982 data) and the computed by Nile Research Institute (NRI) water levels for the same conditions. On the other hand, Figure 4 shows an example of the relationship between the 1982 cross sections, the predicted 1997 cross sections, and the surveyed 1997 cross sections. The sections used for calibration are distributed throughout the reach with the following locations:

-Km 204.56,
-Km 227.09,
-Km 299.18,
-Km 324.00, and
-Km 352.78.

By reviewing the different calibration comparisons, it can be concluded that, there are close relationships between the predicted and the actual parameters. This implies for the predicted water levels, velocities, and the predicted cross sections.

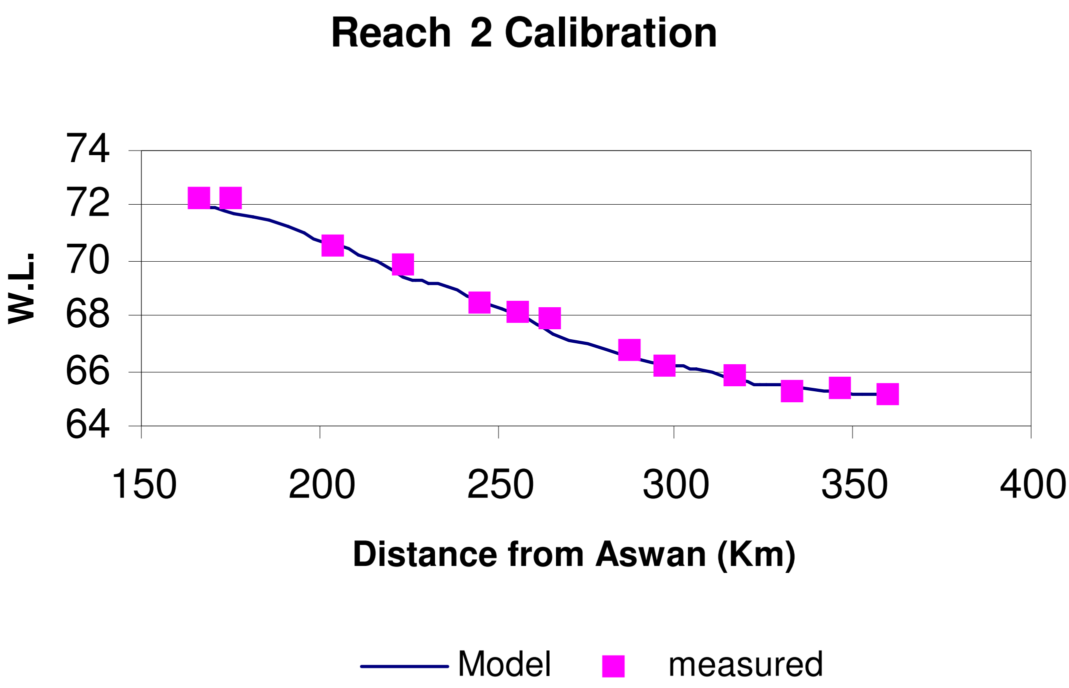

Figure 1. Water level comparison for a flow of 1160 m^3/sec.

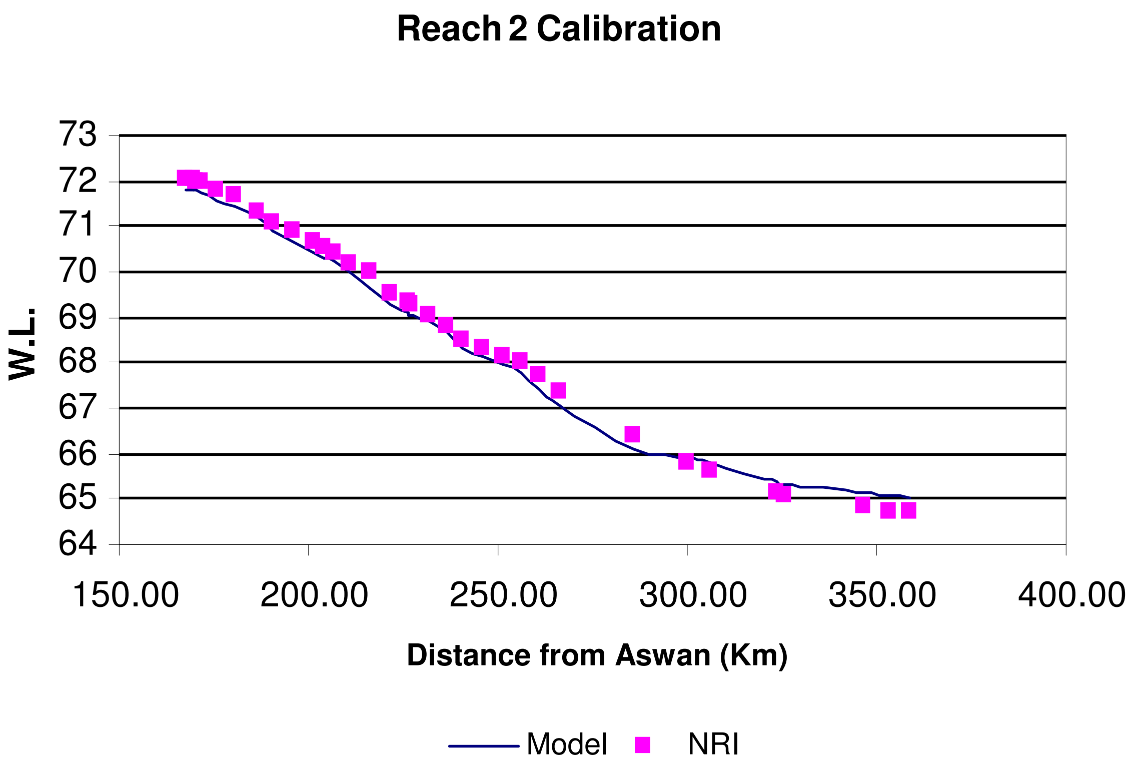

Figure 2. Water level comparison for a flow of 1000 m^3/sec.

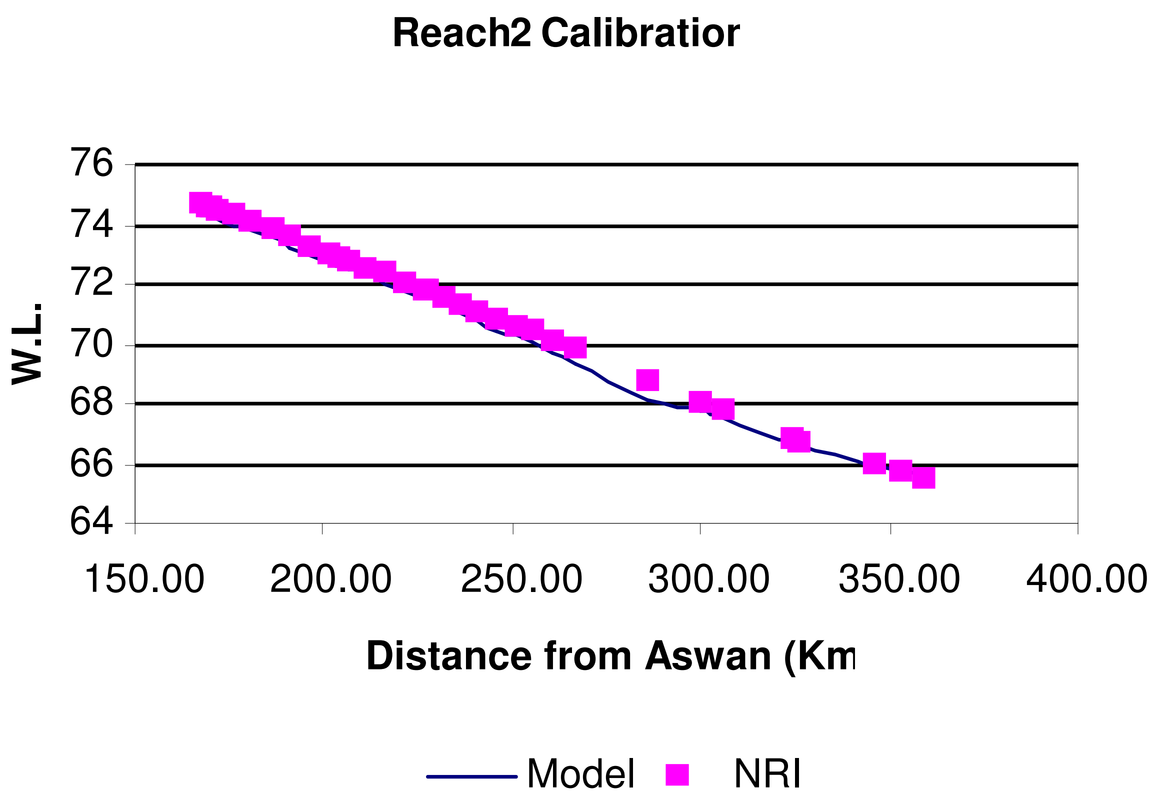

Figure 3. Water level comparison for a flow of 2500 m^3/sec.

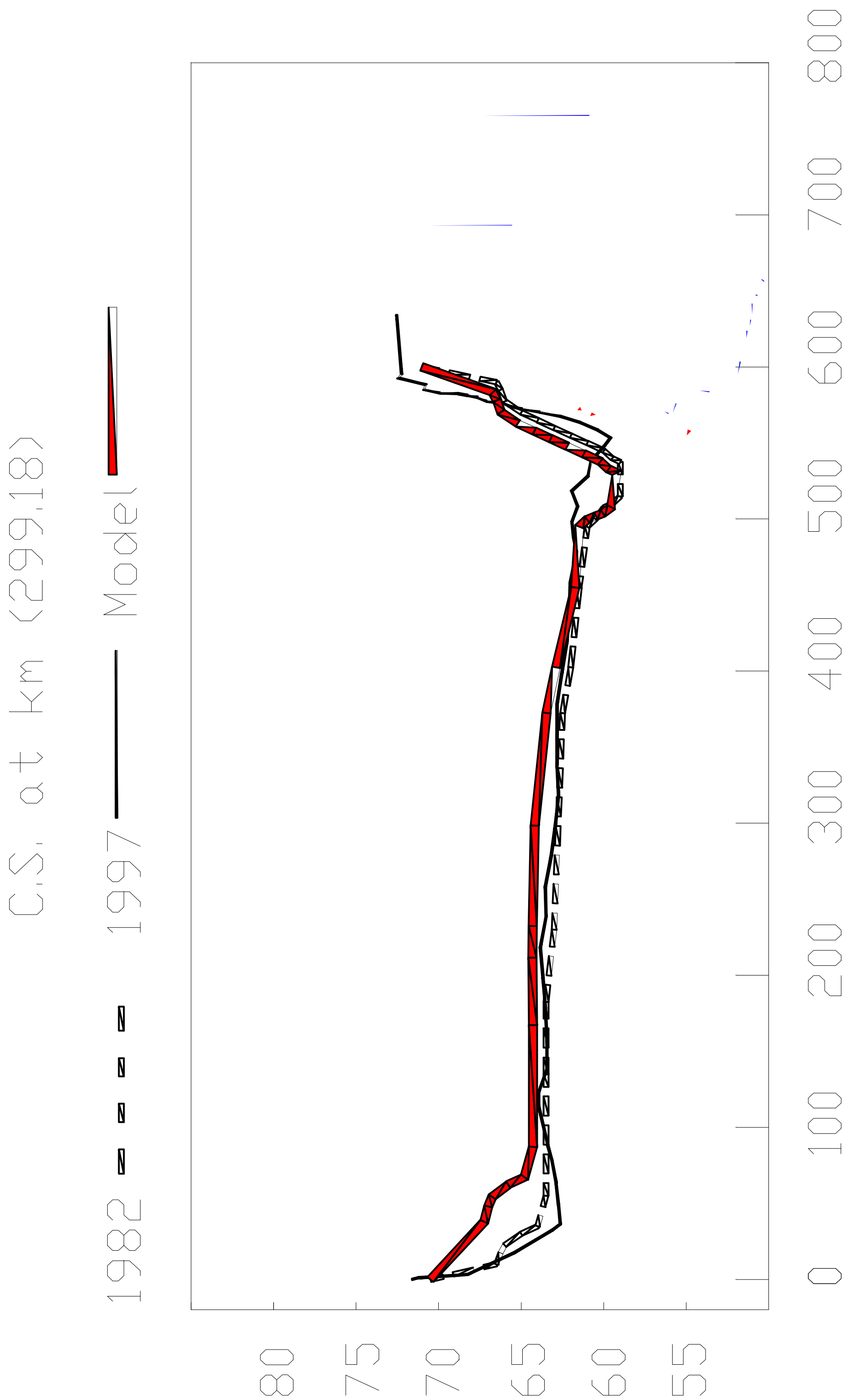

Figure 4 Cross section comparison at Km. 299.18.

Reach 3 calibration

The mathematical model was calibrated using actual measured data for the flow of 1160 cubic meters per second (100 million cubic meters per day) during the period 1-10, April, 1988. Figure 5 shows the relationship between the predicted and the measured water levels. For cross section comparison, Figure 6 shows an example of the relationship between the 1982 cross sections, the predicted 1997 cross sections, and the surveyed 1997 cross sections. By reviewing the different calibration comparison, it can be concluded that, there are close relationships between the predicted and the actual parameters. These sections are distributed throughout the reach with the following locations:

- -Km 377.75,
- -Km 397.80,
- -Km 418.55,
- -Km 447.30, and
- -Km 506.10.

By reviewing the different calibration comparisons, ~~it~~ can be concluded that, there are close relationships between the predicted and the actual parameters. This implies for both the predicted water levels and the predicted cross sections.

Effect of different flow conditions on Reach 2

Different flow conditions were simulated for this reach. This includes relatively low floods and high floods. The considered flow conditions are:

- -50 million cubic meters /day,
- -100 million cubic meters /day,
- -300 million cubic meters /day, and
- -350 million cubic meters /day.

The purpose of this part is to determine the water levels for each case. For the cases of low floods this will help in determination of navigation bottle necks according to bed configuration. For the cases of high floods, the water level determination will give an indication about the risk of overtopping of different areas of the river banks and agricultural lands. Figure 7 shows the water level for the cases of the flood of 50, 100, 300, and 350 million cubic meters /day.

Effect of different flow conditions on Reach 3

The flow condition studied for this case includes the same conditions similar to Reach 2 conditions. This includes relatively low floods and high floods. The considered flow conditions are:

- -50 million cubic meters /day,
- -100 million cubic meters /day,
- -300 million cubic meters /day, and
- -350 million cubic meters /day.

For the cases of low floods, this will help in determination of navigation bottle necks for this reach according to bed configuration. For the cases of high floods, the water level determination, for this reach, will give an indication about the risk of overtopping of different areas of the river banks and agricultural lands. Figure 8 shows the water level for the cases of the flood of 50, 100, 300, and 350 million cubic meters /day.

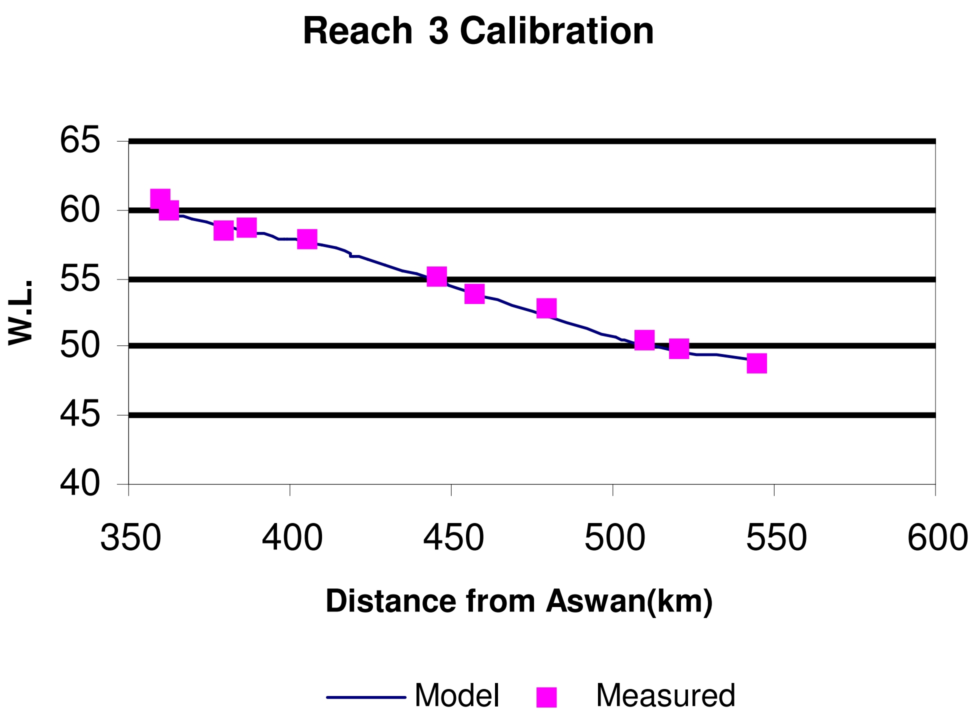

Figure 5.Water level comparison for a flood of 1160 m^3/sec.

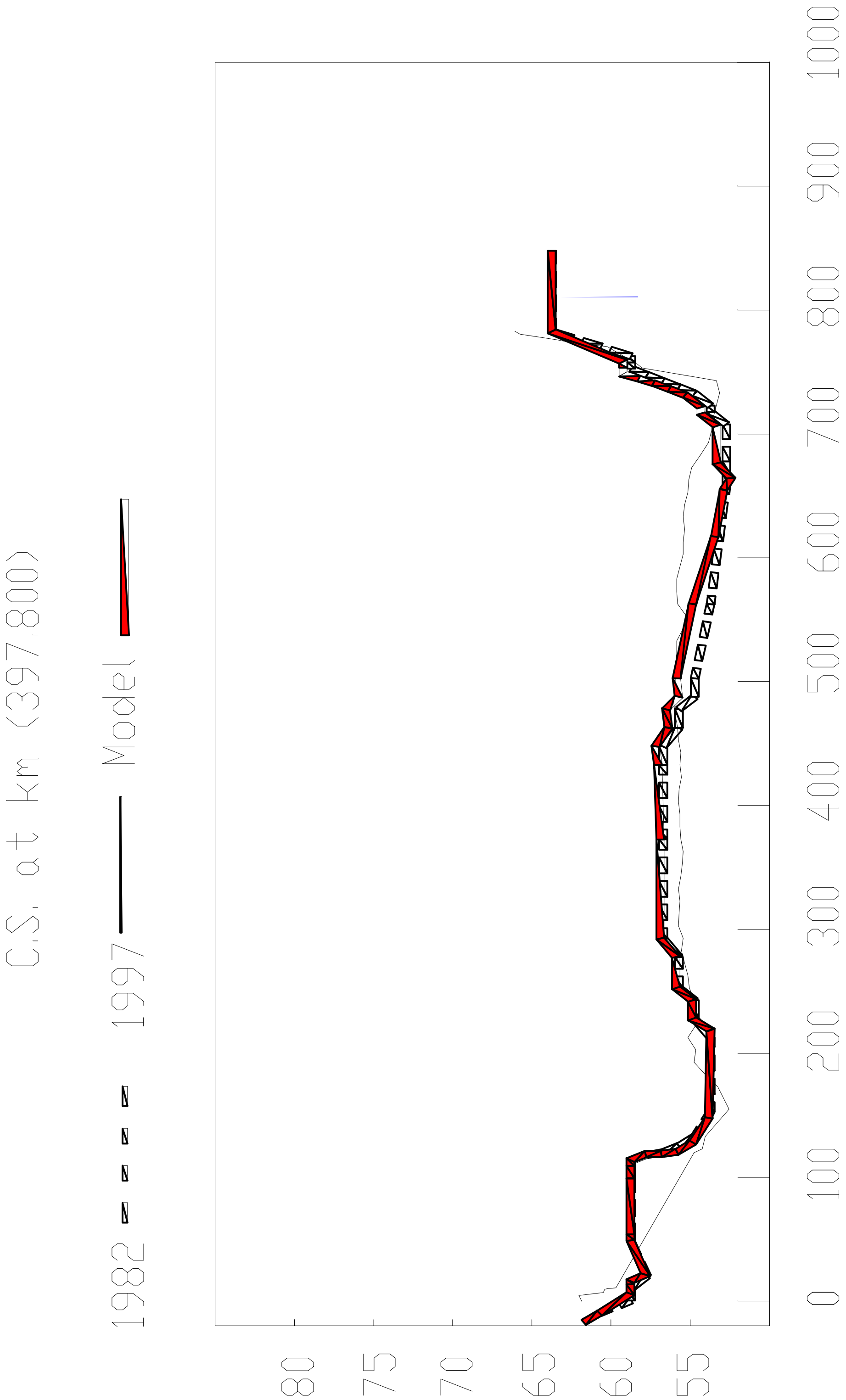

Figure 6.Cross section comparison at Km. 397.80.

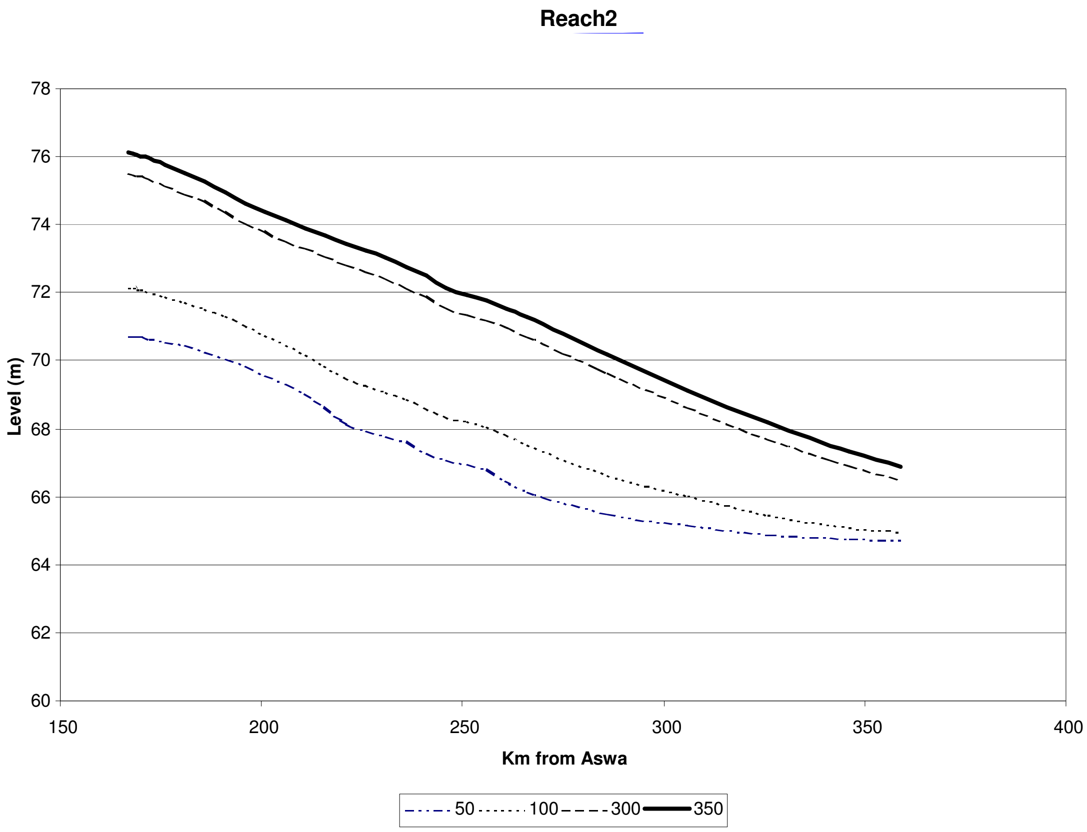

Figure 7. Water level for a flow of 50, 100, 300, 350 m.m^3/day, Reach 2.

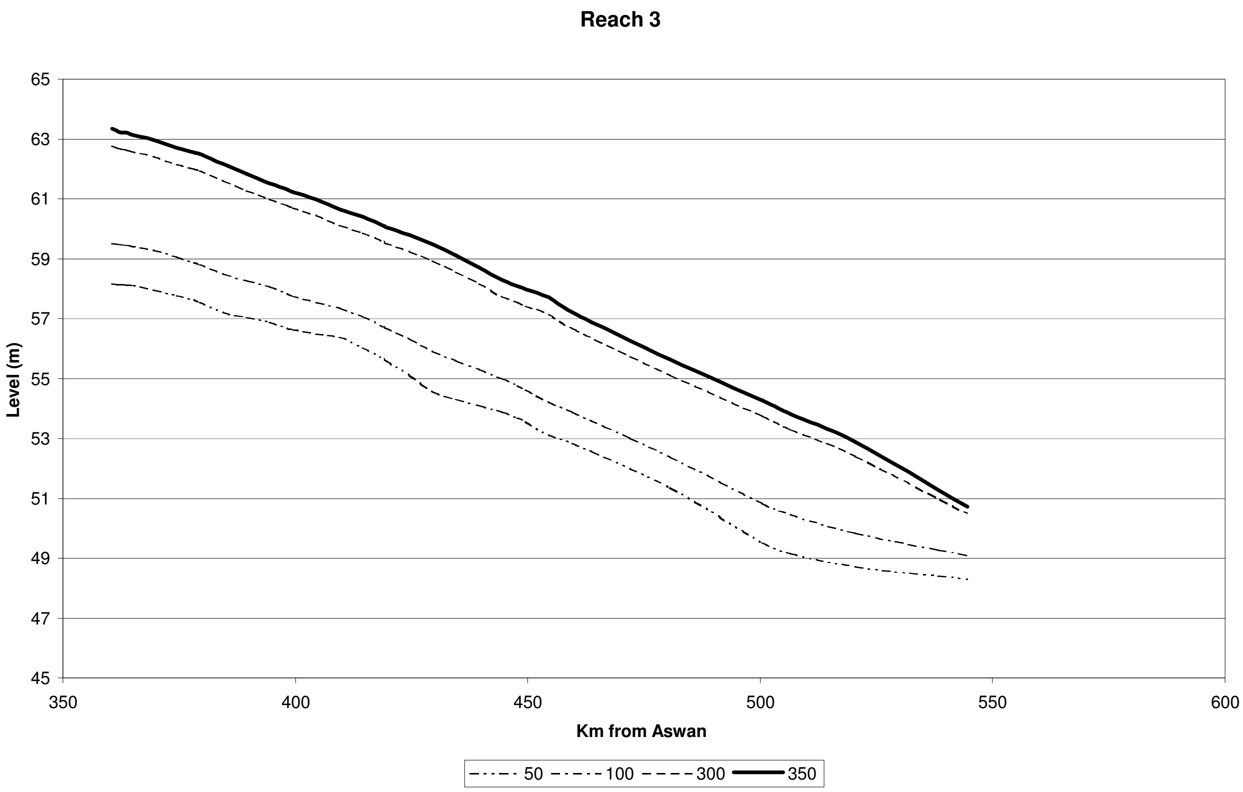

Figure 8. Water level for a flow of 50, 100, 300, 350 m.m^3/day, Reach 3.

From the previous figures, it can be concluded that:

I) Reach 2:

- Low water levels:

1- For a flow of 50 million cubic meters /day, the water level down stream Esna Barrage is about 70.66 while the water level upstream Naga Hammadi Barrage is about 64.72 m.
2- For a flow of 100 million cubic meters /day, the water level down stream Esna Barrage is about 72.37 while the water level upstream Naga Hammadi Barrage is about 64.99 m.

Throughout the reach, the minimum water levels and navigation difficulties can be located from the survey maps at the required locations.

- High water levels:

1- For a flow of 300 million cubic meters /day, the water level down stream Esna Barrage is about 76.34 while the water level upstream Naga Hammadi Barrage is about 66.05 m.
2- For a flow of 350 million cubic meters /day, the water level down stream Esna Barrage is about 77.05 while the water level upstream Naga Hammadi Barrage is about 66.32 m.

Throughout the reach, the maximum water levels and the areas subjected to overtopping can be located from the survey maps at the required locations. Risk analysis may be constructed to determine the high hazard areas which contain: schools, important projects, and any other high hazard areas.

II) Reach 3:

-Low water levels:

1- For a flow of 50 million cubic meters /day, the water level down stream Naga Hammadi Barrage is about 58.15 while the water level upstream Assiut Barrage is about 48.29 m.
2- For a flow of 100 million cubic meters /day, the water level down stream Naga Hammadi Barrage is about 59.50 while the water level upstream Assiut Barrage is about 49.08 m.

Throughout the reach, the minimum water levels and navigation difficulties can be located from the survey maps at the required locations.

-High water levels:

1- For a flow of 300 million cubic meters /day, the water level down stream Naga Hammadi Barrage is about 62.72 while the water level upstream

Assiut Barrage is about 50.50 m.

2- For a flow of 350 million cubic meters /day, the water level down stream Naga Hammadi Barrage is about 63.34 while the water level upstream Assiut Barrage is about 50.72 m.

Throughout the reach, the maximum water levels and the areas subjected to overtopping can be located from the survey maps at the required locations. Risk analysis may be constructed to determine the high hazard areas which contain: schools, important projects, and any other high hazard areas.

CONCLUSIONS

In this section, the reaches down stream the hydraulic structures were simulated and the different floods were analyzed. Two cases were selected for this analysis;

Reach No. 2: which is located from Esna to Naga-Hammadi Barrage and it has a length of 192 km., i.e. from km. 167.000 to km. 359.000,

Reach No. 3: which is located from Naga-Hammadi to Assiut Barrage and it has a length of 186 km, i.e. from km. 359.000 to km. 545.000.

To study the effect of high floods on the two reaches, these flood conditions, geometrical configurations, and bed grain size distribution, were simulated using the mathematical model. GSTARS 2.000. This model simulates the reach responses using different sediment motion approaches for the calibration analysis. By reviewing the different calibration comparisons, it can be concluded that, there are close relationships between the predicted and the actual parameters. This implies for the predicted water levels, velocities, and the predicted cross sections. From this analysis, different water levels, the minimum water levels related to navigation difficulties, and the maximum water levels related to areas subjected to overtopping can be located from the survey maps at the required locations. Risk analysis may be constructed to determine the high hazard areas which contain: schools, important projects, and any other high hazard areas.

REFERENCES

U.S. Bureau of Reclamation, 1998. “GSTARS 2.000 Model Manual”, U.S. Bureau of Reclamation, Denver, Colorado.