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Indian National Committee on Large Dams

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DAM SAFETY CONFERENCE

DRIP
Dam Rehabilitation & Improvement Project

Central Water Commission

Dambreak flood simulation: Sensitivity analysis

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INTRODUCTION

- **Sensitivity analysis helps to study the relationship among different parameters involved in the dam break and dam break flood waves propagation.**
- **The sensitivity analysis study of the dam breach parameters involve the estimation of the parameters like: side slope of the breach, manning's coefficient, time to failure, breach width etc.**

STUDY AREA

Rangit dam

- **Concrete gravity dam on Rangit River, tributary of Tista River, Sikkim (NHPC).**

Lower Manair Dam (LMD)

- **Earth cum Masonry dam constructed on Manair river, tributary of river Godavari, Karimnagar district, Telengana**

DAMBREAK SIMULATION

Open channel flow- Saint Venant equations (1D)

- Continuity Equation (mass conservation)
- Momentum Equation

Dynamic Wave Routing Method

Based on the complete 1-D equations of unsteady flow (St. Venant equations)

Continuity

$$\frac{\partial Q}{\partial x} + \frac{\partial A}{\partial t} - q_L = 0$$

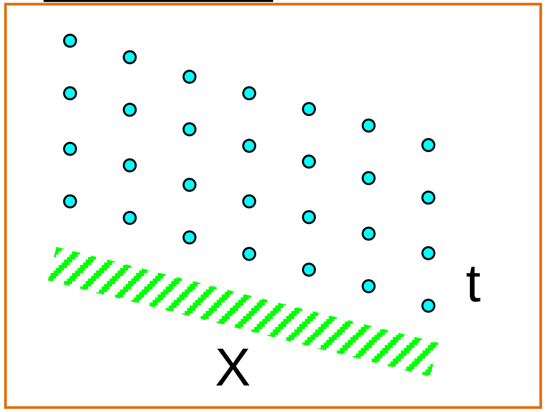
Momentum

$$\frac{\partial Q}{\partial t} + \frac{\partial (Q^2 / A)}{\partial x} + gA\left(\frac{\partial h}{\partial x} + S_f\right) = 0$$

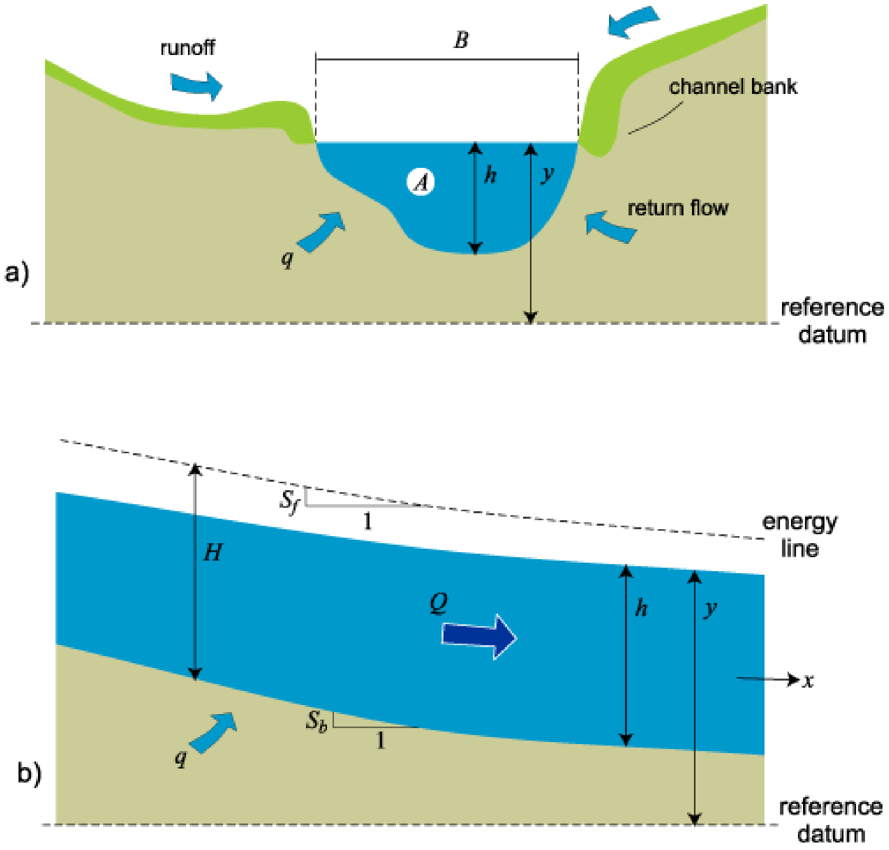
$$\frac{\partial h}{\partial x} = \frac{\partial y}{\partial x} - S_o$$

Where: h = water surface elevation and

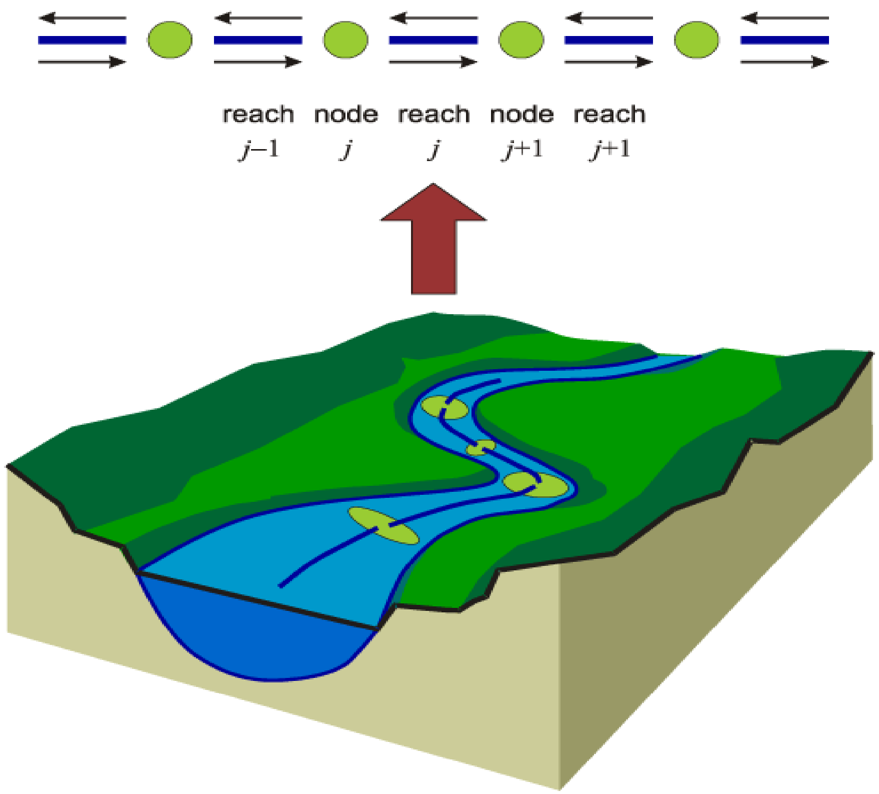
The discharge (Q) and water surface elevation (h) at each location along the river is computed using an algebraic representation of the St. Venant equations. Q and h are determined for the river system at each time step.



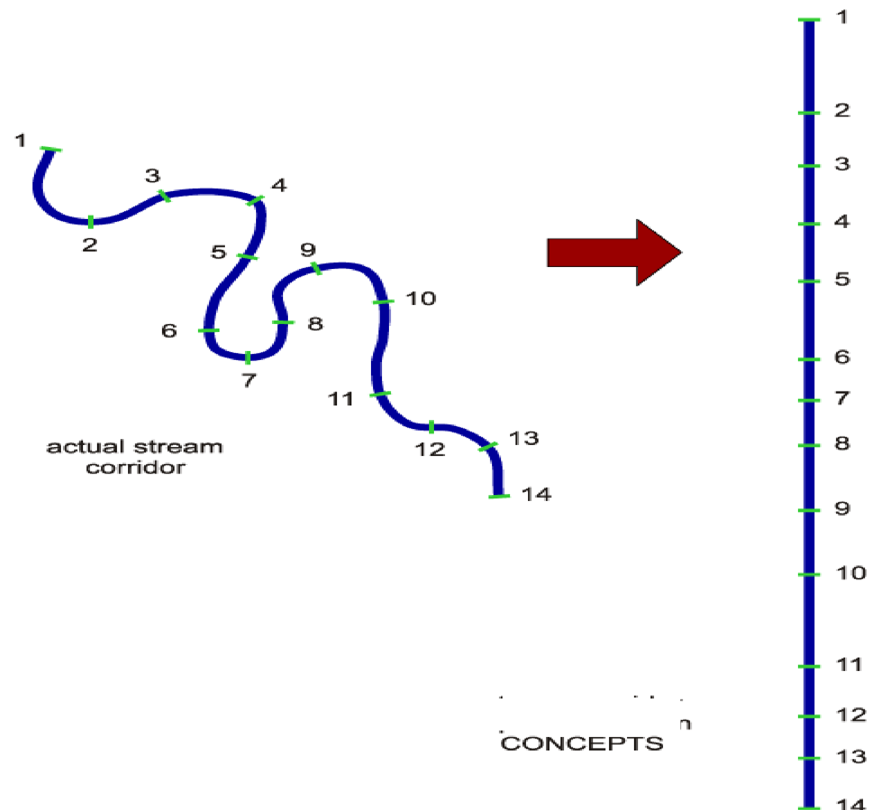
HYDRAULIC VARIABLES



DISCRETIZATION - BRANCHES



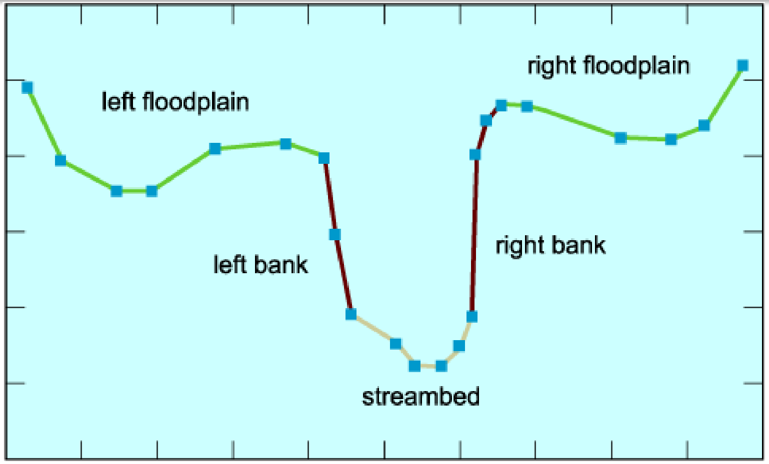
DISCRETIZATION - BRANCHES



DISCRETIZATION - CROSS SECTIONS

Required at representative locations throughout the branches of the river

Must accurately represent the flow changes, bed slope, shape, flow resistance characteristics



EQUATIONS VARIABLES

Independent variables

- space x
- time t

Dependent variables

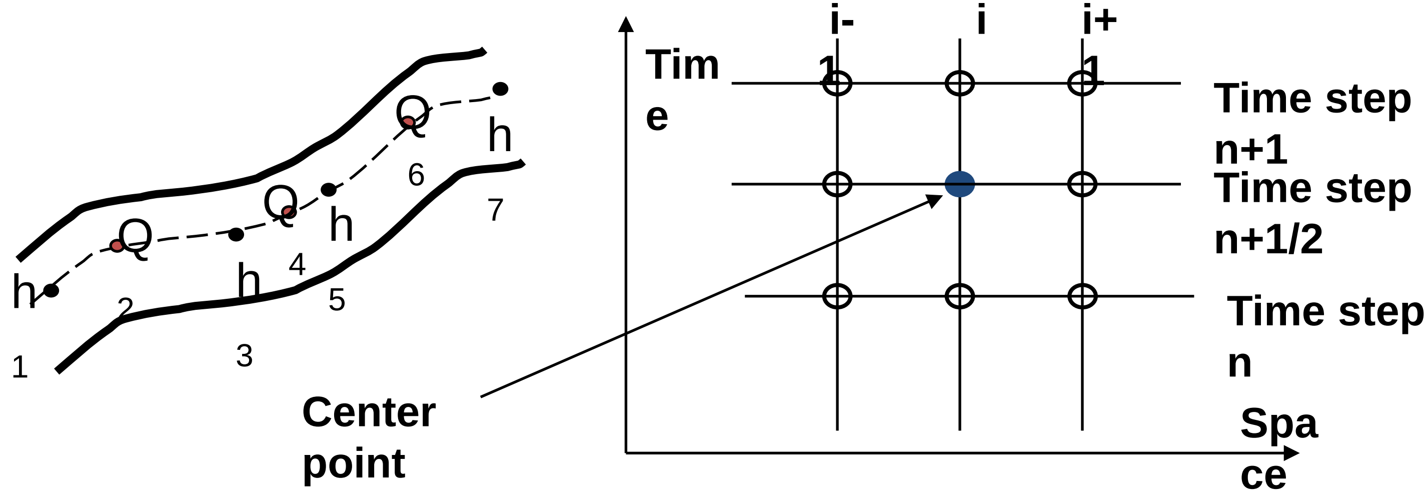
- discharge Q
- water level h

All other variables are function of the independent or dependent variables

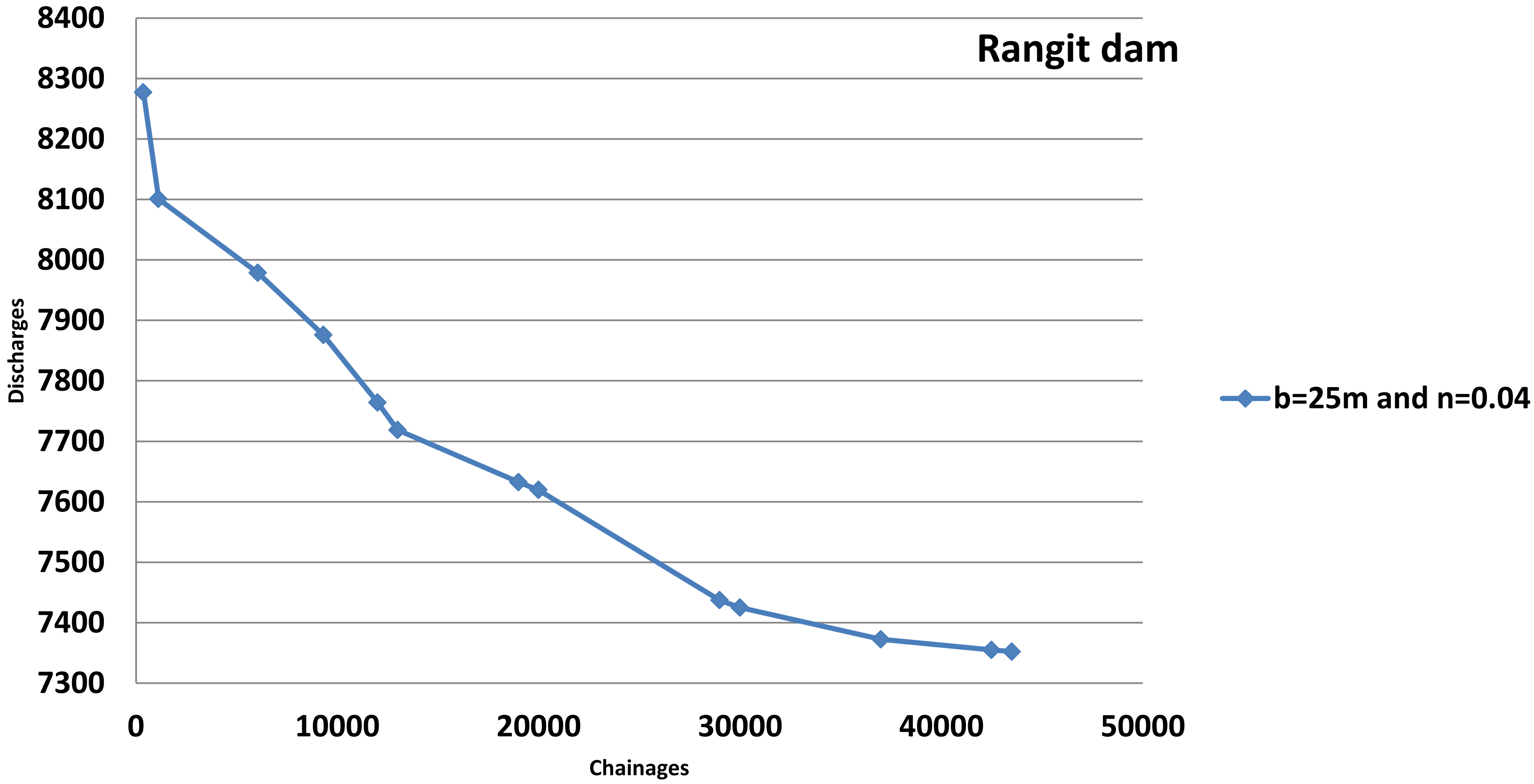
SOLUTION SCHEME

Equations are transformed to a set of implicit finite difference equations over a computational grid

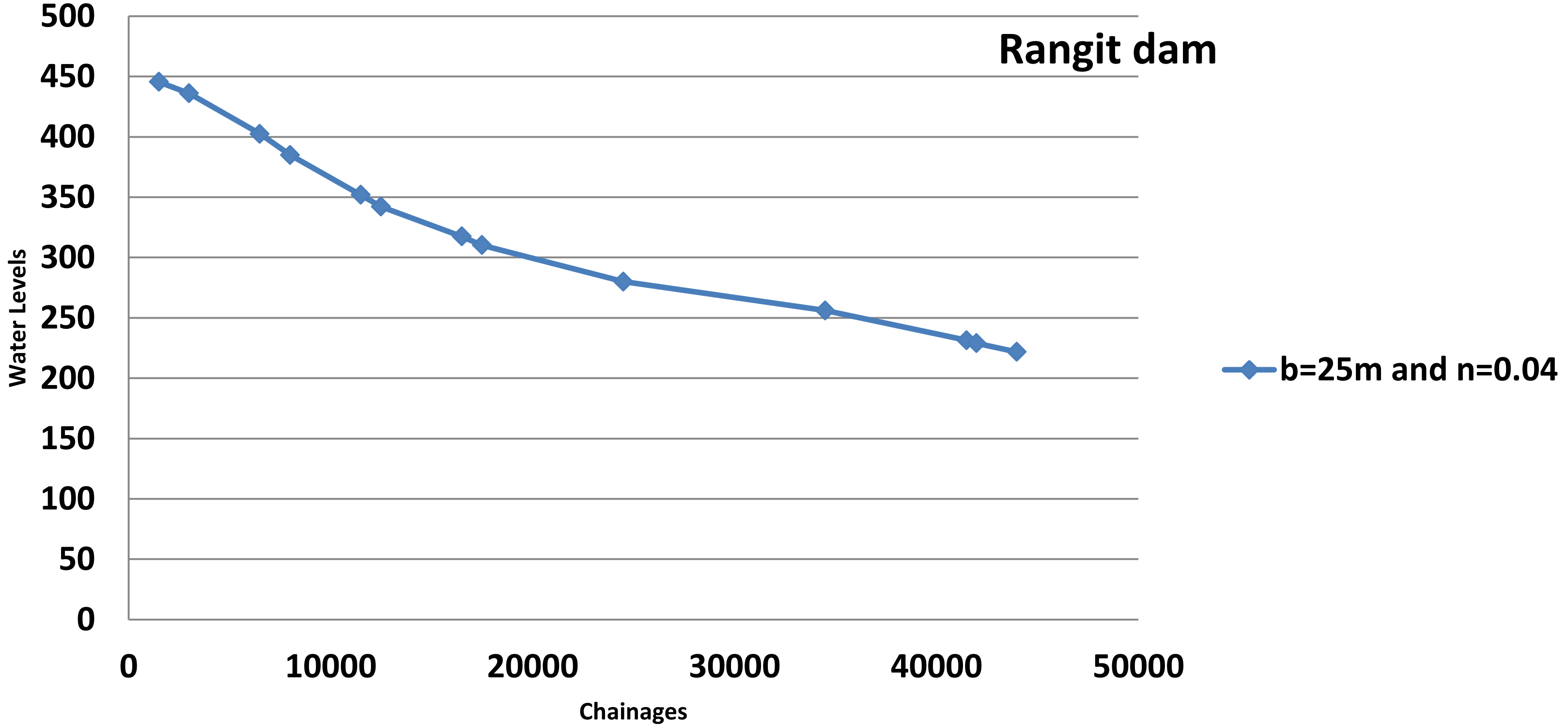
- **alternating Q - and H points, where Q and H are computed at each time step**
- **numerical scheme - 6 point Abbott-Ionescu scheme**



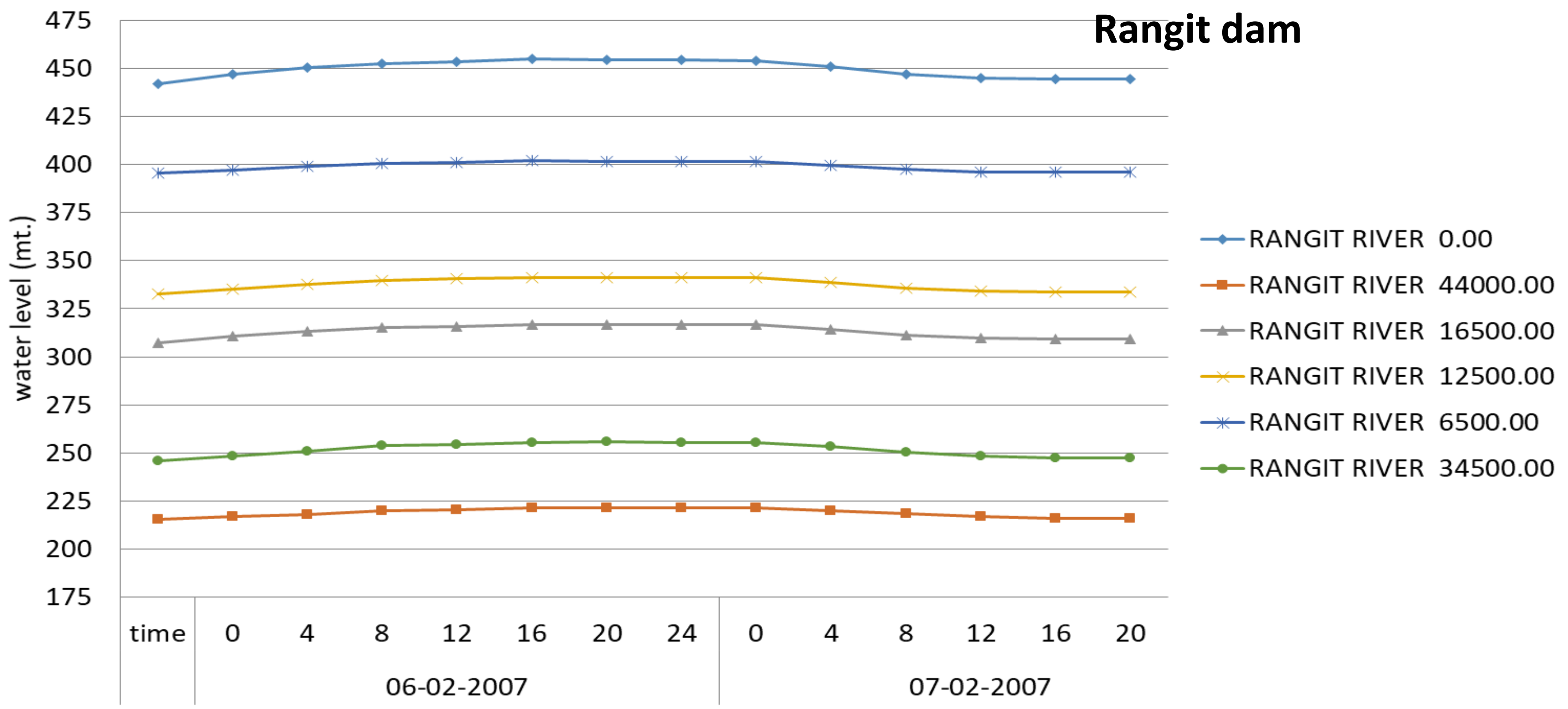
Peak dam break flood values in the river



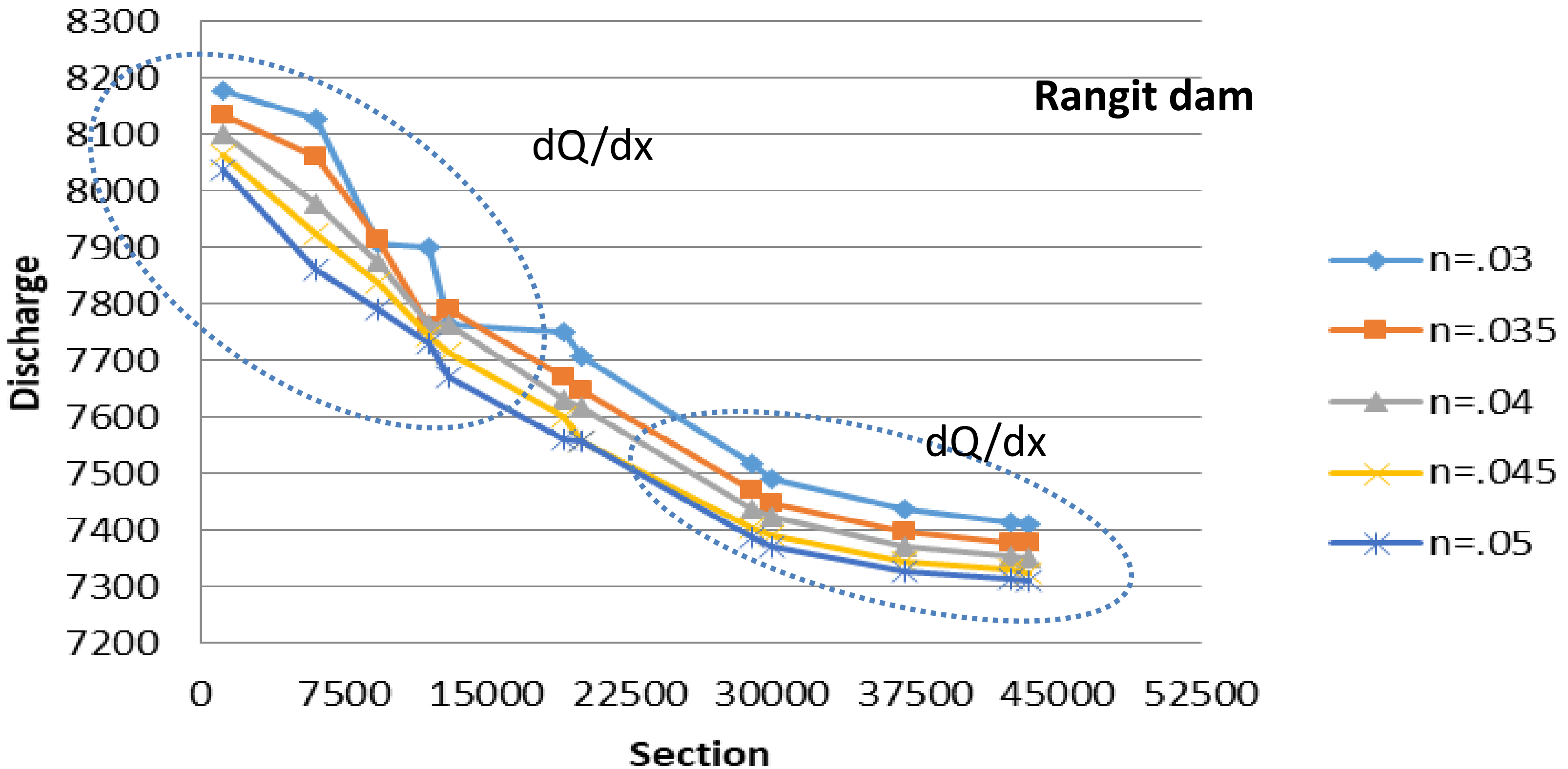
Highest water levels due to dam break flood in the river



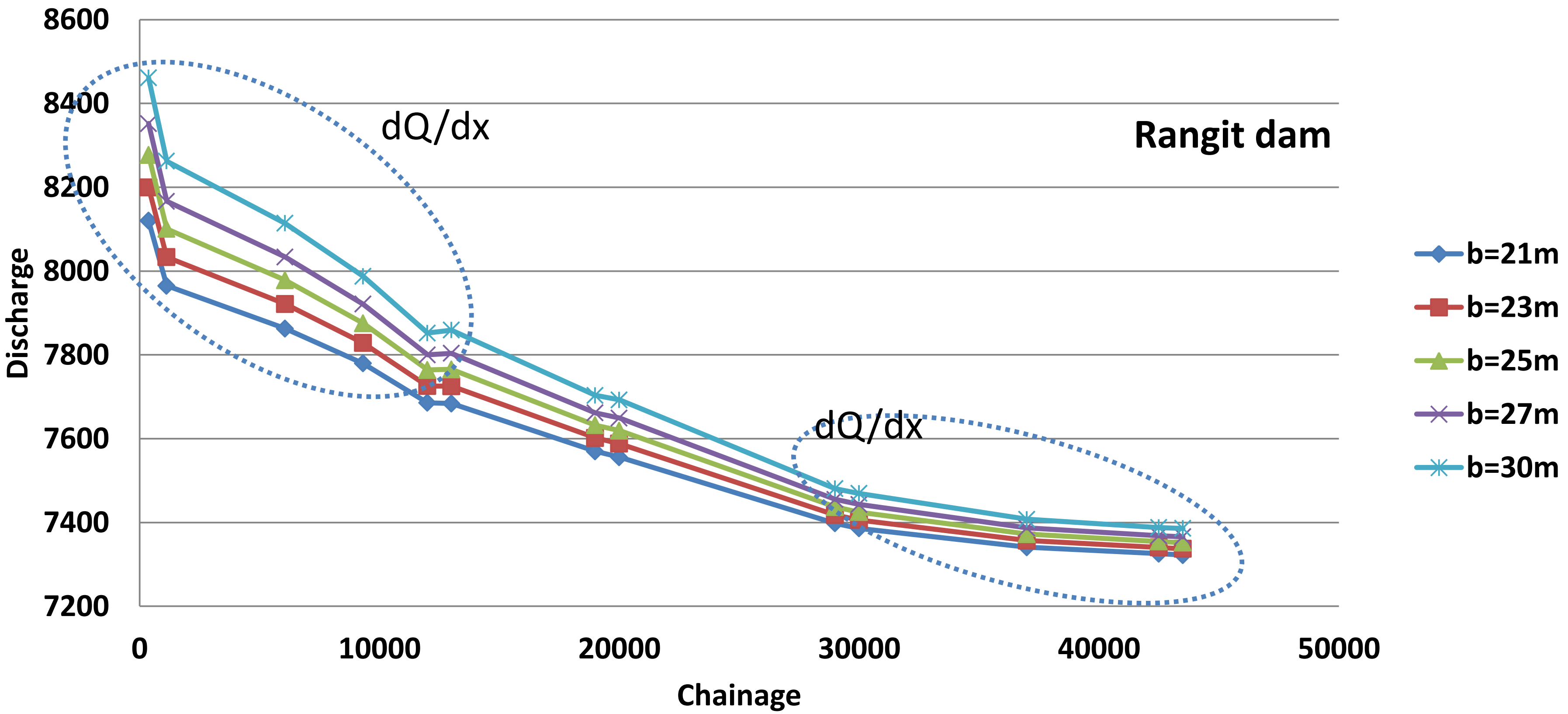
Highest water levels due to dam break flood at different sections



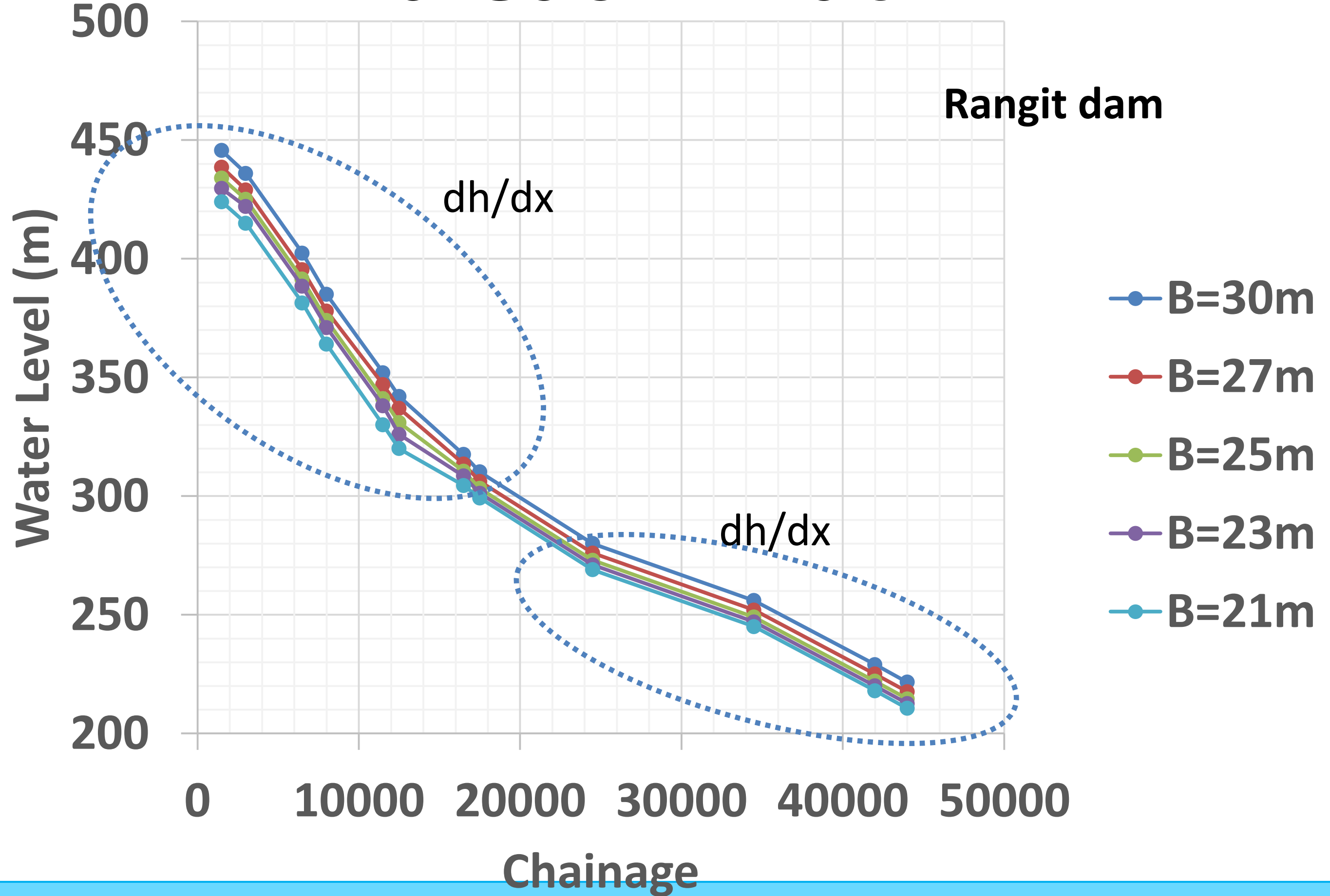
Variation of discharge for different "n" values



Variation of discharge for different breach width

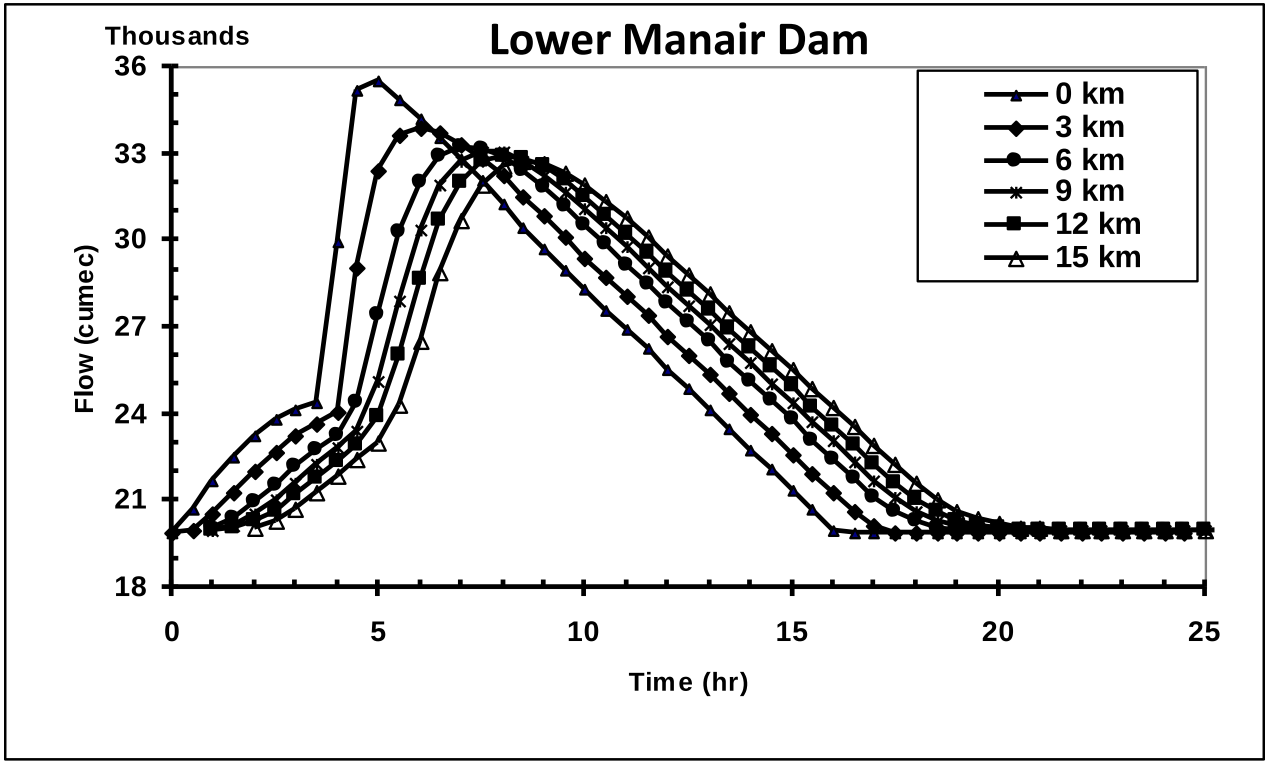


Variation of water level for different breach width

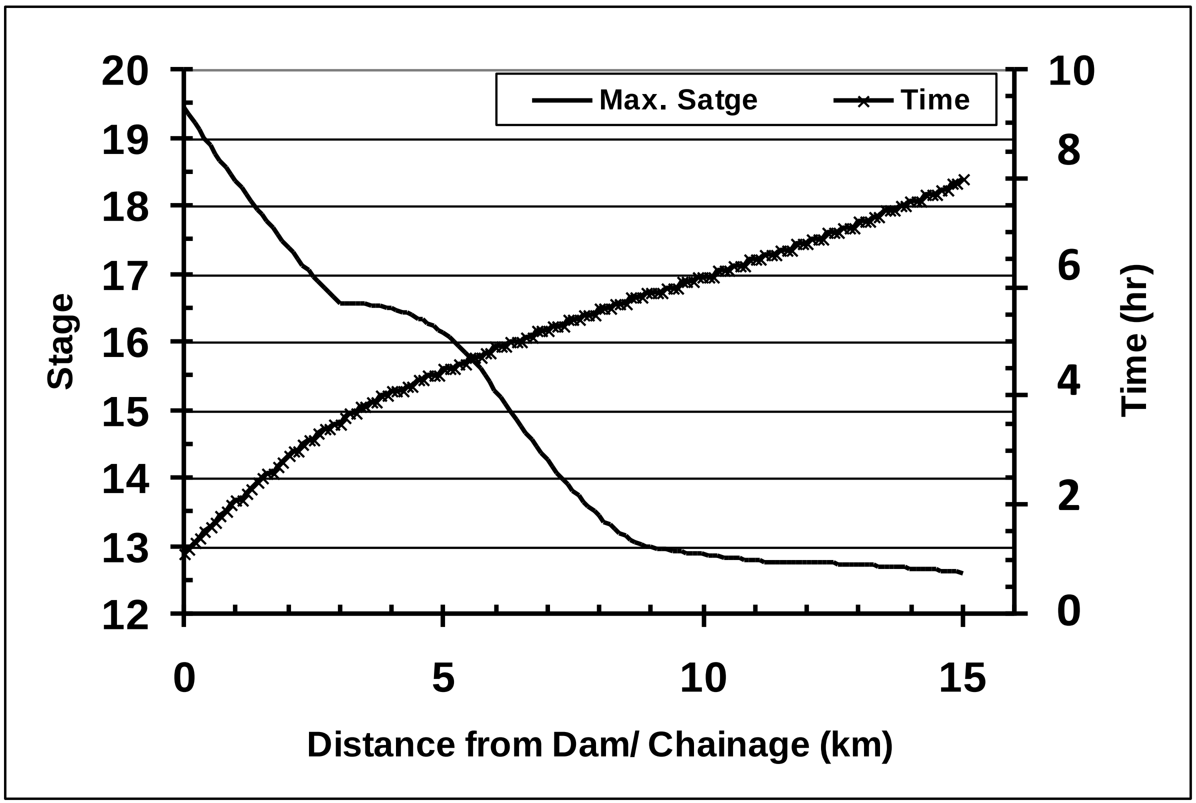


Lower Manair Dam (LMD)

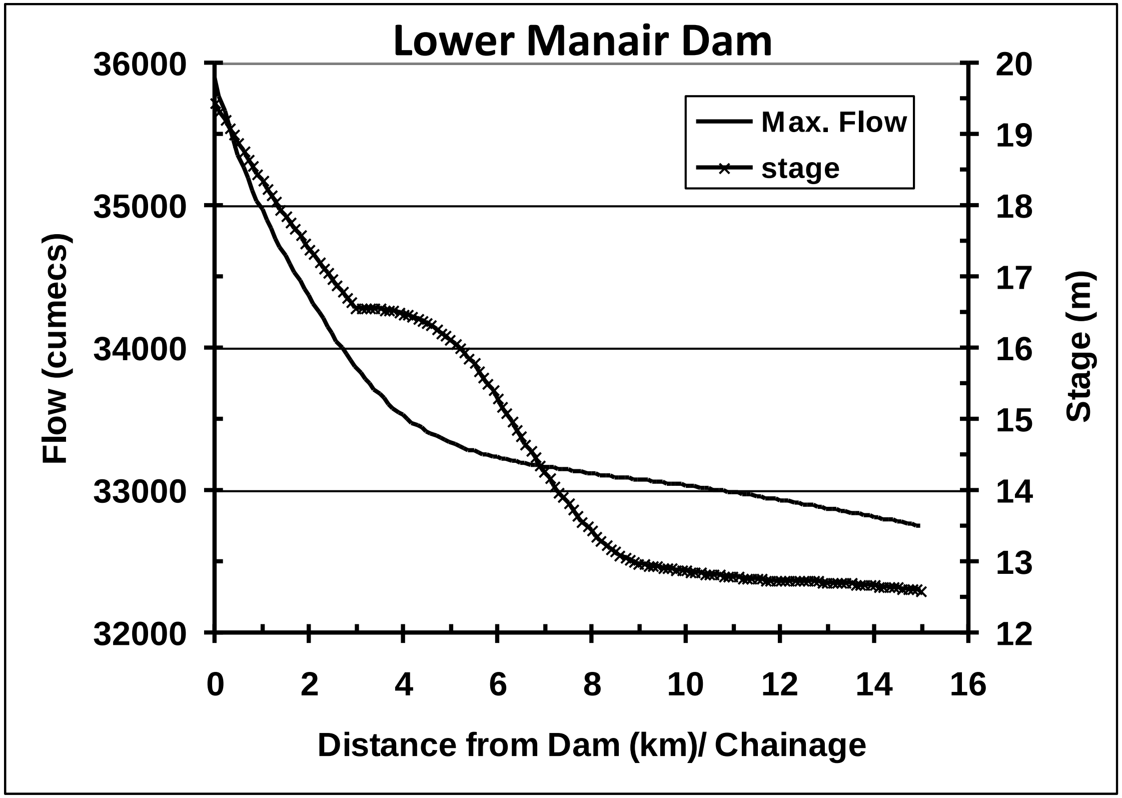
Dam break flood hydrograph attenuation as flood moves downstream



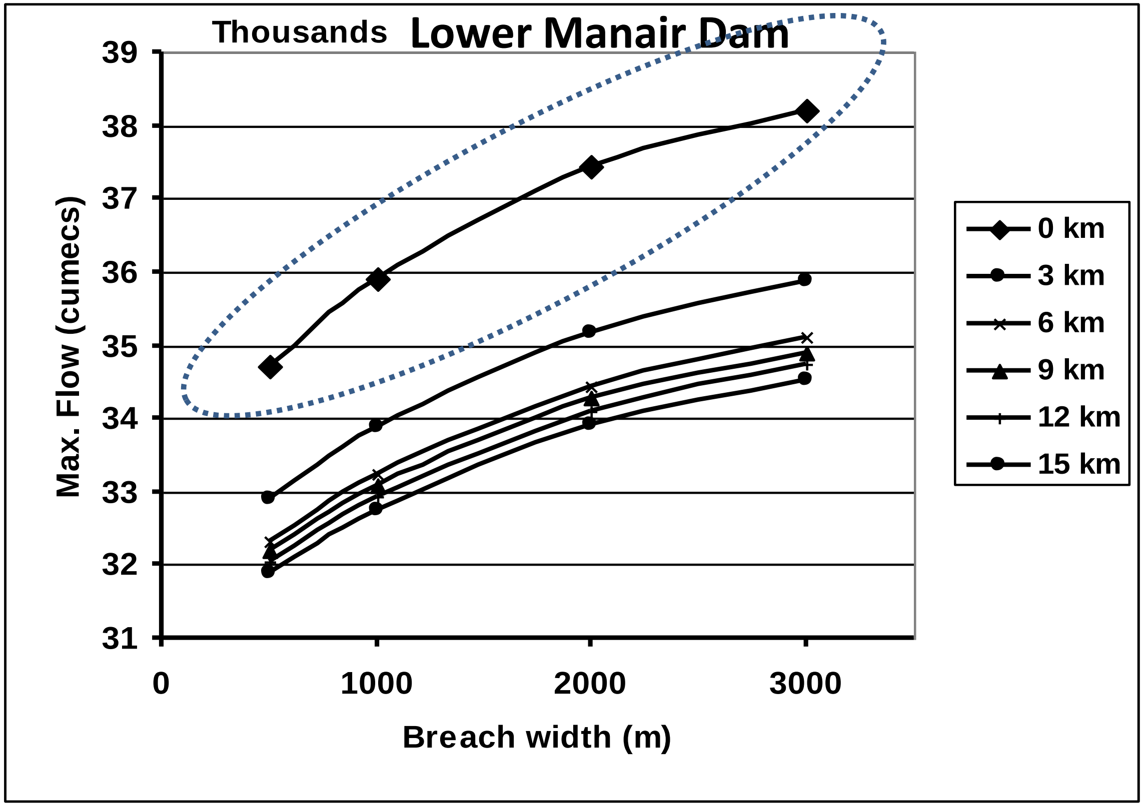
Maximum stage downstream of dam and its time of occurrence



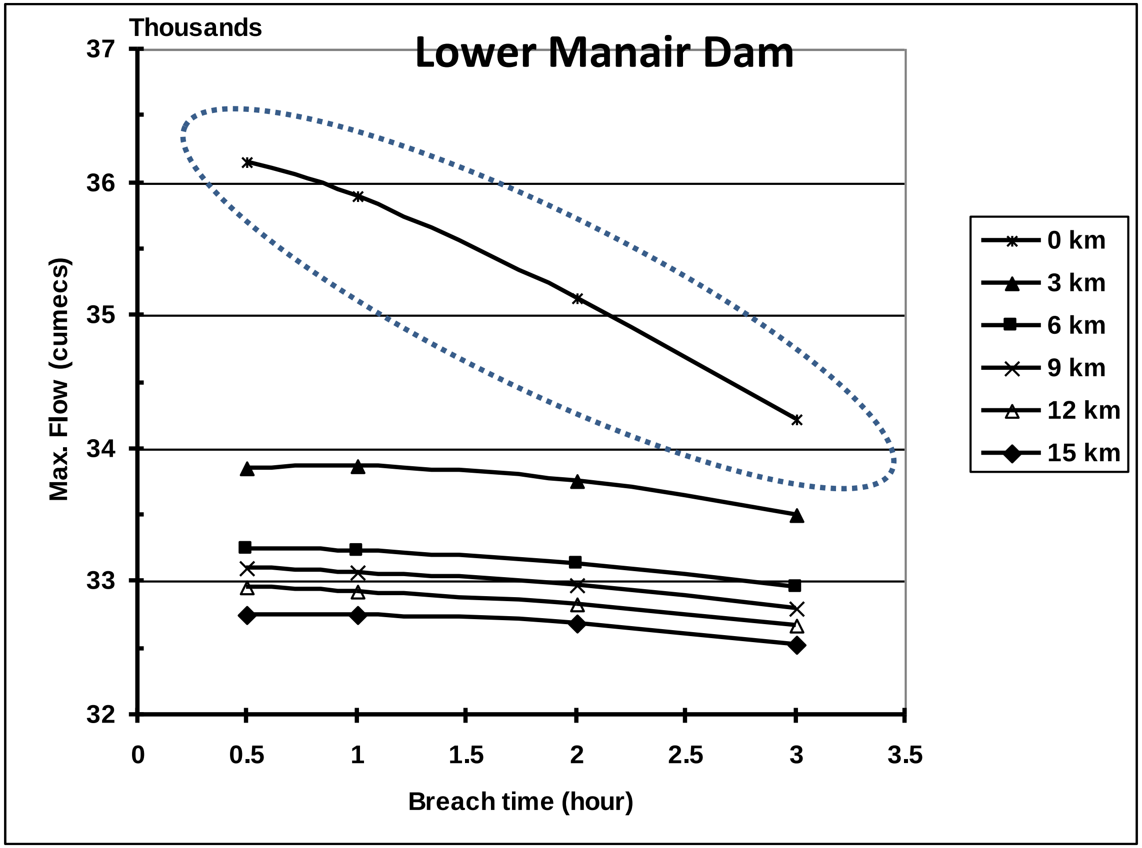
Maximum stage and maximum flow attained by dam break flood flow



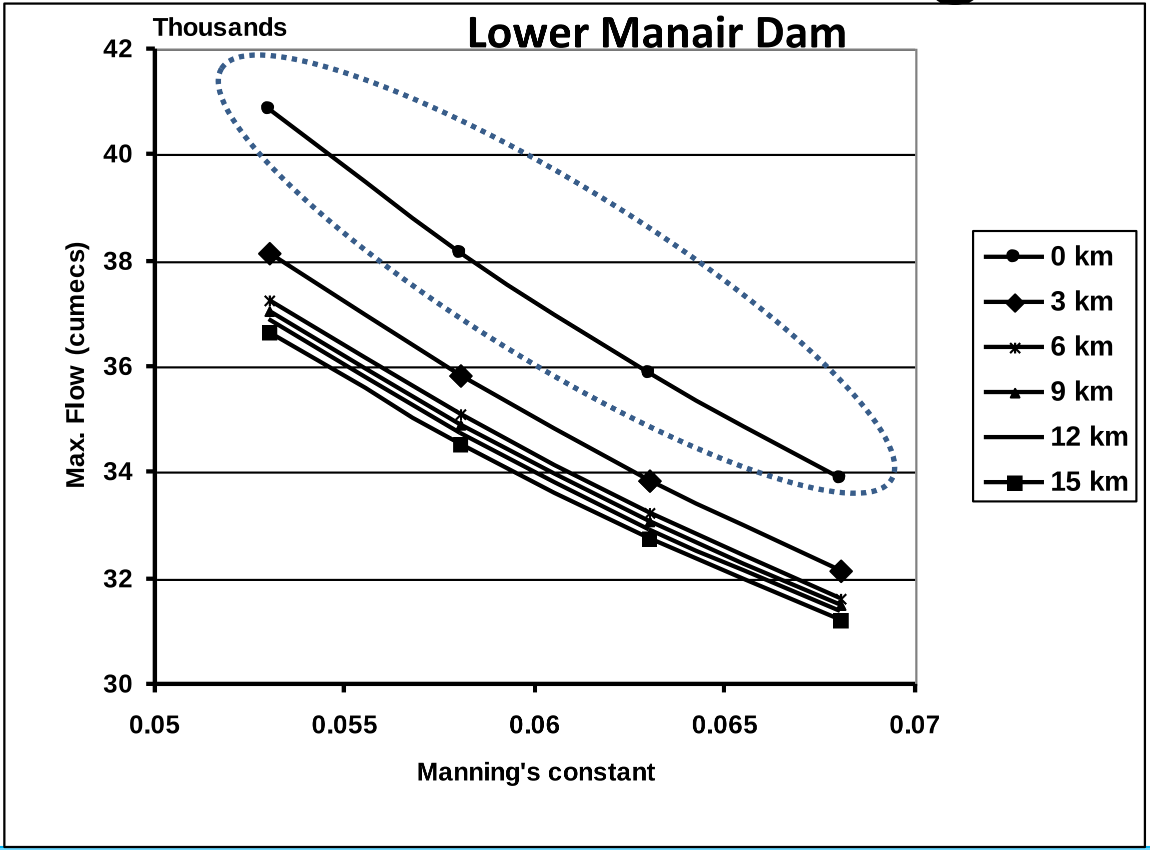
Effect of breach width on maximum flow



Effect of time of breach on maximum flow



Effect of Manning's coefficient on maximum discharge



CONCLUSIONS

- Increase in breach width results increase in maximum discharge at all sections. Rate of increase of maximum discharge is quite high in smaller value of breach width.
- Increase in breach time results in decrease of maximum flow at all sections. This effect is dominant in the river reach nearer to dams.
- Increase in Manning's coefficient results in decrease of maximum flow at all sections.

CONCLUSIONS

- Manning’s coefficient increases the maximum flow decreases at all sections.