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Victoriia Belchikhina

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Using of the flood reservoir capacity for the improvement of river ecology

BELCHIKHINA VICTORIA

Department of hydrology, hydro-geology and the water reservoir operation, Moscow State University of Environmental Engineering (MSUEE), 127550, Prianishnikova street, 19, Moscow, Russia

ABSTRACT

Today the flood capacities of the Moscow water reservoir system are determined depending on catastrophic spring floods.

The rain flood volumes and the consequent maximum discharges are much less of spring flood volumes and the consequent maximum discharges.

Main hypothesis of the research is possibility of safe use of flood capacity and drafts from water reservoir after the end of spring flood recession. Accordingly, the aim of the research is safe use of flood capacity part for the water storage during summer after spring floods. The aim has required of solving of next problems:

- to model the spring and rain flood hydrographs respecting of different probability;
- to develop the new logical conditions for flow control by water reservoir;
- to research different scenarios of river flow and reservoir operation respecting of the possible drafts from flood capacity;
- to check the developed new rules with help of simulation of water reservoir operation;

The modeling of the spring and rain flood hydrographs respecting of different probability was made on the base of long time observations according to Russian normative methods.

It have been established that there is possibility of the increasing water level upper Normal Water Reservoir Level after main wave of spring flood for the added drafts from flood capacity and for the increasing of water exchange in water reservoir and river system.

The added drafts from flood capacity and increased of water exchange in water reservoir and river system during June month allows decrease of blossom blue-green algae and improve the quality of water resources. A probability of alarm situation respecting of big water levels during spring and rain floods is not increased.

Methods and materials.

The calculated model hydrograph of the spring flood runoff (probability 0,01%) to the water reservoir and consequent hydrograph of draft discharges are represented on the Figure 1.

The draft discharges calculated by Potapov method of approximate integration [1,2] with condition of full storage of water reservoir (Normal level 182,5 m) before flood. The maximum draft discharge 620 m³/s and maximum flood level was obtained 183,8 m. That is the project level, which must not exceed during water reservoir operation. The main hypothesis of the research is possibility of safe small exceed of Normal level before rain flood, since volume and maximum discharge of rain flood are less spring flood. That hypothesis was checked earlier for the irrigation water reservoir [3].

The hydrographs of rain flood and of consequent draft discharges were calculated. They are represented on the Figure 2.

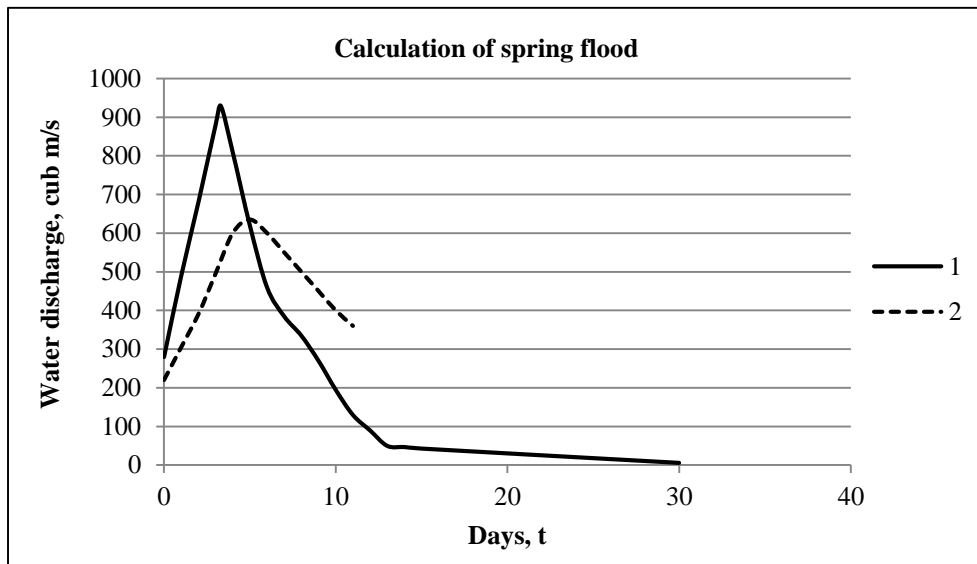


Figure 1. Calculation of spring flood hydrographs
 1 – runoff to the water reservoir; 2 – draft discharges.

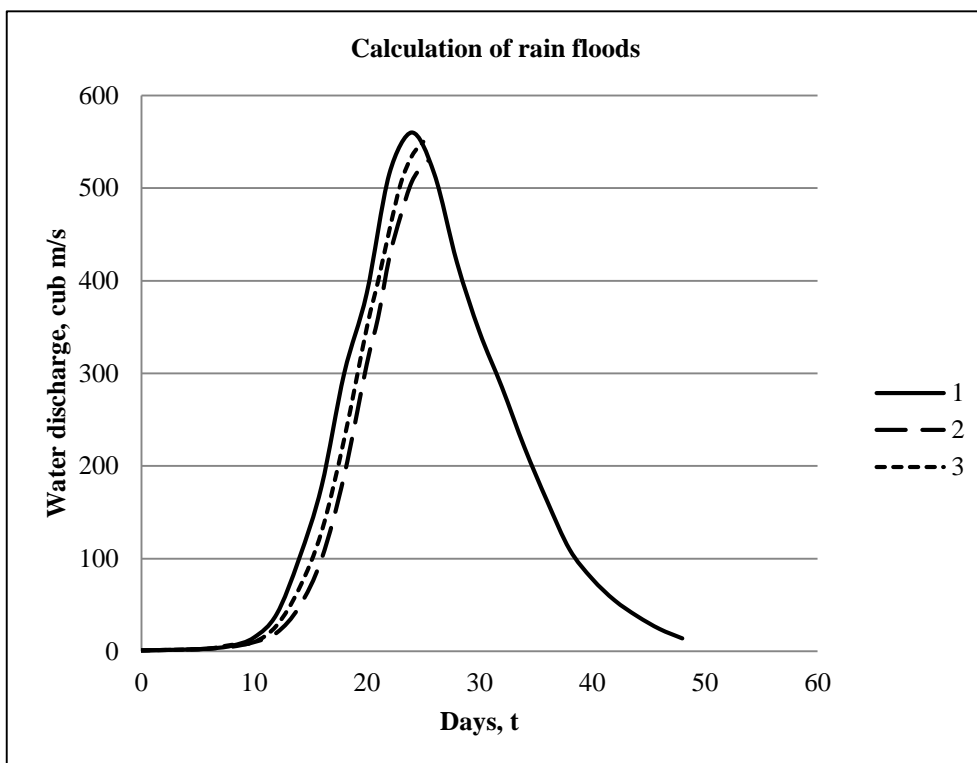


Figure 2. Calculation of rain flood hydrographs
 1 – runoff to the water reservoir; 2 – draft discharges according to Normal level before flood beginning; 3 - draft discharges according to water reservoir level 183,0 m before flood beginning and maximum draft discharge was increased until 550 m³/s instead 530 m³/s.

Calculations of draft discharges for rain flood according to Normal level before flood beginning showed that maximum the water reservoir level equal 183,1m, the maximum draft discharge was 530 m³/s.

So there is reserve of flood capacity of reservoir in comparison with elevation 183,8 m. Therefore we have took a decision to increase start level after end of spring flood peak and before rain flood (May-June month) until 183,0 m. Then a calculations of draft discharges was repeated according to start water reservoir level 183,0 m. In that case - maximum water reservoir level was equal 183,3 m according to new rules of water reservoir operation during floods. The elevations of normative and new levels are presented on the scheme of Figure 3.

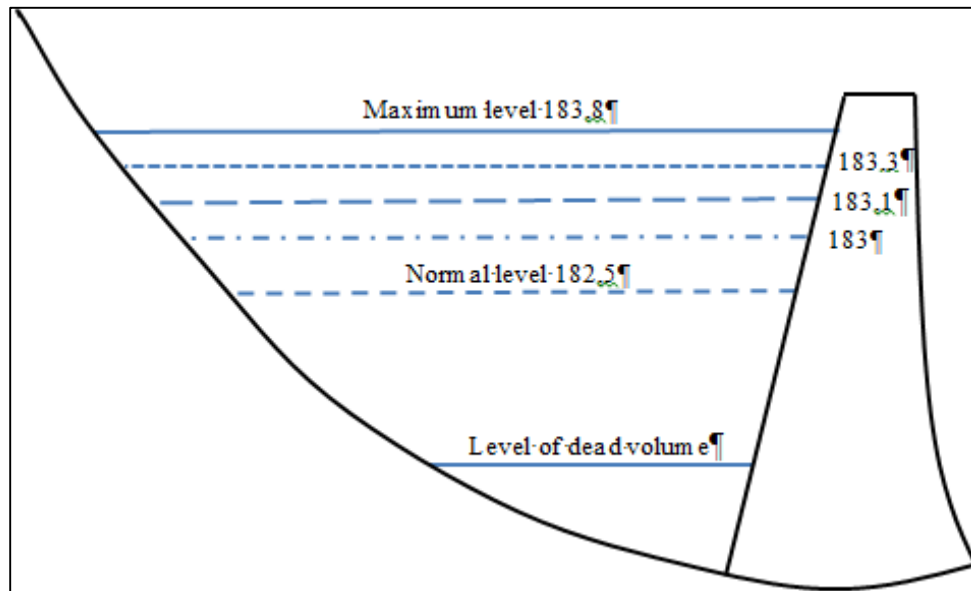


Figure 3. Scheme of the water reservoir levels

The maximum draft discharge was increased until 550 m³/s instead 530 m³/s, but it is much less spring maximum draft discharge (620 m³/s). So, the added part of flood capacity for the storage may be used for the increasing of water exchange in water reservoir and total river system during intensive algae blooms in the water reservoir (the second half of June month and first half of August month). So, there is necessary to change the rules of water reservoir operation during year. Their logical conditions were developed for every month taking into account the new normative levels.

VERIFICATION

The developed new rules of water reservoir operation were checked in different scenarios of river flow and reservoir operation on the base of the observed data rank during 90 years. Every year contained 36-decade (ten days) intervals. Calculation of water reservoir volumes, deficits of the plan consumption and of the drafts were made according to the traditional and new rules of the water reservoir operation, which were compared among themselves.

RESULTS

- Draft maximum discharge during spring and summer were not higher than in the traditional rules of water reservoir operation;
- The water exchange in the reservoir was increased during June and some years in August month;
- Warranty of plan consumption increase on 3 percent;
- The maximum annual deficit was reduced from 49 mln m³ to 37 mln m³;

– Water deficit in the period to September was not observed while probability of their appearance was equal 10% and maximum deficit during period from May to August was 16 mln m³ according to the traditional rules of water reservoir operation.

CONCLUSIONS

The new rules of water reservoir operation have allowed increase the water exchange in the reservoir. That decreases the bloom of blue-green algae.

General parameters of water reservoir operation were improved.

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