Flood disaster and Adaptation measures in Brisbane Australia

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Abstract This study selects the region of Brisbane, River to analyse the adaptation measures against 2011 flood through a Coastal Reservoir (CR) technique. Numerical model based on MIKE-21 is used to investigate the feasibility of proposed CR after being calibrated and validated. The results show that the gate operation of the CR shows that the flood level can be reduced up to 13% and under joint operation of CR and Wivenhoe dam its can be reduced to 28% at the Brisbane city, which can safeguard infrastructure damage. This study is of interest and could provide useful information of flood management for the regional community.

Keywords: Flood mitigation, Coastal Reservoir, MIKE-21, Estuary, Gate operation

Methods

Coastal Reservoir technique is used for flood adaptation in Brisbane River Estuary (BRE) (Khalil et al., 2020) and may be used to store water for Brisbane City water supply. Coastal Reservoir size is selected based on available bathymetry and has a storage capacity of 900GL (surface area 75 km^2 and the water depth approximately 12 m). The reservoir dike with hydraulic gates to regulate the river flows into CR are shown in Figure 1.

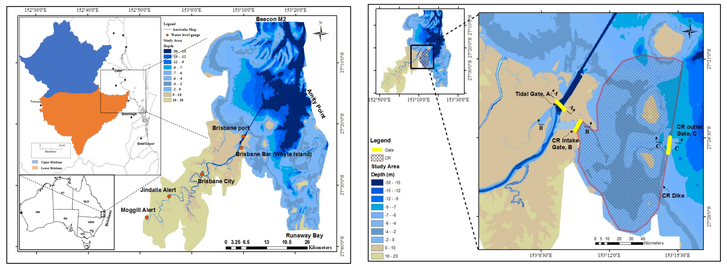

Figure 1. Brisbane River and Moreton Bay with marked boundary conditions data and Costal Reservoir gates in Moreton Bay

The MIKE 21 FM, the hydrodynamic model is set up with topographic data, Manning's roughness coefficients, water level and tidal data for the year 2011 and successfully calibrated and validated as shown in Figure 2.

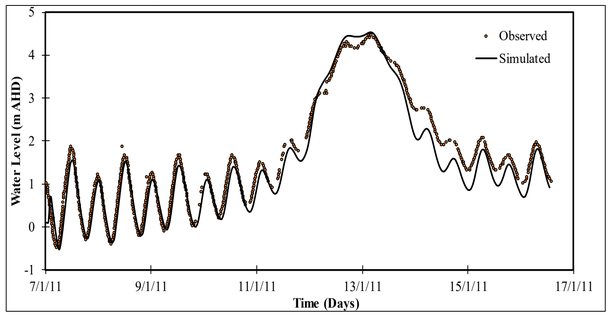

Figure 2. Simulated and observed water levels at Brisbane City

Gate location and size is optimized according to the width of the river mouth. Gate A and B operation is optimized to allow water inside the CR and to stop the tidal water entering the estuary as shown in Figure 3.

During high flood, water could be diverted into the CR, which will cause decrease in upstream flood level as there will be no resistance from tidal water and all flow will move to CR.

While during low flow season, water will be discharged towards the Brisbane bar by closing the CR gate without storage.

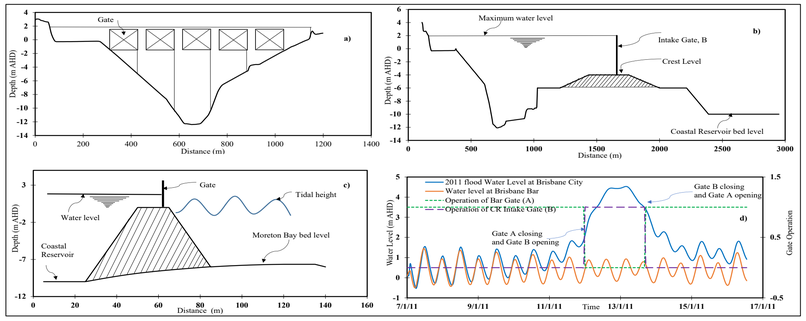

Figure 3. Gate *sections and* operation for the 2011 flood mitigation

Results

The water level remains unaffected before the gate operation. As the gate start operating at 12 January 2011 12:05 am, the water level starts decreasing in the Brisbane River and it reduces the peak water level at Brisbane city gauge from 4.46 m AHD to 3.95 m AHD, with overall 0.51 m reduction in peak water level as shown in Figure 4. This reduction in water level will save the infrastructure damage. Further, with improved flood management of the Wivenhoe Dam, the releases will be controlled and the water level at Brisbane city would be reduced below the major flood level

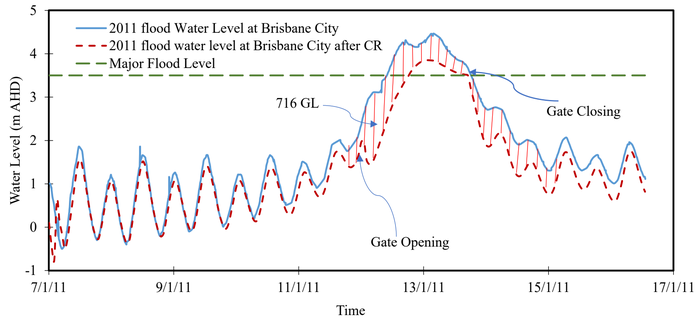

Figure 4. The water level during the 2011 flood in BRE with and without CR.

Conclusions

To enhance flood disaster mitigation in BRE, we analyzed the feasibility of a proposed CR at the river mouth. The major flood of 2011, was simulated and CR operation was analyzed using MIKE 21. The operation of the CR intake gate shows that the 2011 observed flood level (4.46 m AHD) can be reduced to 3.88 m AHD (13% reduction).

While under the improved management of Wivenhoe dam, flood level will be (4 m AHD), by suitable operation of CR gate, flood level can be reduced to 2.87 m AHD (28.3% reduction) at the Brisbane city, The CR has great prospects to adapt to the flood of the Brisbane catchment and thus to mitigate BRE the flood disaster.

Bibliography

Khalil, U. et al., 2020. Investigating an Innovative Sea-Based Strategy to Mitigate Coastal City Flood Disasters and Its Feasibility Study for Brisbane, Australia. Water, 12(10). DOI:10.3390/w12102744