

Estimation of Combined Sewer Overflow Volume from Outfall Chambers in Tokyo 23 wards

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Introduction

Since the Sewerage Law Enforcement Order was amended in 2003, the measures are being carried out to complete a certain improvements for combined sewer systems in the 21 cities with large treatment district areas by 2023 and in 170 other cities by 2013. In this improvements, it is required the effective improvements about reduction in frequency of combined sewer overflow (CSO), but overflows situation from outfall chambers is not fully-comprehended. In order to reduce the amount of CSO effectively, it is expected to carry out the countermeasures considering the CSO from outfall chambers as well as pumping stations. In this study, runoff analysis with model simulation was applied for Tokyo 23 wards to estimate the occurrence of CSO from outfall chambers and pumping stations. Additionally, the volume of CSO from both facilities were calculated quantitatively.

Materials and methods

The study areas are 8 drainage areas in Tokyo (Kojima and Furumai, 2011). Distributed model, InfoWorks CS (Version 10.0), was applied for runoff analysis. The sewer pipes and networks data, classified surface data, rainfall data and condition of rain runoff were referred to previous study (Kojima and Furumai, 2011) which studied the model parameters. The occurrence of CSO from outfall chambers and pumping stations were estimated on the basis of the sewer pipes and networks data, that is SEMIS data, served by Tokyo Metropolitan Government in 2007. Although the 828 outfall chambers were recorded in this data, the truth number is 733 outfall chambers because of existence of unused and closed outfall chambers. The stormwater reservoirs were not considered in this study, while the water storage pipes were considered.

Results and discussion

The volume of CSO from outfall chambers and pumping stations in rainfall event on 10-11 November, 2007 were estimated using distributed model simulation. In the runoff analysis, rainfall distribution condition was considered using rainfall data by 56 precipitation stations. The amount of precipitation and maximum rainfall intensity per 5 minutes were 17-55 mm and 1-9 mm/5 min, respectively. In the result, it was estimated that about 1.68 million m³ CSO was discharged from 480 outfall chambers. Since this value constitutes about 57% of whole CSO (2.97 million m³) including discharge from pumping station, this result suggested that it is impossible to ignore the amount of CSO from outfall chambers. By comparing the CSO volume at each drainage area, it is estimated that Kanda river drainage area discharged about 0.53 million m³ CSO from 202 outfall chambers among 333 outfall chambers, which accounts

for 31% of whole CSO from outfall chambers. Then it is estimated that Shakujii river drainage area discharged about 0.37 million m³ CSO from 106 outfall chambers among 154 outfall chambers, which accounts for 22% of whole CSO from outfall chambers.

To comparing the situation of CSO from outfall chambers by drainage area, runoff analyses were simulated using spatially-uniform rainfall data (Chuo precipitation station). The rainfall event were on 30-31 May, 2007 (amount of precipitation: 22 mm, maximum rainfall intensity per 5 minutes: 2 mm/ 5 min), 4-7 September, 2007 (140 mm, 5 mm/5 min) and 10-11 November, 2007 (30 mm, 3 mm/5 min). Figure 1 shows the estimated volume of CSO from outfall chambers per unit area at each drainage area. The Shakujii river drainage area indicated most highest CSO amount from outfall chamber per unit. On the other hand, Rivers in Kotoh ward including left bank of Sumida river drainage area indicated most lowest value. By ratio of these CSO amount from outfall chamber per unit to amount of precipitation, it implies the ease of overflow to receiving water by drainage area. In Shakujii river drainage area, the ease of overflow to receiving water were estimated the highest values, 20-28%.

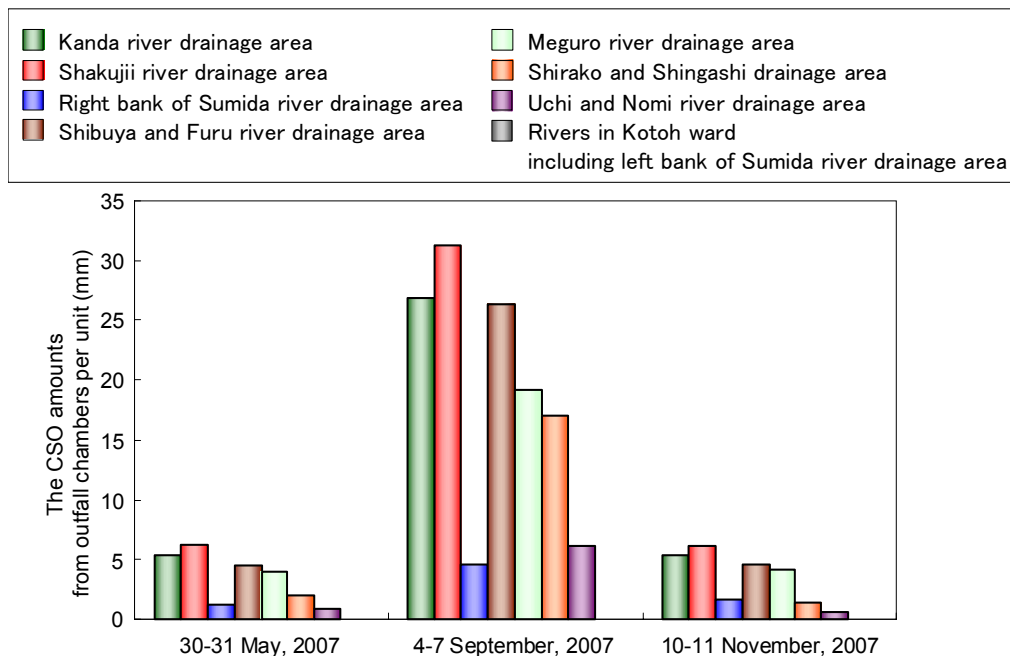


Figure 1 Comparison of the CSO amounts from outfall chambers per unit by drainage are. But the name of drainage area don't indicate the receiving river.

Conclusions

The results of simulation about the CSO from outfall chambers in rainfall event on 10-11 November, 2007, it suggested that it is impossible to ignore the amount of CSO from outfall chambers. To compare the CSO amount from outfall chambers per unit by drainage area, runoff analyses were simulated using spatially-uniform rainfall data. These results suggested that it is effective to carry out measure for outfall chambers in Shakujii river drainage area.

References

Kojima K. and Furumai H. (2010), Elaboration of efficient rainfall model parameters for rainfall event envisioned combined sewer overflow, 48th Annual Conference JSWA, pp.350-352 (in Japanese)