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HYDRAURIC ANALYSIS ON WATER STAGE CHANGE ALONG THE SUBMERGED WEIR AND TIDES EFFECT IN HAN RIVER

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Sinkok submerged weir in Han river, Seoul Korea was built in early 1980's for the purpose of water level maintenance and protection from sea water intrusion from the estuary. Its length is almost 1 km and 2.4 meter height which has two composite structures of rigid and movable weir. Huge wetland developed as the results of weir construction just down to the weir. However, recently social conflicts for the weir removal occurred for the river rehabilitation and aqua-eco system recover.

This study focused on hydraulic analysis, especially water level changes in terms of with and without submerged weir along the tides where the height has 9 meters difference between ebb and high tide. HEC-RAS for the 1-D simulation and SMS for 2-D analysis were used covering 25 km river length and tributaries. Tides time series records and discharge records from upstream dam of 1-year were and 2 submerged weirs as well as 25 bridges were considered in boundaries. Hydraulic data in the 4 gauging stations were collected for the model calibration.

Water level changes were reviewed along 4 cases – with/without weir and flood/dry season - The results showed that more than 3 meter difference of water surface fluctuation along up and downstream including wetland as tide changes in a day. The wetland dimension and water quality were also affected along the water level. The contraction of wetland area might cause the changes of aqua habitat to plants and animals. These results make it difficult to make a decision of removal of the submerged weir. A comprehensive analysis of not only hydraulic but also water quality and environmental effect should be considered.

INTRODUCTION

Sinkok submerged weir in Han river, Seoul Korea was built in early 1980's for the purpose of water level maintenance and protection from sea water intrusion from the estuary. Its length is almost 1 km and 2.4 meter height which has two composite structures of rigid and movable weir. Huge wetland developed as the results of weir construction just down to the weir.

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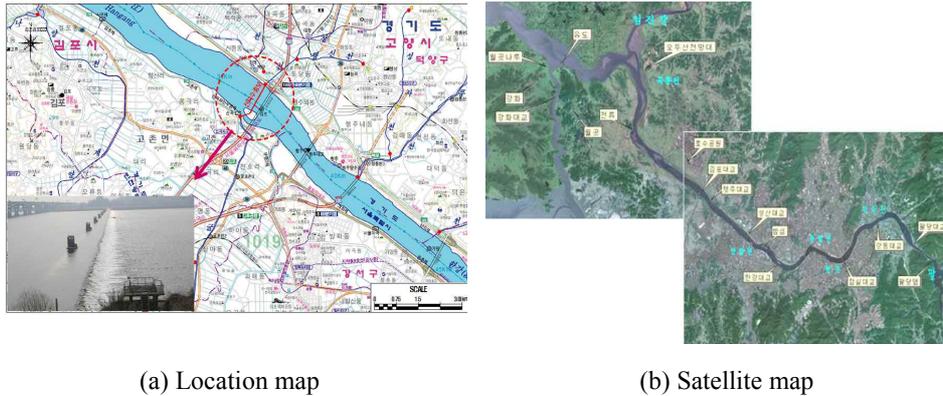


Figure 1. Location and Satellite map by Singok Submerged weir

This study focused on hydraulic analysis, especially water level changes with and without submerged weir along the tides where the height has 9 meters difference between ebb and high tide. HEC-RAS for the 1-D simulation and SMS for 2-D analysis were used covering 25 km river length and tributaries. Tidal time series records and discharge records from upstream dam of 1-year were adopted for simulation initial condition. 2 submerged weirs as well as 25 bridges were considered in boundaries and hydraulic data in the 4 gauging stations were collected for the model calibration.

Numerical analysis conditions and range

In this study, unsteady analysis was carried out from the estuary “Yudo” to upper boundary dam “Paldang” which has 492 cross sections, 28 bridges and 2 submerged weir. Tributary Imjin river was also considered as an inflow condition of main stream Han river which has 47 sections for the simulation.

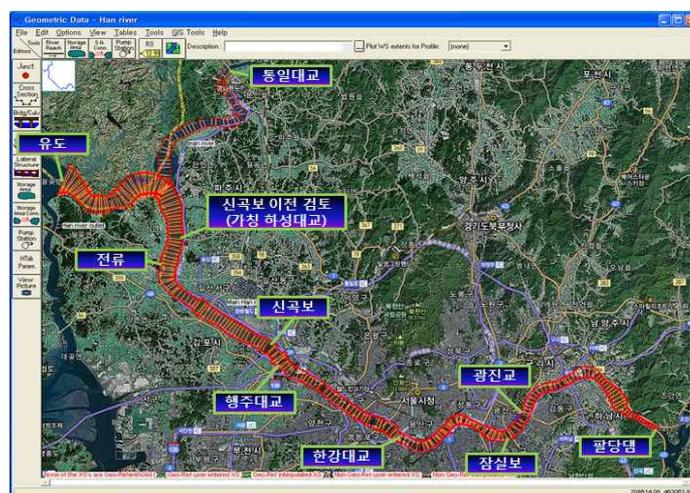


Figure 2. Range of study

Observation data in the 4 water level gauging station were made use of model calibration. The data of tides and dam release discharge applied to the simulation from March 15th to April 30th, 2011 as a dry season condition and from June 15th to July 31st as flood season condition

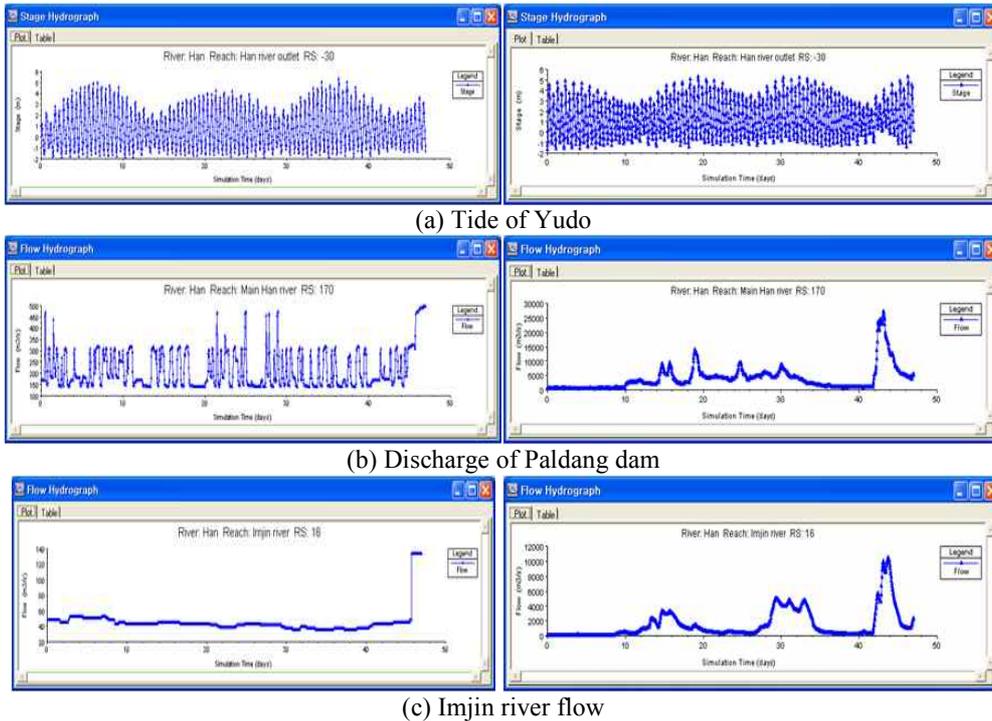


Figure 3. Numerical conditions of dry/flood season

Result of water level change

In dry season, wetland “Janghang” is now affected by tides, fluctuating from 0.5m to 4.3m (Fig.4). Water level changes in the area of wetlands causes typical characteristics of the brackish water zone together with the tidal influence, showing ecosystem variety.

On the other hand, in flood season, water level of wetlands rises 1.5m~2m more than that in dry season, inundated that much.

In case of submerged weir removal, water level changes reduce 1m to 1.5 m due to the water level around wetland rises due to weir removal in dry season. This might weaken the brackish function and also intrude salinity to the upstream. Plants and animals in wetland and river corridor seem to change in habitat. Depending on disappearance submerged weir, dramatic changes can occur in eco system in the Han river. However in flood season, since water level changes only 0.12m between with and without submerged weir, there might not influence to the wetland habitat environment.

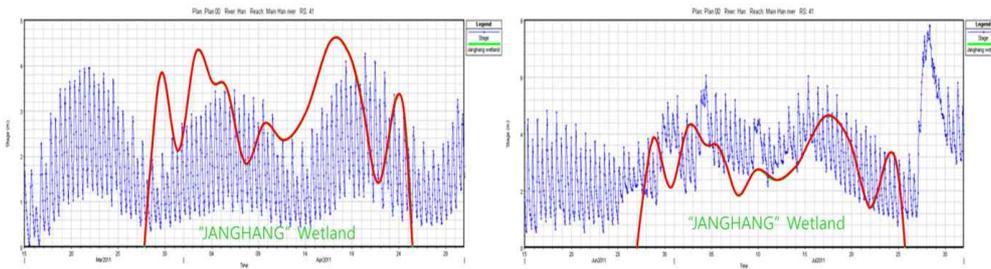


Figure 4. Water stage of Current Status in dry / flood season

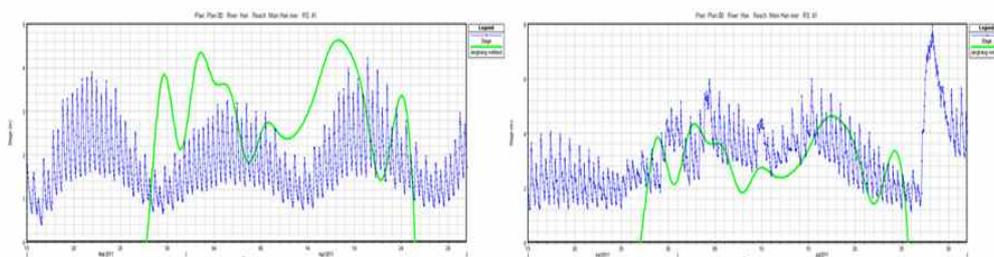


Figure 5. Water stage change in case of weir removal in dry / flood season

Influences to wetland in case of weir removal

If the weir is removed, the area of wetland “Janghang” will reduce to 38% of the wetland area to 1.24 km² due to water level rise in dry season and out of inundated area 0.11 km² is the vegetation area. Based on the average water level of EL.3.57m in flood season, 1.24 km² of the area in wetlands is expected about 1.6% inundated more.

Table 1. Dry/Flood season water level changes

Classification	Dry season		Flood season	
	Current status	Without weir	Current status	Without weir
Low water level	0.45	0.76	0.78	1.15
Quartile 1	1.03	1.36	2.78	2.83
Average water level	1.73	1.83	3.53	3.57
Median	1.59	1.69	3.43	3.45
Quartile 3	2.33	2.21	4.43	4.18
High water level	4.27	4.22	7.82	7.94
Standard deviation	0.84	0.65	1.30	1.22

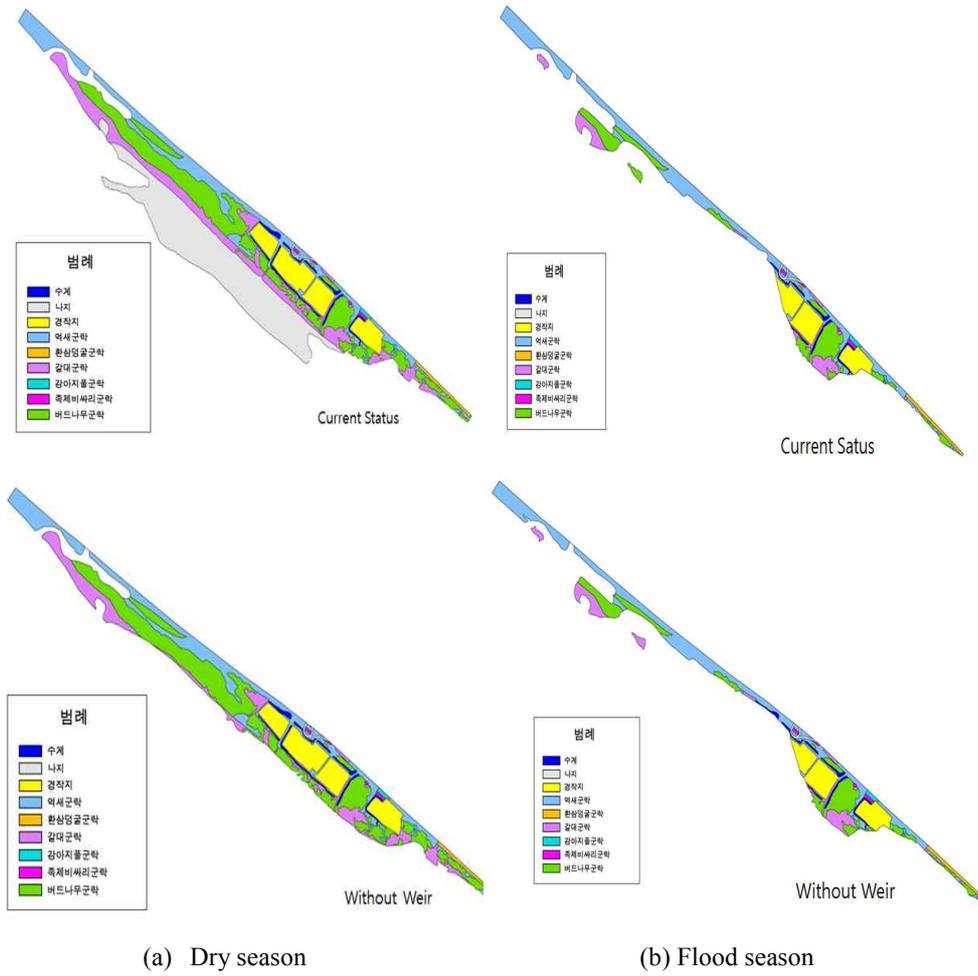


Figure 6. Simulated changes in wetland dry/flood season

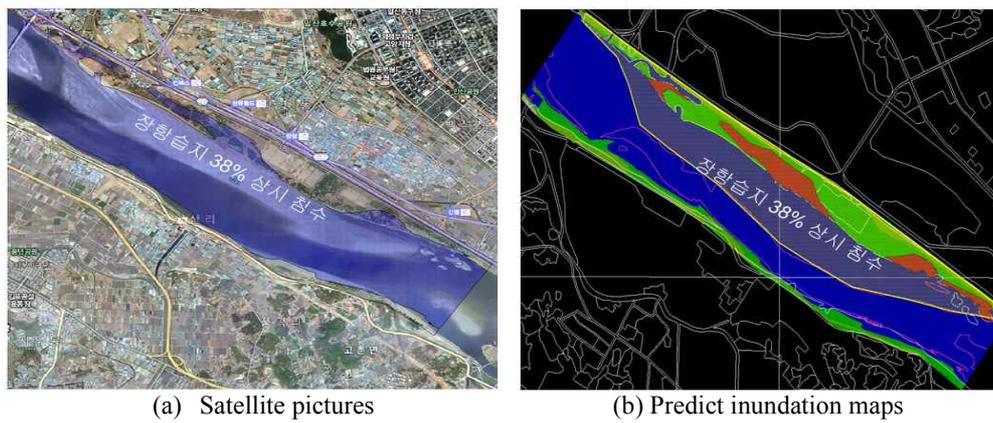


Figure 7. Predict inundation map by water level

Conclusion

As results of simulation in case of removal of weir “Sinkok” in Han river, there are dramatic changes in hydraulic condition as well as environmental condition. Also some results can be concluded as below.

1. In case of submerged weir removal, water level changes reduce 1m to 1.5 m due to the water level around wetland rises due to weir removal in dry season. This might weaken the brackish function and also intrude salinity to the upstream.
2. Depending on disappearance submerged weir, dramatic changes can occur in eco system in the Han river. However in flood season, since water level changes only 0.12m between with and without submerged weir, there might not influence to the wetland habitat environment.
3. If the weir is removed, the area of wetland “Janghang” will reduce to 38% of the wetland area to 1.24 km² due to water level rise in dry season and out of inundated area 0.11 km² is the vegetation area.

Acknowledgement

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