

Water Quality Impact Assessment of Future Songdo Sewage Treatment Plant using Korean Water Quality Index

Dongwoo Jang^{1,1}, Hyoseon Park¹

¹ Incheon National University, Dept. Of Civil & Environmental Engineering, 119 Acdademy-ro, Yeonsu-gu, Incheon, Korea
nightray@paran.com

Abstract. This study aims to estimate the water quality impact in future Songdo city's waterfront area by the sewer from Songdo STP (Sewer Treatment Plant). 3D numerical model, MIKE 3 FM was setup and used to analyze the water quality with respect to the gate operation which will be constructed at the ends of the Songdo canal. The model has computed the changes of the water quality under annual duration. Real measured data from Incheon coast was used and WQI (Water Quality Index) estimated the polluted water from land inflow which comes from Songdo city. BOD, Nitrogen and phosphorous parameters coming from land are increased and influence the water quality at Sondo canal. WQI analyzed based on the water quality simulation, the degree shown 3~5 in Songdo canal. That is higher polluted value than the coastal area. Especially near the STP, WQI increased by the polluted water from Songdo STP.

Keywords: Water Quality Index, MIKE 3 FM, Water quality analysis, Songdo City

1 Introduction

Incheon Songdo city has a concerned about the potential issues as water quality and algal problems, and there is a need to ensure a natural stream flow and maintain a good water quality [1]. In order to do this, Water Quality Index was used to evaluate future water quality of Songdo city's water front. A 3D numerical model, MIKE 3 FM, was setup and used to investigate the water quality with respect to the operation of the water gates which will be constructed at the ends of the Songdo canal [2]. The model has computed water quality changes under annual boundary conditions by using EcoLAB module which was analyzing the water quality parameter. WQI (Water Quality Index) represents the water clearness in future Songdo waterfront canal system. The location and future topographic water-way plan of Songdo City is shown in Figure 1.

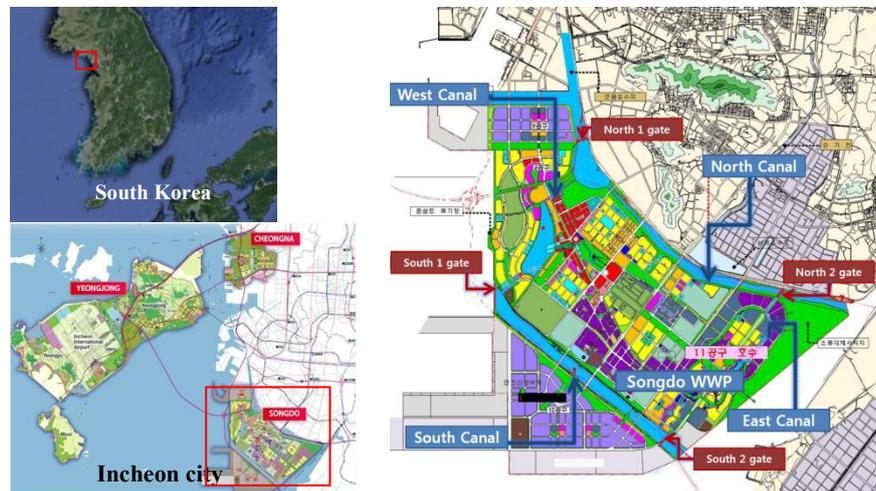


Fig. 1. Plan of future Songdo City (2025) [1]

Future plan of this water movement system is confirmed by operating the South 1 gate and North 2 gate, in order to keep the water circulation in the Songdo canal, water inflow and outflow conditions are planned as inflow from South 1 gate and outflow to North 2 gate as shown in the Figure 1. The Songdo STP was located in the middle of South 1 and South 2 gate.

2 Model Set-up

The bathymetry of the Songdo channel system was built with the mesh generator from MIKE 3 FM using as input values the coordinates taken from a given designed plan. In the Mesh Generator, the UTM-52 projection was selected. The boundaries were created and each inflow and outflow boundary conditions were decided.

The concentrations of water quality constituents were simulated by MIKE 3 FM ECOLab module which is based on the advection and dispersion simulation. This module can simulate the biological, chemical and physical processes related to environmental issues and water pollution.

We decided on the water quality as an input boundary condition (sea water) and forcing parameters like temperature, salinity, wind speed, wind direction and so on. The data was provided by Incheon weather station. We also used as an input the water discharge and water quality from land area.

3 Modeling Results

Time series water quality parameter of COD, DIN, DIP, Chl-a and SS in the Songdo canal were simulated. Main 5 water quality parameters are needed for WQI analyses : Surface DIN (Dissolved Inorganic Nitrate), surface DIP (Dissolved Inorganic phosphorous), Saturated DO (Dissolved Oxigen), Chl-a (Chlorophyll-a) and Secchi Disk (transparency). Annual WQI results were analyzed in future Songdo city (2025) at each waterfront's canal.

Sea water impact on almost of the Songdo canal. Because of 90% inflow water from sea, Songdo water quality parameters were basically affected from sea condition. But certain pollutant load from Songdo STP and runoff water that occurs in the summer season (from July to September) has a great influence on the overall water quality inside the Songdo canal. Surface DIN, DIP are increased and Saturation DO is decreased during the summer season and the total water quality index shows a higher level, with a score of 3 to 5. The most influenced Canals are the South & East ones with a very high WQI [4] score; this variance is caused by the Songdo STP discharge.

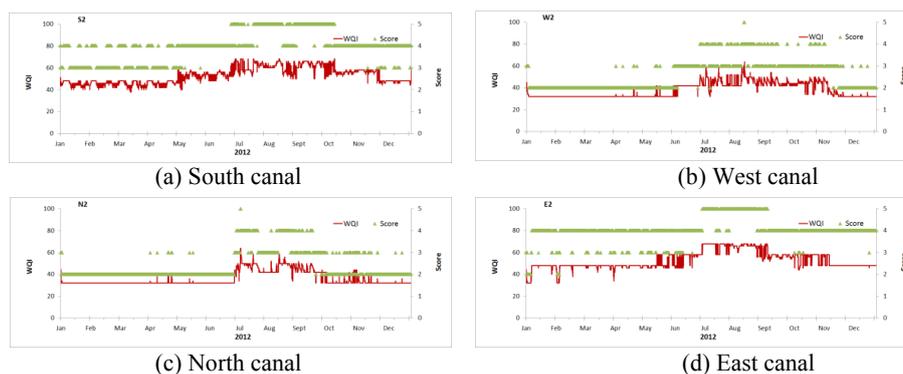


Fig. 2. Annual WQI results at Songdo canal

4 Conclusion

MIKE 3 FM ECOLab module made it possible to simulate the water quality index for the future Songdo City with considering Songdo STP. The numerical modeling of the water flow helped to forecast water quality shown through a WQI score, which will play an important part in the water quality estimation. The WQI score was showing a score of 3 to 5. South and East canal were more impacted by Songdo STP, these canals are maintaining high WQI which means water quality is more polluted. The modeling results shown in the previous figures were all computed with real data. We also want to add that some areas in the canal are still yet to be constructed so the current condition might be influenced in accordance with the future changes that will be made. After completing the Songdo canal, calibration and validation must be conducted through simulation modeling or hydraulic experiments.

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References

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