Sedimentation in the Botlek Harbour -
A research into driving water exchange mechanisms.

Master Thesis
FINAL REPORT
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SUMMARY

Siltation of harbour basins and navigation channels is a serious problem in the port of Rotterdam as well in many other harbours all over the world. Due to siltation, basins and channels require frequent maintenance dredging to guarantee safe navigational depths. The costs associated with these dredging activities are quite high.

To keep the channels and harbours in Rotterdam navigable, Rijkswaterstaat and the Port of Rotterdam are dredging approximately 15 million m$^3$ of sediment a year. The dredging cost of the Botlek Harbour only is already about 3 million Euros a year. It is a task to keep the costs in the Port of Rotterdam as low as possible to compete with other ports. Reducing maintenance dredging costs is in line with the goal of the Port of Rotterdam to be the most competitive, innovative and sustainable port in the world.

Most sedimentation within the maintenance area of the Port of Rotterdam occurs in the Botlek. According data, between 1.5 and 3 million m$^3$/year is dredged in the Botlek Harbour. Although the current dredging philosophy more or less works, the question arises whether there are solutions that are more cost-effective. However, the problem is so complex that it narrowed down for the sake of research quality.

The main causes of siltation in general and specifically in the Botlek Area form an important part of the study. Hydrodymical models (SIMONA & Delft3D), were used to gain insight in the sedimentation problem. The focus in this thesis was more on the hydrodynamics. The exchange mechanisms between the river and Botlek Harbour were investigated, which were needed to examine the effectiveness of certain solutions. In practice a lot of solutions are proposed in literature, however in this study only a couple of ‘hard’ measures are investigated. The first possible solution that was examined was the use of a Current Deflecting Wall. It turned out that the hydrodynamics were very sensitive to the configuration of the CDW. While sometimes it would lower the exchange flow, at other cases it would even make the problem worse. The second solution was to make a gap in the Geulhaven dam. However this was not a good solution as high exchange flows occurred. The last proposed solution, the filling of the underwater dam, seemed more feasible as it would decrease the exchange flow according the numerical models.

The research has first order results which can be used in further studies. According to this results, certain solutions will decrease the exchange flows. On turn it would very likely result in lower sedimentation rates in the Botlek Area. It is expected that some CDW configurations and the filling of the underwater dam would have a positive effect when it comes to sedimentation. However, this research is the first step of an extensive study that must made to deal with the problem.

First of all many things can be done to improve the models, for example by using a higher spatial resolution. Secondly, other sets of conditions must be modelled to see what kind of effect this has on exchange flows. In addition, sediment must be included in the models to have more insight on the sedimentation itself. The next step would be a feasibility study, including a cost benefit analysis. It would be wise to improve the models further and to make a scale model for the most feasible solution. In the ideal case, were all steps are positive and hard conclusion can be made, it would be a good idea for the Port of Rotterdam to start a pilot.