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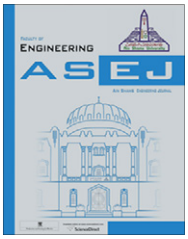

CIVIL ENGINEERING

Solving the problem of sedimentation at water intake of Rowd El-Farag pump station using 2D model

Ahmed Moustafa A. Moussa *

Nile Research Institute (NRI), National Water Research Center (NWRC), Delta Barrages, Qanater, Qalubia, Egypt

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KEYWORDS

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Dredging;
CCHE2D;
Sedimentation;
Water intake

Abstract This research presents and analyzes the problem of sedimentation at water intake of Rowd El-Farag pump station using a 2 dimensional computational model, CCHE2D. A study reach with a length of 1.53 km from 7.785 to 9.31 km from El-Roda gauging station was selected. The pump station is located at 8.63 km from El-Roda gauging station. The study shows there is a significant morphological change in this reach due to the long study period and two hydraulic Structures (Imbaba and Rowd El-Farag Bridges). Moreover, the different alternatives for sediment control are discussed such as: dikes on the western side of the river at different locations or dredging the study area at different levels 14 and 12.5 (1 and 2.5 m respectively) below minimum water level. Finally, the research recommended the using of dredging as a sustainable solution for sediment control at Water Intake of Rowd El-Farag Pump Station although this solution is an expensive solution.

1. Introduction

Nile River is subjected to different floods with a relatively wide variations ranging from low to high floods. The Nile flood can be as high as 150 billion cubic meters per year (1878) as natural inflow at Dongla gauging station and as low as 43 billion cubic meters per year (1913). In the last two decades the discharge through Reach Four (which starts from Asyut Barrage at 544.75 km to the Delta Barrage at 953.00 km with a length of about 408.25 km) of the Nile is between 436.34 and 2094.91 m^3/s. Even though high floods have their side effects on riverbanks, hydraulic structures and riverbed. Low floods have many other critical outcomes on the availability of water resources and low water levels. The side effects of low flows are many. The examples of these side effects are the water supply deficiency, navigation problems, and some local sedimentation problems.

* Tel.: +20 105182698.
E-mail address: ahmed_moussa@hotmail.com

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In practice, there are many different purposes for water use such as irrigation, drinking, cleaning, and cooling. This water is extracted from different intakes from dynamic fresh water sources in the rivers or streams. The inlets of these pipes are usually submerged under water surface to ensure a continuous water supply. If such submergence is not deep enough or the water surface is fluctuating causing the pipe submergence depth to become smaller, problems of vortexing and cavitation are always expected.

This research presents and analyzes the problem of sedimentation at water intake of Rowd El-Farag pump station using a 2 dimensional computational model, CCHE2D. The different alternatives for sediment control are submerged dikes to control flow directions and dredging are discussed.

2. Objective

The objective of this research is to analyze the problem of sedimentation at the water intake of Rowd El-Farag pump station and the different alternatives for sediment control using 2D model as follows:

1. Analyze and discuss the factors causing the problem of sedimentation at the intake of Rowd El-Farag pumping station. Also, different alternatives for sediment control to solve the problem of sedimentation at the intake of the pumping station.
2. Recommending a solution of the problem.

3. The study reach

A Nile reach with a length of 1.53 km was selected where the pump station is at the middle. The selected reach covers the area from 7.78 km to 9.31 km downstream El-Roda gauging station (934.785 km to the 936.31 km from Aswan Dam). The intake of Rowd El-Farag pump station is located at 8.63 km downstream El-Roda gauging station as shown in Fig. 1. The pump station is located in between two bridges. Imbaba Bridge is located at the upstream where Rowd El-Farag Bridge is located at the downstream of the pump station [1,2].

Imbaba Bridge is a steel structure, with two levels one for railway and the second one for roadway. It has seven piers, the second pier from the left bank is circular with 10.6 m diameter and the other six piers are rectangular with 15 m long and 3.6 m wide having rounded noses. The deep scour hole lies 97 m from the left bank and 32 m downstream of the centerline of the bridge with a bottom elevation of −8.3 m [3]. It was found that the mean velocity is not larger than 0.6 m/s.

The reach is nearly straight. There are some low lands (shallow areas) in the eastern bank of the river, at the intake. The low lands extend from downstream Imbaba Bridge until the axis of the pump station. The top width of the cross-sections ranges between 316 m at cross-section (1) just downstream of Imbaba Bridge and 470 m at cross-section (20) downstream Rowd El-Farag Bridge during the low water level, and on the other hand, the top width ranges between 410 m at cross-section (1) and 688 m at cross-section (20) during the high water level.

Figure 1 Plan at Rowd El-Farag pump station and part of Reach Four.