Modelling of Privalul Tinoasa channel, in irrigation system
Borcea 2 - Danube Romania

Hausler - Cozma Dorian Petrica, Belicci Erika, Belicci Robert

Politehnica University Timisoara, Department of Hydrotechnical Engineering, Spiru Haret str. 1/A, 300022 Timisoara, Romania
beilicci@yahoo.com

Abstract. The study case is situated in Calarasi County, Romania, near Danube river. The sprinkler irrigation arrangement serves the area of 1018.67 ha, useful, net irrigated area. The sprinkler irrigation arrangement comprises fixed irrigation equipment consisting of 16 central irrigation pivots equipped with nozzle ramps for water spray, the pivots are supplied with water through a network of underground pipes, pumping station, water source the Privalul Tinoasa channel fed from the Danube River. The Privalul Tinoasa channel will be cleared and re-profiled, having the role of water accumulation basin that will ensure the aspiration for the designed pumping station. Numerical modelling was performed using the program MIKE11. MIKE 11 is a user-friendly, fully dynamic, one-dimensional modelling tool for the detailed analysis, design, management and operation of both simple and complex river and channel systems. With its exceptional flexibility, speed and user-friendly environment, MIKE 11 provides a complete and effective design environment for engineering, water resources, water quality management and planning applications. The Hydrodynamic (HD) module is the nucleus of the MIKE 11 modelling system and forms the basis for most modules including Flood Forecasting, Advection-Dispersion, Water Quality and Non-cohesive sediment transport modules. The MIKE 11 HD module solves the vertically integrated equations for the conservation of mass and momentum, i.e. the Saint-Venant equations. The input data are: area plan with location of cross sections; cross sections topographical data and roughness of river bed; flood discharge hydrograph. Advanced computational modules are included for a description of flow over hydraulic structures, including possibilities to describe the structure operation.

1. Introduction
Location of the objective irrigation system 1000 ha Borcea 2-Danube for which it is proposed for the present project is located in the embankment Borcea above, out of the south side bordering the left bank of the Danube with the following neighbourhoods (Figure 1):

- north - agricultural trains OUAI BORCEA DE SUS, OUAI GRADISTEA FETESTI
- south - Danube River
- west - agricultural lands ODD BORCEA DE SUS, compartment II
- east - agricultural land OUAI GRADISTEA FETESTI
Figure 1. Area layout plan [1]

The SPA2 pumping station was refurbished in 2010 with 4 pumps with a capacity of 1296 m³/hour and a pumping height of H = 70 m. capacity of 1250 m³/hour and pumping height of H = 70 m.a SPA2 to maintain a constant volume in the accumulation buffer [2].

There will be an underground water transport pipeline from the existing pumping station SPA2 OUAI Borcea de Sus, to the existing channel Tivalasa Prival (1326/1). The pipe will be made of PEID, PN10, DE 560 mm, will have a length of 3640 m, will be mounted buried (Figure 2).

On the existing OL discharge pipe, DN800 mm of the pumps of the pumping station will be fitted with a reduced OL pipe DN 800/500 mm, where the projected pipeline will be connected.

In the vicinity of the pipeline in the vicinity of the connection with the pump discharge, there will be built a flowmeter of reinforced concrete with a road cap. This fireplace will be equipped with a DN500 butterfly valve and a body electromagnetic flow meter with DN 500 mm flanges.

At the downstream end of the adduction pipeline at the intersection with the Tivalasa Prival, a spillway will be arranged.

The spout will be made of reinforced concrete in the form of a support wall located in the channel bed. The inlet pipe will be equipped with a check valve with counterweight DN 500 mm.

In the vicinity of spillways on the pipeline, a concession valve DN 500 mm with a manoeuvring rod and road cover will be fitted.

The Tinoasa Canal on a width of 5 m upstream and 5 m downstream will be brushed with concrete with a thickness of 10 cm placed on a 15 cm sand bed. For the evacuations to the pipeline, a trapezoidal channel with dimensions b = 0.50 m, B = 1.50 m, h = 0.50 m, m = 1 will be created on the channel's trough.
Figure 2. Master plan

The Tivalasa Prival Canal (1326/1) will be cleared and re-profiled, having the role of water accumulation basin that will ensure the aspiration for the designed pumping station.

The descaling will be done by earthworks, levelling and compaction. Excavation works will be carried out on depths between 0.30 and 1.50 m deep. The free surface of the arranged canal is 33340 square meters and the volume of water is 59403 square meters with an average depth of 2.0 m [3].

Excavation volumes will be used to level local micro-depressions on the 1000 ha site.

The discoloured channel is realized in deblue having the following characteristics [2]:
- the inclination of the inner wall of 1:1.5
- the width of the trough 14 m
- the channel depth with a guard of 0.30 m is 2.30 m.
- the arranged channel will be waterproofed with polyethylene or geomembrane foil so that the upper aquifer layer is not affected, both qualitatively and quantitatively. This foil will be partially weighted (in the grid system) with concrete slabs.

In the catchment area of the basin - at the SPP pumping station, a concrete lining with a thickness of 10 cm is provided, which is made with a width of 10.50 m, the lining being laid on a sand bed 15 cm thick [2]

There will be a pumping station where 4 pumps with horizontal axes powered by electric motors and soft starter will be positioned, along with the related valves, bellows anti-vibration valves on
discharge and suction valves, pumps that will draw water to pump it, under the necessary pressure, into the underground pipeline network that will supply the irrigation facilities.

The pipelines chosen are from PE HD, PN10, intended for the management of irrigation water to irrigation plants. The pipe lengths and diameters are shown in the table below. (Table 1)

**Table 1. Pipe lengths and diameters.**

| Section      | L (m)  | De (mm) | Di (mm) |
|--------------|--------|---------|---------|
| 1            |        |         |         |
| Aduction     |        |         |         |
| CD-GV        | 3640.00| 560     | 493.6   |
| SPP-CV1      | 215.00 | 450     | 396.6   |
| CV1-P6       | 253.00 | 225     | 198.2   |
| CV1-P5       | 507.50 | 450     | 396.6   |
| P5-P1        | 1004.50| 280     | 257.24  |
| P5-P4        | 492.00 | 225     | 198.2   |
| P5-P8        | 1118.00| 355     | 312.8   |
| 2            |        |         |         |
| SPP-CV2      | 1149.00| 450     | 396.6   |
| CV2-P9       | 371.50 | 280     | 257.24  |
| CV2-P12      | 874.00 | 450     | 396.6   |
| P12-P11      | 1011.00| 280     | 257.24  |
| P12-P14      | 1172.50| 280     | 257.24  |
| 3            |        |         |         |
| SPP-CV3      | 475.00 | 450     | 396.6   |
| CV3-P2       | 706.50 | 280     | 257.24  |
| CV3-P3       | 843.00 | 280     | 257.24  |
| CV3-P7       | 765.50 | 400     | 352.6   |
| P7-P10       | 521.00 | 280     | 257.24  |
| 4            |        |         |         |
| SPP-CV4      | 2145.00| 500     | 440.6   |
| CV4-P13      | 269.50 | 280     | 257.24  |
| CV4-P15      | 1069.00| 400     | 352.6   |
| P15-P16      | 1079.00| 355     | 312.8   |

Sprinkler irrigation arrangement includes fixed irrigation equipment (machines) consisting of 16 central irrigation pivots equipped with nozzle ramps for water spray.

2. Results and discussions

Numerical modelling was performed with the program MIKE11. MIKE11 advanced hydroinformatic tool, part of the DHI software products, is a professional engineering software package for the simulation of flows, water quality and sediment transport in estuaries, rivers, irrigation systems, channels and other water bodies. MIKE11 is a user-friendly, fully dynamic, one-dimensional modelling tool for the detailed analysis, design, management and operation of both simple and complex river and channel systems [4-6].

Site plan with the network model in this situation is shown in Figure 3. Cross sections through the channel as topographical surveys are shown in Figure 4. According to data entry or formulated boundary conditions, namely, the upstream inflow [3, 7] at chainage 1660 are constant Q 347 m³/s and in the downstream at chainage 0 curve key for a downstream section of the river [3]. After running the program MIKE11 was obtained through existing channel longitudinal profile, presenting water levels along the channel (Figure 5).
Figure 3. Network model

Figure 4. Cross sections

Figure 5. Longitudinal profile
3. Conclusions

This study presents the application of a 1-dimensional unsteady flow hydraulic model used for the simulation of flow in rivers: the MIKE 11 model from the Danish Hydraulic Institute (DHI).

MIKE 11 is the preferred choice of professional river engineers when reliability, versatility, productivity and quality are the keywords.

MIKE 11 is a professional engineering software package for the simulation of flows, water quality and sediment transport in estuaries, rivers, irrigation systems, channels and other water bodies.

MIKE 11 is a user-friendly, fully dynamic, one-dimensional modelling tool for the detailed analysis, design, management and operation of both simple and complex river and channel systems.

Acknowledgment

This paper can be possible thanks to the project: Development of knowledge centres for life-long learning by involving specialists and decision makers in flood risk management using advanced hydroinformatic tools, AGREEMENT n0 LLP-LdV-ToI-2011-RO-002/2011-1-RO1-LEO05-5329. This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

References

[1] Google Earth, base maps, 2020 [Online] Available at: https://earth.google.com/web/.
[2] SC Antrepriza generala indigo design SRL, “Techhnical project Irrigation extension 1000 ha Borcea 2 Danube”, 2019.
[3] National Agency for Land Improvements, Data from various documents and studies, Calarasi, Romania, 1987-2018.
[4] M. Visescu, E. Beilicci and R. Beilicci “Sediment transport modelling with advanced hydroinformatic tool. Study case: modelling on Bega Channel sector”, The World Multidisciplinary Civil Engineering – Architecture – Urban Planning Symposium - WMCAUS 2018, Praga, Czech Republic, vol. 161, pp. 1715–1721, 2016.
[5] C. Gradinaru, R. Beilicci and E. Beilicci, “Advance Hydraulic Modelling of Maciovita River, Caras Severin County, Romania”, The World Multidisciplinary Civil Engineering - Architecture - Urban Planning Symposium - WMCAUS 2018, Praga, Czech Republik., vol. 471, 2019.
[6] DHI, MIKE 11 - “A modeling system for rivers and channels, Short introduction and tutorial”, Horsholm, Denmark, pp. 5-6, 2014.
[7] National Administration “Romanian Waters”, Buzau-Ialomita Branch, Data from various documents and studies, Calarasi, Romania, 1987-2018.