1 Korte Woerden 1D model

Quality Assurance

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Version information

Executable	:	Deltares, DIMR_EXE Version 2.00.00.66927M, Jun 7 2020, 23:24:09
Location input	:	https://repos.deltares.nl/repos/DSCTestbench/trunk/cases/e02_dflowfm/f150_1d2d_acceptance_urban/c11-KorteWoerden-1D
Revision input	:	-
Location output	:	https://repos.deltares.nl/repos/DSCTestbench/trunk/references/e02_dflowfm/f150_1d2d_acceptance_urban/c11-KorteWoerden-1D
Revision output	:	-

Purpose

This test originates from a D-Flow Flexible Mesh validation model and is used here to test import + export of a 1D urban model, including RR. The purpose of the original validation test is to validate the one-dimensional (1D) model of Korte Woerden in D-Flow Flexible Mesh.

Linked claims

The 1D modelling in D-Flow Flexible Mesh for Korte Woerden is validated.

Approach

In this test case, a 1D sewer model for Korte Woerden was created in D-Flow Flexible Mesh (D-Flow FM), with semi-distributed rainfall-runoff processes modelled via D-RR NWRW module. The D-Flow FM model and a 1D SOBEK 2 model were used for flow simulation under a rainfall event of 2 year return period.

Conclusion

N/A

Model description

This test case consists of a 1D D-Flow Flexible Mesh model of Korte Woerden, which is a small urban area (approximately 750 m in length and 350 m in width) located in the town of Waardenbrug in the Netherlands.

In the 1D model, the surface runoff generation and routing is through a semi-distributed rainfall-runoff (rr) model. The runoff enters the sewer network via manholes and is routed in the sewer before exiting the system via system outlets. The model contains 73 rr catchments, 85 pipes and 86 manholes (including 3 outlets). The flow in the system is regulated by 2 pumps, 3 weirs and 1 orifice. Layout of the model can be found in Figure 1. Note that the PMP 2 splits the sewer network into 2 parts - an upstream parts on the North-East side and a downstream part on the South-West side.

More specifically, bed-levels of the sewer network are shown in Figure 2. Widths of the pipes and storage area of the manhole wells are shown in figure Figure 3. The manholes are reservoir type with street storage area of 100 m^2. The street-levels of the manholes are shown in Figure 4 The pipes have roughness of Whilte-Colebroke (CW) type with values indicated in Figure 5. Description of the structures are shown in Table 1. All structure links have a length of 1 m.

For the simulation, the model starts with an initial water level of -5 m, i.e. as an empty system. During the simulation, the dry weather flow is not considered. The rainfall event is of 2 year return period , applied uniformly over the entire model (See Figure 6). Temperature is at 18 $^{\circ}$C. Evapotranspiration is set to 0.16 mm/d. Water level boundaries at the outlets below the bed-levels of the network. The model runs with a user timestep (`DtUser` - interval for external forcing update, D-Flow FM and D-RR communication and his/map output) of 1 min for 2 hours. For calculation, the initial time step (`DtInit`) is set to 1 s and the maximum time step (`DtMax`) is set to 10 s to avoid instability caused by larger time steps.

Note that the following modelling practise are adapted in the model:

- Water level boundaries at the outlets are by default applied one computational grid cell length outside the system in a mirrored pressure point in D-Flow FM. The mirrored pressure point outside of the system is referred to as the mirrored external pressure point; The pressure point inside of the system that was mirrored is referred to as the mirrored internal pressure point; The flow link connecting the mirrored internal and external pressure points is referred to as the mirrored flow link. In this model, an `uniformwidth` of 0.1 m is initially set for the mirrored flow links with a default length 1 m. This, however, may cause extra storages on these flow links. Therefore, to maintain the boundary water-levels below the bed-levels of the network without causing extra storages, widths of the flow links are assigned to artificial values by setting `bndWidth1D` = 100 m.
- At structures, the option `useVelocityHeight` = False is set. This option simplifies the discharge equations of the general structure (see paragraph 1.4.2.2.5 of User Manual D-Flow FM).
- A circular cross-section profile with a diameter of 250 mm is used for the pumps. The invert levels of the pumps is set to equal to the bed-levles of the upstream/downstream manholes. This avoids having extra storage at the pumps.
- The option `Drop1D` = False is set. The water level slope is limited when the water level in a manhole becomes lower than the invert level of the pipe at the specific manhole.

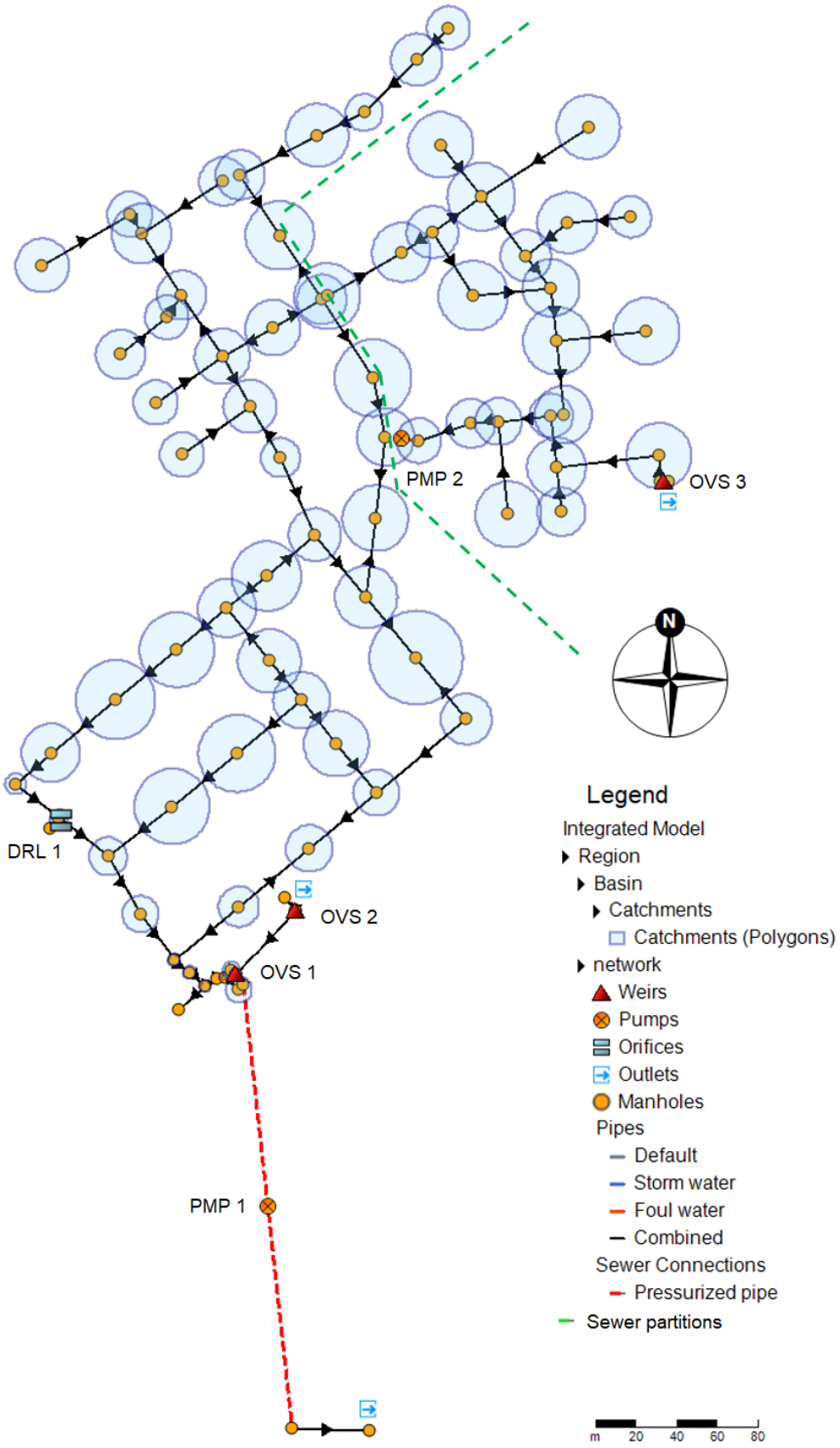

Figure 1: *Lay-out of the Korte Woerden 1D model*

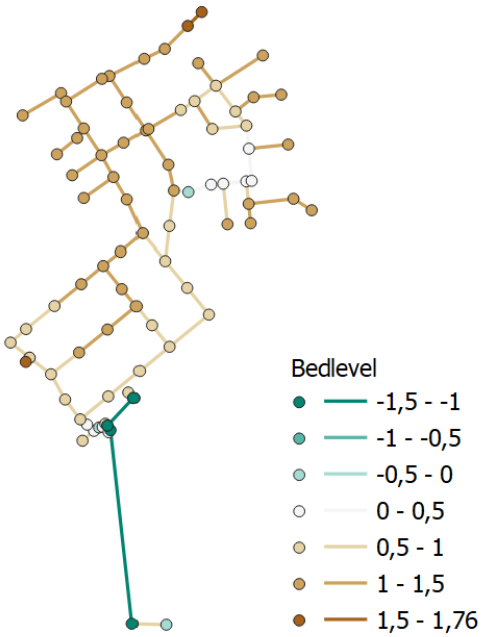

Figure 2: *Bed-levels of the Korte Woerden 1D model*

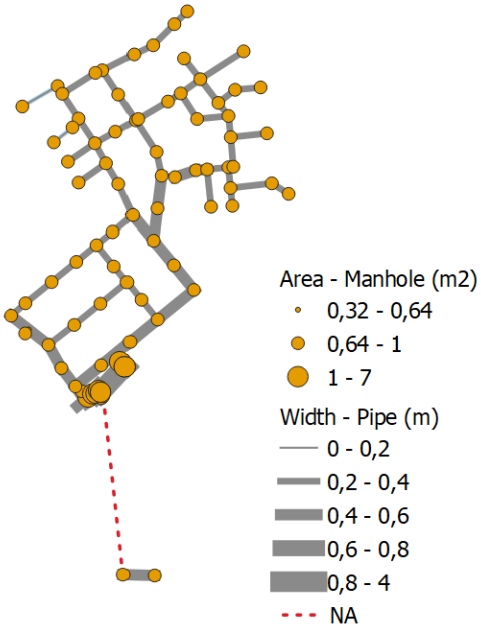

Figure 3: *Sizes of pipes and manholes of the Korte Woerden 1D model*

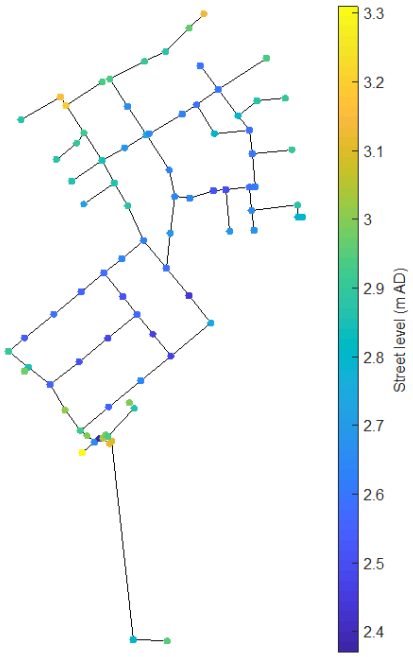

Figure 4: *Manhole street levels of the Korte Woerden 1D model*

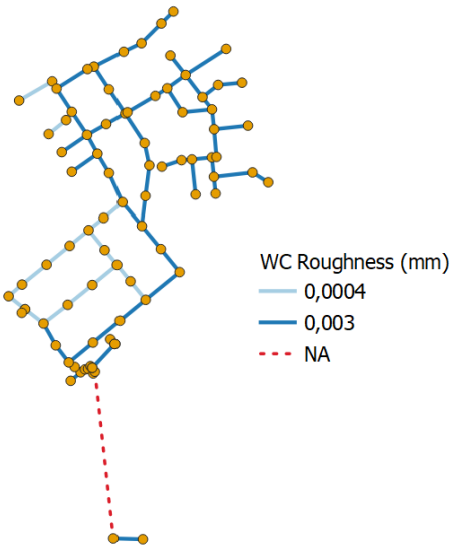

Figure 5: *Roughness of pipes of the Korte Woerden 1D model*

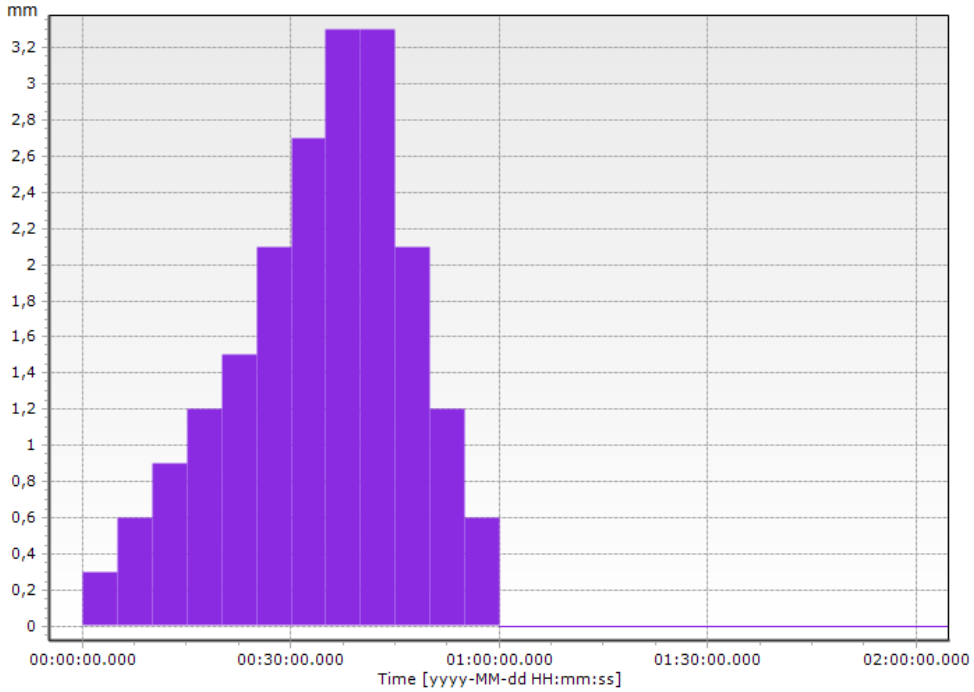

Figure 6: *Profile of rainfall*

Table 1: *Characteristics of the hydraulic structures of the Korte Woerden 1D model*

Name	Type	Parameters
DRL1	Orifice	`allowedFlowDir` = positive `crestLevel` = 1.60 m `crestWidth` = 0.25 m `gateLowerEdgeLevel` = 1.85 m `corrCoeff` = 0.60
OVS1	Weir	`allowedFlowDir` = both `crestLevel` = 2.05 m `crestWidth` = 8.00 m `corrCoeff` = 0.80
OVS2	Weir	`allowedFlowDir` = both `crestLevel` = 2.05 m `crestWidth` = 8.00 m `corrCoeff` = 0.80
OVS3	Weir	`allowedFlowDir` = both `crestLevel` = 2.18 m `crestWidth` = 1.00 m `corrCoeff` = 0.80

Table 1: *Characteristics of the hydraulic structures of the Korte Woerden 1D model*

Name	Type	Parameters
PMP1	Pump	`orientation` = positive `controlSide` = suctionSide `numStages` = 1 `capacity` = 0.015361 m^3/s `startLevelSuctionSide` = 0.07 m `stopLevelSuctionSide` = -0.43 m `startLevelDeliverySide`= 0 m `stopLevelDeliverySide` = 0 m `numReductionLevels` = 0 m `head` = 0 `reductionFactor` = 1
PMP2	Pump	`orientation` = positive `controlSide` = suctionSide `numStages` = 1 `capacity` = 0.011111 m^3/s `startLevelSuctionSide` = -1 m `stopLevelSuctionSide` = -1.49 m `startLevelDeliverySide`= 0 m `stopLevelDeliverySide` = 0 m `numReductionLevels` = 0 m `head` = 0 `reductionFactor` = 1

Results

N/A

Analysis of results

N/A