



## Workshop Hydrodynamic sewer model – Sobek

CIE4491

Date: Wednesday 6 March 2013

### Program Sobek workshop

Start at 8.45h in room 1.97

- Introduction/model instruction by Cees Anton den Dool, Deltares (1 hour)
- Sobek model, assignments 1 to 4

Lunch break

- Feedback model results assignments 1 to 4
- Sobek model, assignments 5 and 6
- Presentation of solutions by a few students from the group

End by 17h (or so much earlier as assignments are finished)



## Sobek workshop assignments

### Introduction

The city council of Watertown has assigned the task to analyse the sewer system of Watertown for hydraulic functioning and pollution loads to surface water to an engineering firm.

The sewer model has been set up at an earlier stage and is now made available to the engineering firm for this assignment. You work as an engineer for this firm and are asked to perform the following tasks:

- Make control calculations to check hydraulic functioning of the system (check for flooding);
- Make control calculations to estimate the amount of pollution to surface water
- Define cost-effective solutions to improve the system by reducing the frequency of flooding and the pollution load.

The city council of Watertown has adopted the following guideline for flood occurrence: no flooding should occur for a control calculation based on a standard design storm with a return period of 2 years: STNBUI08.

The water authority is responsible of water quality management of the surface waters. It requires a maximum pollution load from combined sewer systems to surface water of 50 kg COD/ha/year related to surface area connected to the sewer system. The following assumptions apply for control calculations with respect to pollution loads to surface water:

- Domestic wastewater inflow is 120 l/day per inhabitant
- Industrial wastewater inflows should be quantified separately
- Maximum pollution load of: 50 kg COD/ha\*year, for surface area connected to sewer system

Pollution loads should be calculated based on a model simulation for a standard rainfall series of 10 years, 15 minute time step, for the period 1955-1964, based on data for weather station De Bilt (KNMI).

While going through the workshop assignment you will make adjustments to the system; make sure to save the case (under different name) for each adjustment. At each step you continue with your last case, so each case contains the accumulated changes from previous steps.

After completing the assignment, you will prepare a short report (2-3 A4 pages) in which you answer the questions in the assignment. The report is to be submitted by e-mail to: j.a.e.tenVeldhuis@tudelft.nl. The workshop report will be marked 0, 5 or 10; the mark counts 10% of the final mark.



### Assignment 1 Data analysis

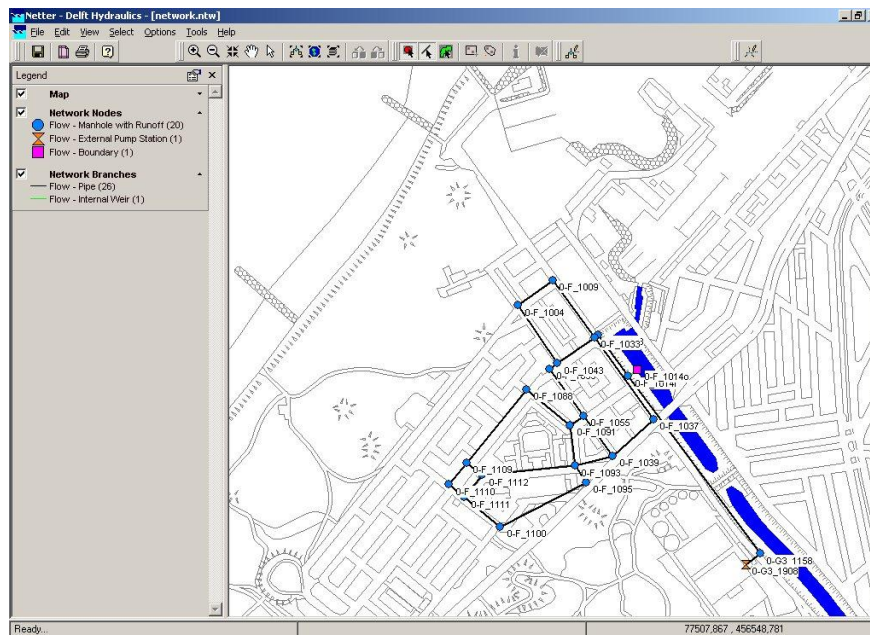
Geometrical data (diameters, sewer invert levels, pipe lengths etc.)

There is an error in the geometrical database; one of the links has unrealistic invert levels (in Dutch: binnenonderkant buis: BOB). Create side views of several sections of the sewer system or use the Multiple Data Editor to detect the unrealistic invert levels.

Change invert levels according the levels of the connected manholes (“get values command”).

### Connected surface area

The database of the sewer system of Watertown is not yet complete. The connected surface areas need to be adjusted.



Map of Watertown; layout of sewer system and surface water

Check the available data in the database concerning connected surface areas.

Open project: Programs\Engineering\Sobek 212. Project: SF-E02\_3.lit. Case: basis1

- Analyse the input data, using the Multiple Data Editor.

The data is specified for ‘Closed Flat area [m<sup>2</sup>]’ only. This is certainly incorrect.

- Adjust the values of connected surface areas in the Multiple Data Editor (Copy and Multiply functions, total area 51.853,50 m<sup>2</sup>), as follows (see table)



Surface type	Percentages	
Open Flat area	50%	30%
Closed Flat area		20%
Roof Sloped area	50%	45%
Roof Flat area		5%

- Analyse the effect of the adjusted connected surface areas with the Case Analysis Tool.

Compare water levels at several nodes, including the overflow weir node, for the two cases. Explain the differences that you see.

Does the water level reach the overflow weir crest and lead to overflow for the new connected surface areas? How much water flows over the overflow?

## Assignment 2 Data analysis – Areas – uncertainty in surface area

Further analysis learns that the total connected surface area is 10% larger than initially estimated in the sewer model

- Analyse the effect of 10% larger connected surface area.

Does the water level reach the overflow weir crest and lead to overflow for the extra 10% connected surface area? How much water flows over the overflow?

It turns out something went thoroughly wrong in the estimation of connected surface areas: two times as much surface area is connected to the system compared to the previous estimate (i.e. the estimate with adjusted surface areas and 10% larger connected area).

- Analyse the effect of 100% larger connected surface area.

Does the water level reach the overflow weir crest and lead to overflow for the extra 100% connected surface area? How much water flows over the overflow?



### Assignment 3 Data analysis - pipes

One of the checks of the geometrical database showed that not all pipes were constructed according to design plans.

- Change the cross-section of pipe section (link) 7 between manhole 0-F\_1088 and 0-F\_1109 into a cross-section of 'round 700 mm'.
- Analyse the effect of the new cross-section.

What is the maximum water level difference between this case (round 700m) and the previous case?

### Assignment 4 Storage

The city council of Watertown wants to realise a minimum of 7 mm storage capacity in the sewer system in order to limit the amount of overflows to surface water.

- Use the tool 'Storage Graph' to determine the current storage capacity of the system.

Does the system comply with the requirement of 7mm storage that is used as a general reference for minimum sewer system storage?

### Assignment 5 Hydrodynamic calculations for standard design storms

The city council of Watertown has set the requirement of no flooding for standard design storm STNBUI08, with a return period of 2 years. The city council wants to get insight into the effect of STNBUI09, for a return period of 5 years. The city council wants to prevent flooding that occurs as a result of this design storm for as far as this can be realized at limited cost.

- Make a hydrodynamic calculation with the sewer model, using design storm STNBUI08 as input.

Does the system comply with the requirement that no flooding occurs for this design storm? If not, apply a few solutions to make sure flooding no longer occurs for design storm STNBUI08. What do you think is the best solution to apply ?

- Make the hydrodynamic calculation using STNBUI09 for your chosen solution.

Does flooding occur for this design storm? If so, apply a solution for STNBUI09 that reduces flooding at limited cost.



### Assignment 6 Pollution load calculation, 10-year rainfall series

- Make a hydrodynamic calculation using the standard 10-year rainfall series RKS5564.RKS. Assume the average COD concentration of combined sewer overflow water is 250 mg/l COD (assumed average concentration to translate overflow volume into overflow load; no water quality calculations will be made).

What is the average annual pollution load for the combined sewer overflow of this sewer system, in kgCOD/year?

Does the system comply with the requirement of max. annual pollution load of 50 kgCOD/ha? If not, apply a few solutions to reduce the overflow load to the acceptable level. What do you think is the best solution to make the system comply with the annual pollution load requirement?