

STORM-SEWSYS

- a Sources and Flux Model (SFM)

Stefan Ahlman, Heiko Sieker, Gilbert Svensson



CHALMERS

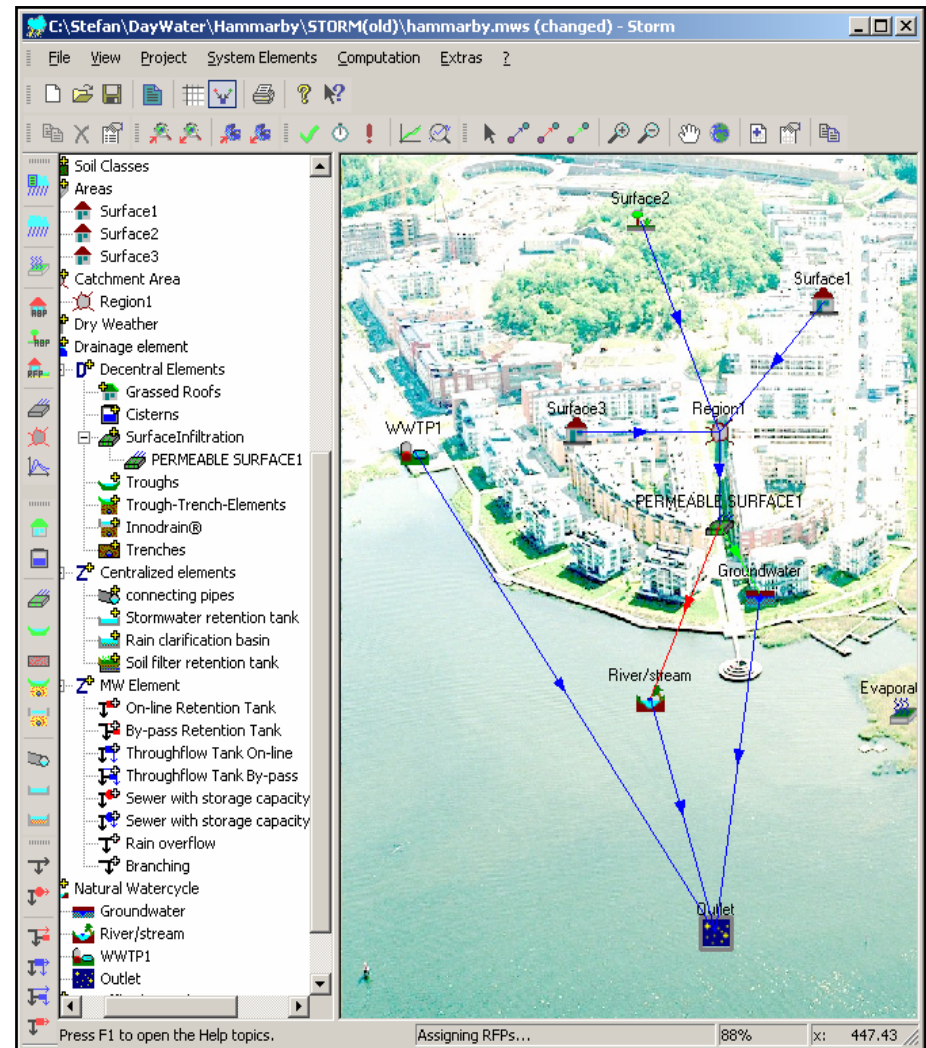


THE STORM WATER EXPERTS.
INGENIEURGESELLSCHAFT
PROF. DR. SIEKER MBH

Reasons for sources and flux modelling

Investigation of:

- Water balance
- Pollutant characteristics
- Fate of pollutants
- Removal efficiencies
- Scenarios
- Best choice(s)



STORM-SEWSYS

- The SFM-tool provides quantitative and qualitative inputs into the ADSS. It consists of two fully integrated parts, STORM and SEWSYS.
- The SEWSYS module assesses stormwater quality on the base of pollution sources, using a database on emission factors.
- Using quality parameters derived from SEWSYS, the hydrological model STORM generates water balances, pollutant fluxes and BMP performance.

Stormwater Pollutant Sources and Pathways

SEWSYS

Rainfall

Generation of Air Pollution

Other

Transports

Dry & Wet
Fallout

Building
Materials

This flowchart is covered by the use of STORM for the hydrology and SEWSYS for the substance flows.

STORM

Stormwater Generation & Transport

Infiltration

Beneficial Use
of
Stormwater

Combined
Sewer

Separate
Sewer

Agriculture

Land-
fill

Ground

Sludge

WWTP

Fresh or Sea
Water

SFM-tool \Leftrightarrow ADSS

- The SFM- tool is capable of giving indicators for different variants
- All simulations are made for rain events
- Indicators may be displayed per rain event or per year
- The indicator values are transferred to the ADSS

STORM-SEWSYS

- can be used to assess stormwater quality related problems regarding:

- Pollution loads
- Pollution concentrations
- Soil and groundwater contamination
- CSO discharges
- Contamination of sewage sludge

Solutions to water quality problems

- Treatment (STORM tool)
 - Source control
 - End-of-pipe
- Pollution Source Control (SEWSYS)
 - Source Management

⇒ **SEWSYS is a source tracking tool**

Specific aims of SEWSYS

- Assess stormwater quality on the base of land use, using data collected all over Europe, at different time scales
- Take into account the identified Selected Stormwater Priority Pollutants (SSPP)
- Integrated part of the STORM software

Important unit processes in STORM-SEWSYS

- Rainfall-runoff formation
- Runoff routing
- Pollutant build-up & wash-off (SEWSYS)
- Treatment by mixing, filtration and sedimentation

D4.3 List of SSPP

Type of SSPP	Selected stormwater priority pollutants
Basic parameters	Biological/chemical oxygen demand
	Suspended solids
	Nitrogen
	Phosphorus
Metals	Cadmium
	Chromium (Chromate)
	Copper
	Nickel
	Lead
	Platinum
	Zinc
PAH's	Naphthalene
	Pyrene
	Benzo[a]pyrene
Herbicides	Pendimethalin
	Phenmedipham
	Glyphosate
	Terbutylazine
Miscellaneous	Nonylphenol ethoxylates and nonylphenol
	Pentachlorophenol
	Di(2-ethylhexyl) phthalate

Selected Stormwater Priority Pollutants (SSPP) incorporated in the pollution generation module (at present)

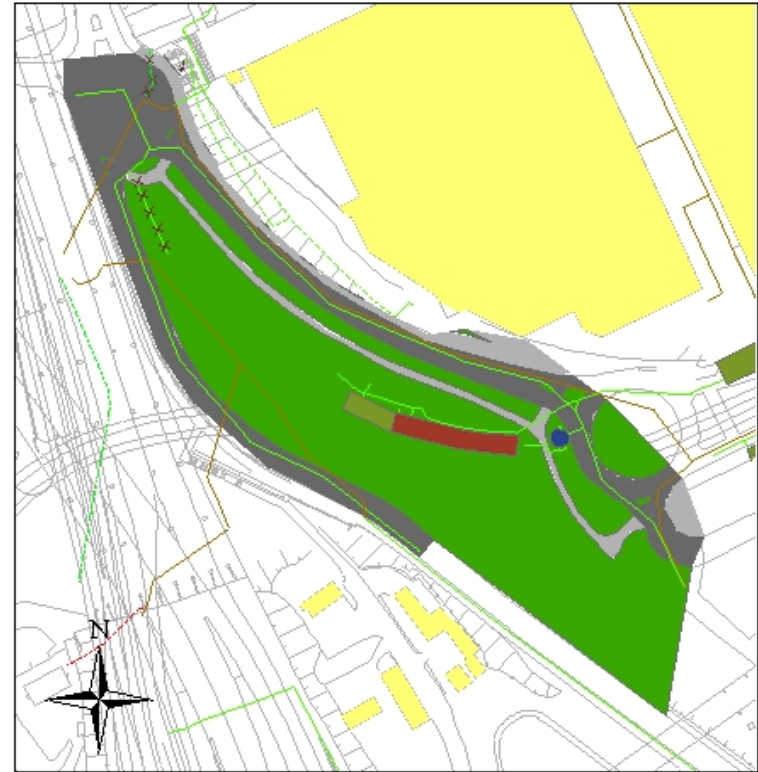
SFM Input - Output

INPUT			
Catchment	Hydrology	Total impervious area	m ²
		Roads	m ²
		Roofs	m ²
		Other	m ²
		Yearly rainfall	mm/year
		Rainfall series	time;mm/h
		<i>Temperature series</i>	<i>time; °C</i>
	<i>Water retaining capacity</i>		
	<i>Melt constant</i>		
	Materials	Zinc by roads	%
		Zinc roofs	%
		Copper roofs	%
	Activities	Traffic	vehicles/day
Heavy vehicles		%	

OUTPUT			
Hydrology		Runoff hydrograph	time; m ³ /s
		Runoff volume	m ³ /year
		<i>Snowpack depth</i>	<i>time; mm water equivalent</i>
Annual Loads	Wet deposition	A number of substances	g/year
	Roads	A number of substances	g/year
	Roofs	A number of substances	g/year
	Other	A number of substances	g/year
Sources	Roads	A number of sources	%
	Roofs	A number of sources	%
	Other	A number of sources	%

GIS Analysis to find input data

- Total area
- Pervious
- Impervious
 - Roads
 - Roofs
 - Other impervious
- Traffic load:
Unit vehicle_km day⁻¹



Stormwater quality

Standard concentrations or emissions factors

Properties Substance values

Tyre material | Road material | Exhaust | Brake wear | Dry Deposition
Copper surface corrosion | Oil discharge | Zinc surface corrosion
Model components | Substance values | Sewsys-Const. | Wet Deposition

Name: Substance parameters Source: WET DEPOSITION

Parameter: No. 1-12 Unit: ug/m²_year
 No. 13-24 consider source

Pollution

P	7500	Zn	8000
N	1000000	Pb	1500
SS	0	Cd	150
BOD7	0	Ni	0
COD	0	Cr	0
Cu	1500	Pt	0

Ok Cancel Apply

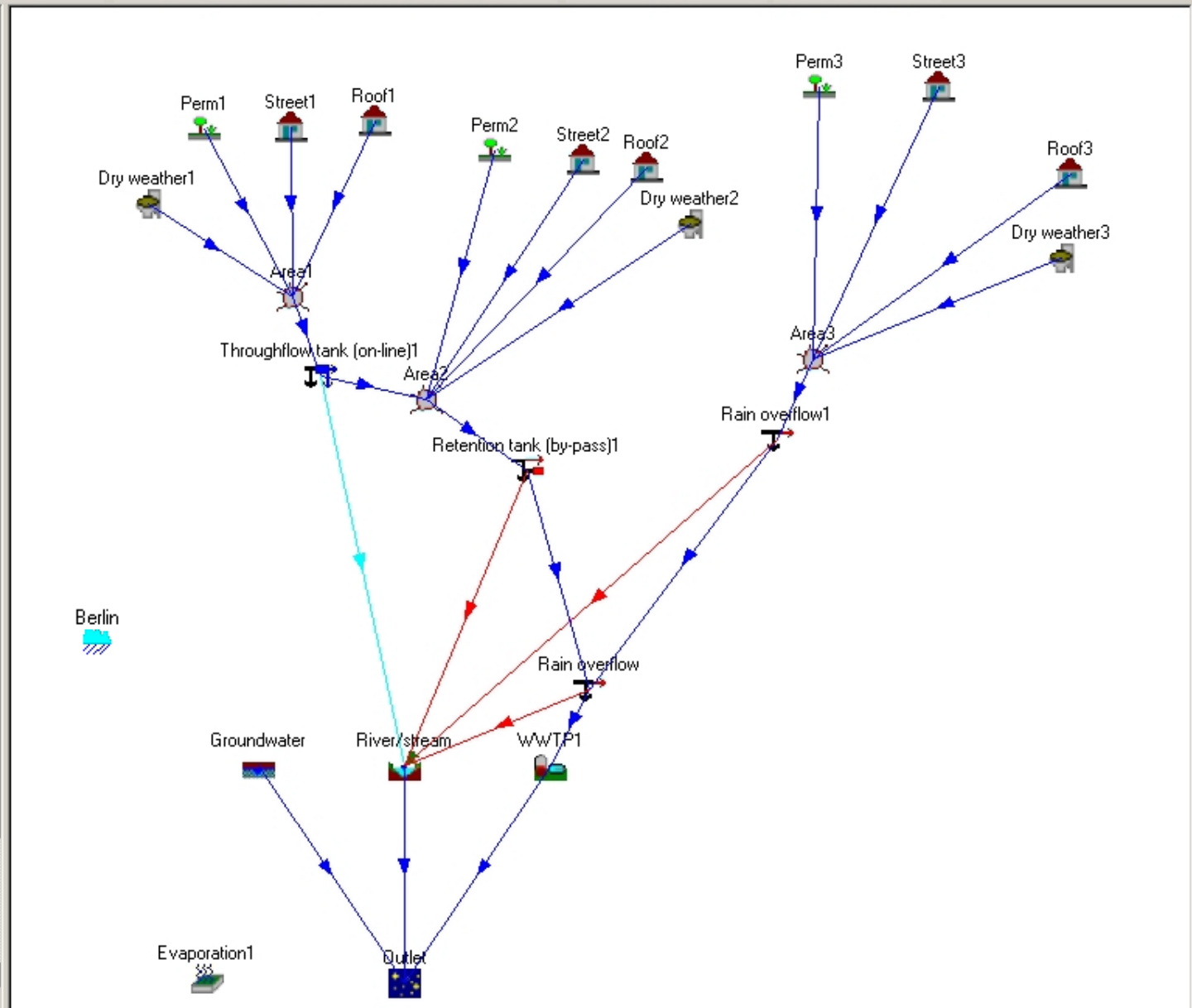
Dataset from Sewsys-Database

- [-] Catchment Area
 - [-] Vasastaden
 - [-] Sweden
 - [-] Hammarby Sjostad
 - [-] Karlebo (DK)

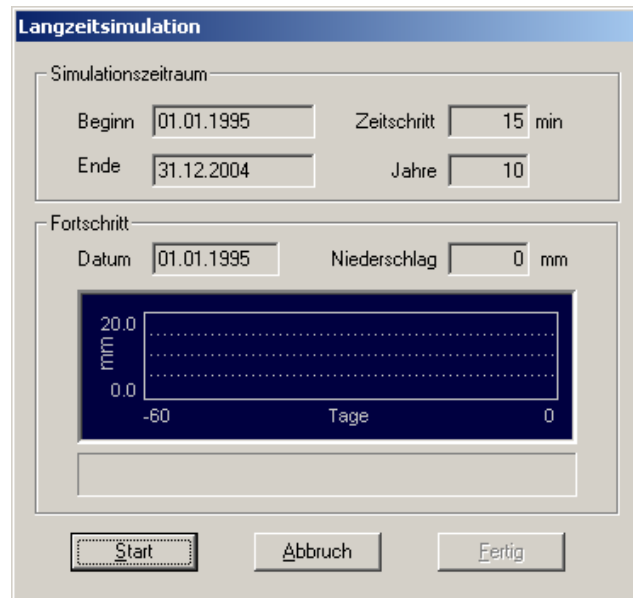
OK Cancel



- Rain-Runoff Model
 - General Info
 - Substance parameters
 - Hydrographs
 - Rain data
 - Evaporation
 - Runoff formation parameter
 - Impermeable
 - Permeable
 - decentral
 - Soil Classes
 - Areas
 - Catchment Area
 - Dry Weather
 - Drainage element
 - Decentral Elements
 - Grassed Roofs
 - Cisterns
 - SurfaceInfiltration
 - Troughs
 - Trough-Trench-Element
 - Innodrain®
 - Trenches
 - Centralized elements
 - connecting pipes
 - Stormwater retention
 - Rain clarification basin
 - Soil filter retention tank
 - MW Element
 - On-line Retention Tank
 - By-pass Retention Tank
 - Throughflow Tank On-line
 - Throughflow Tank By-pass
 - Sewer with storage capacity
 - Sewer with storage capacity
 - Rain overflow
 - Branching
 - Natural Watercycle
 - Groundwater
 - Evaporation



Rain data for long-term simulation



Several years of historical rain data for the site

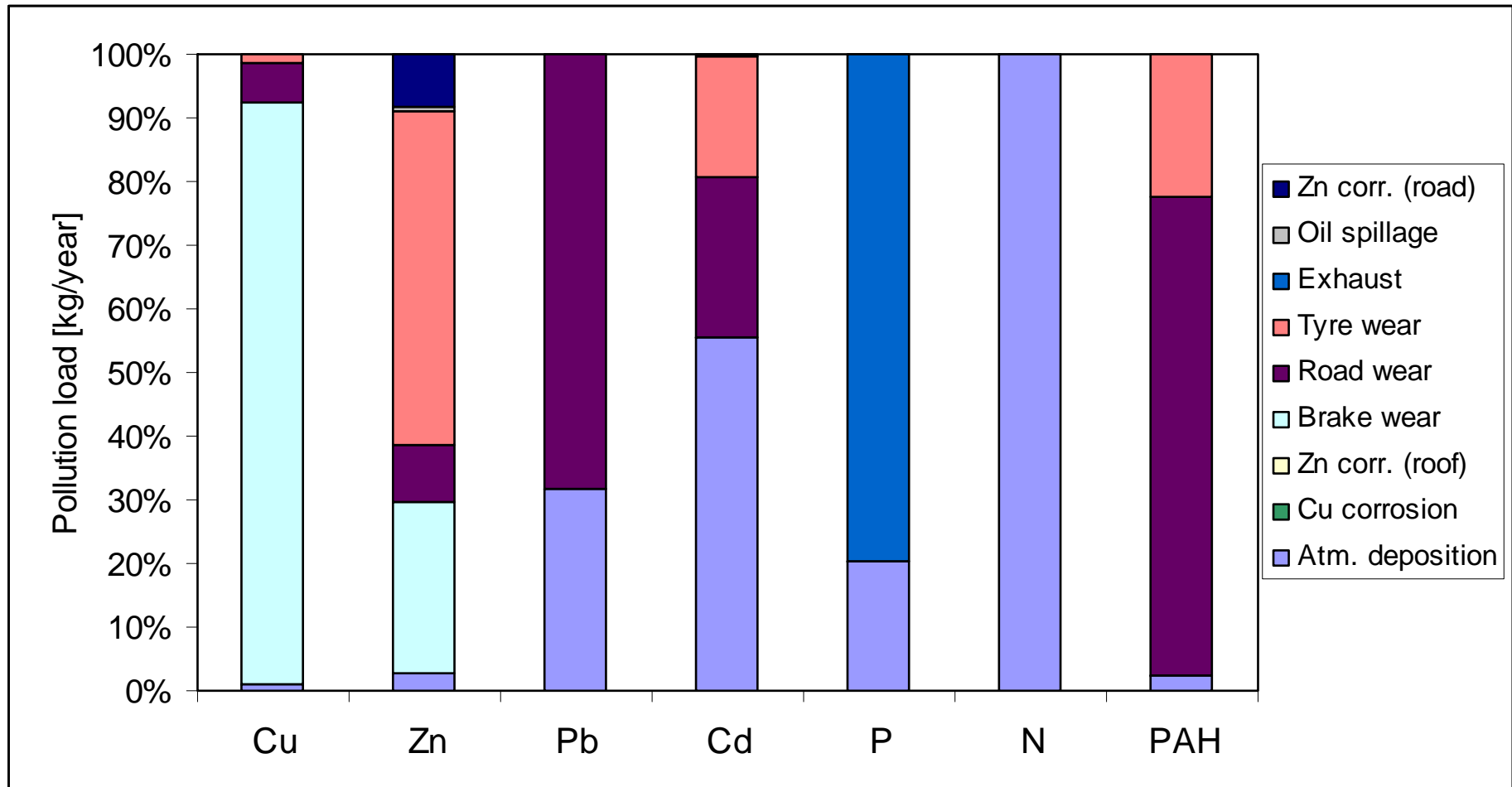
Example of results

– pollution load

	Cu	Zn	Pb	Cd	P	N	PAH
Load [kg/year]	42	66	3.1	0.10	24	381	0.30
Load per unit area [kg/imp. ha/year]	0.84	1.3	0.06	0.002	0.45	7.5	0.006
SMC [mg/L]	0.161	0.250	0.012	0.0004	0.093	1.5	0.0012

Example of results

– pollution sources



Indicators (Output to ADSS)

- Runoff fraction
- Discharges to different recipients
- Overflow events
- Total mass flow from different sources
- Total mass flow to different recipients
- % of total mass flow from different sources
- % of total mass flow to different recipients

STORM/SEWSYS is able to:

- Give overall water balances and BMP performance with respect to quantity
- Provide catchment-specific pollution data
- Identify the important sources of pollution in a catchment
- Make it possible to study the effects of both structural and non-structural BMPs