Application of the AISUWRS-Computer-Tools for the balancing of urban water and contaminant fluxes under special consideration of sewer defects

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AISUWRS

General frame and funding

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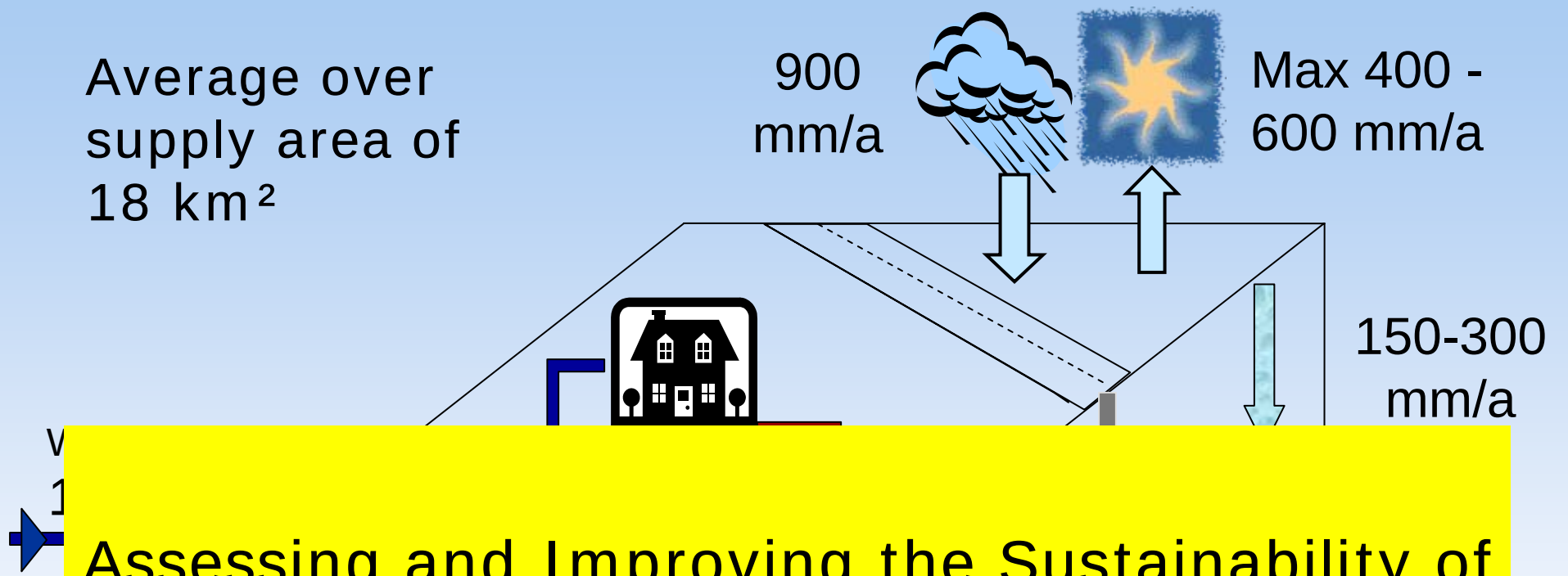
Structure of the presentation

- Introduction: groundwater in urban areas
- In- & output fluxes of urban areas
- The AISWURS model chain
- Application on a case study city
- Results and conclusions

Introduction, problem definition

Groundwater Status	Potential Consequences	Example Cities
Rising groundwater levels	Cellar & basement flooding, increased infiltration of groundwater into the sewer systems, increased construction costs for new buildings, etc.	Dessau (Riemann 2003), Berlin (Limberg 2006), Hamburg, Barcelona (Kofod 2001), Moscow (Dhzamalov 2001), Buenos Aires
Declining groundwater levels (in topmost or deeper aquifers)	Water scarcity, land subsidence, damage to buildings, drying of groundwater dependent aquatic habitats, increased flooding danger in coastal cities (e.g.Venice)	Mexico City, Bangkok, Venice
Water **quality deterioration**	Health risks, usage restrictions, water scarcity	Almost every urban area. Example for fatal consequences: Lusaka.

In- & output fluxes of urban areas



Assessing and Improving the Sustainability of Urban Water Resources and Systems

AISUWRS

The AISUWRS model chain

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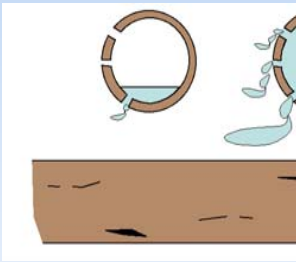
UVQ
Urban Volume & Quality

DSS

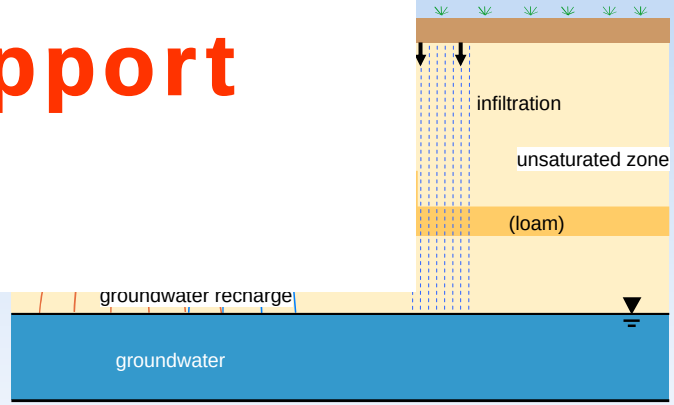
(Decision Support System)

NEI



Network Ex- and Infiltration

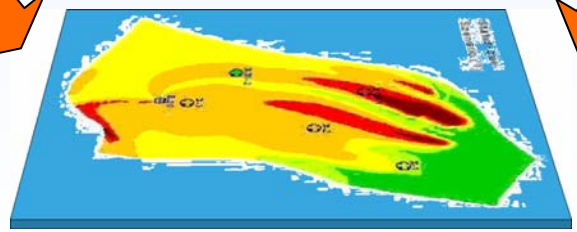
POSI



Unsaturated Zone

GIS-Application

Groundwater flow and transport model



model chain

The AISUWRS model chain

- Mt. Gambier/Australia
  - A Karstic Aquifer System
  - Water supply derives from surface water reservoir, Blue Lake
- Doncaster/UK
  - A Sandstone Aquifer
- Ljubljana/Slovenia
  - A Layered Aquifer System
  - Septic tanks, scarce database
- Rastatt/Germany
  - A Porous Aquifer

The AISUWRS model chain

Scenario-approach:

- Description of the actual state
- Evaluation of the system due to changing boundary conditions
- Sustainability assessment

Scenario	Description
Base line	water and substance fluxes for the actual state
Infiltration	infiltration of roof runoff
Grey water reuse	decentralized waster water treatment, reuse
Climate change	climate data from 2070-2100
Population growth	actual state combined with statistical data
Sewer rehabilitation	rehabilitation of sewers with larger defects

Application on a case study city

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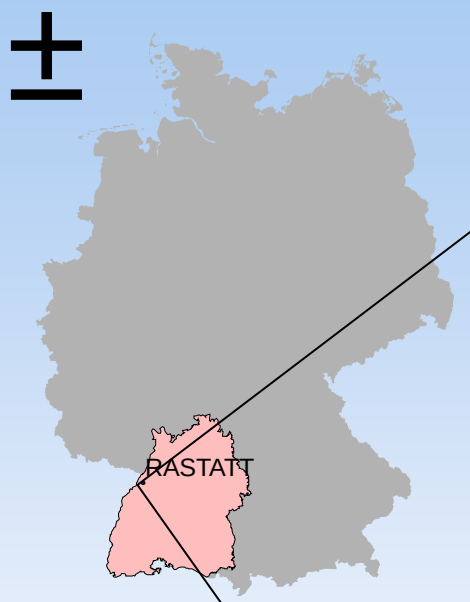
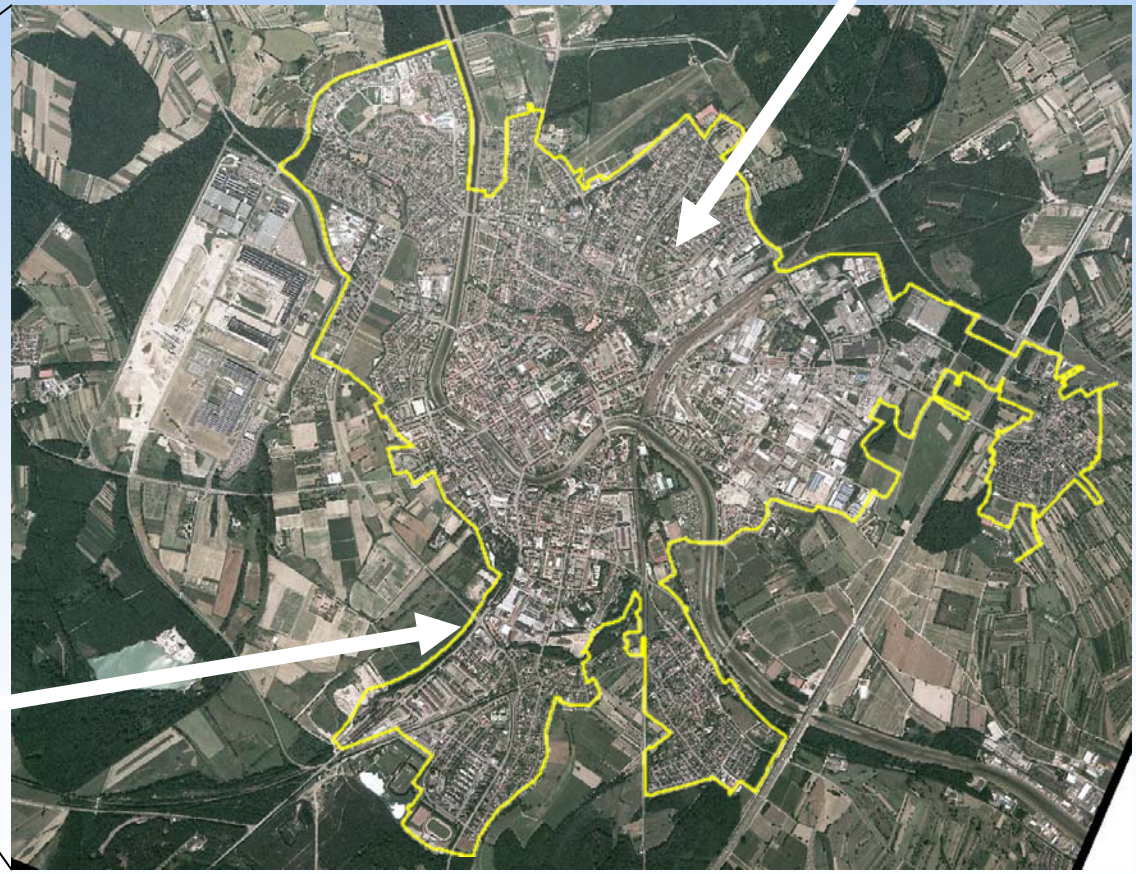


Urban Area of Rastatt



Test site

Application on a case study city

- UVQ (fluxes in the sewer)
  - Demographic data (nb of households, population density, water consumption data)
  - Physical data (area distribution of roof, garden, road; soil properties)
  - Contaminant data: Concentration of runoff, load per capita per day (literature)
- NEIMO (Ex- Infiltration of sewer pipes)
  - Pipe properties (length, gradient, material, age, etc.)
  - Bedding material of pipes
  - Nb of house connections, location relativ to groundwater
- SleakI, POSI (unsaturated zone models)
  - Thickness of the soil, soil properties, substance properties

Case Study City Rastatt

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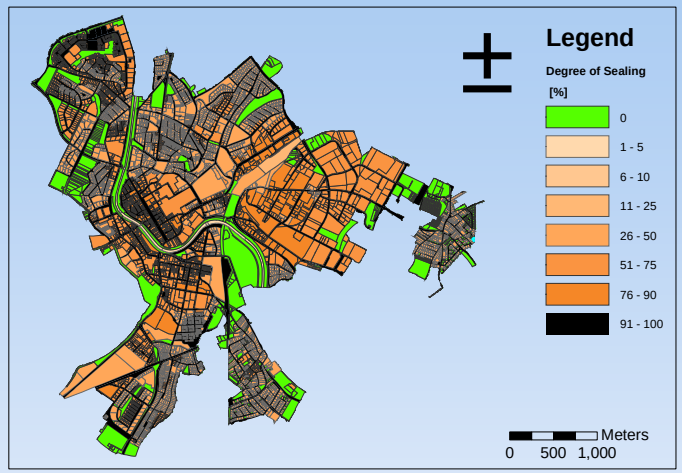
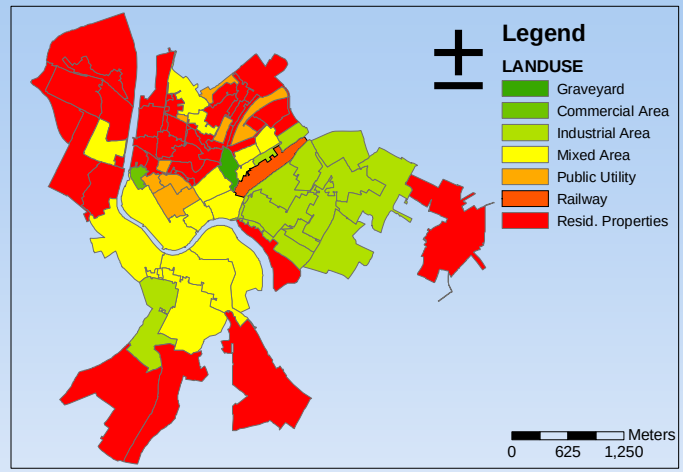
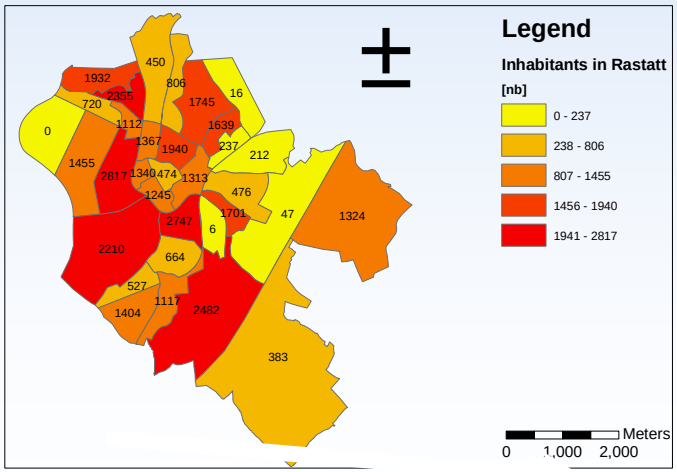
Degree of sealing

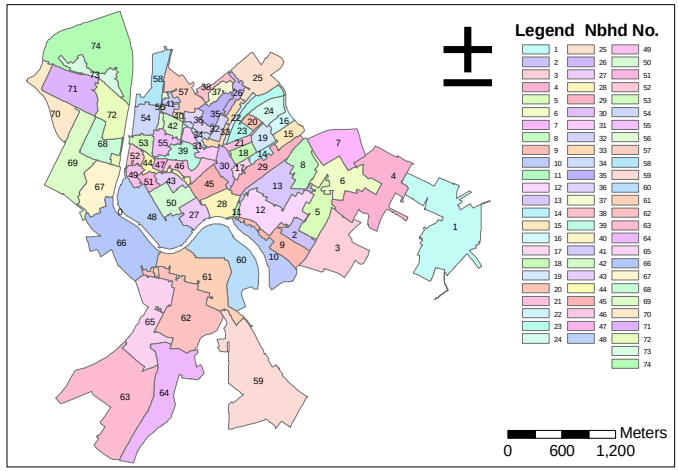


Land use



Population density





data processed

Field investigations - calibration

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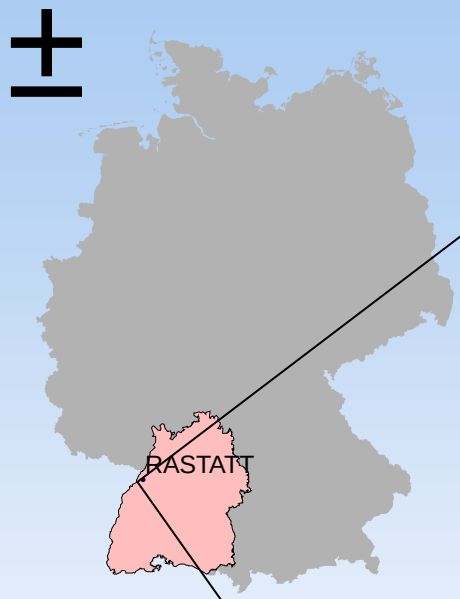
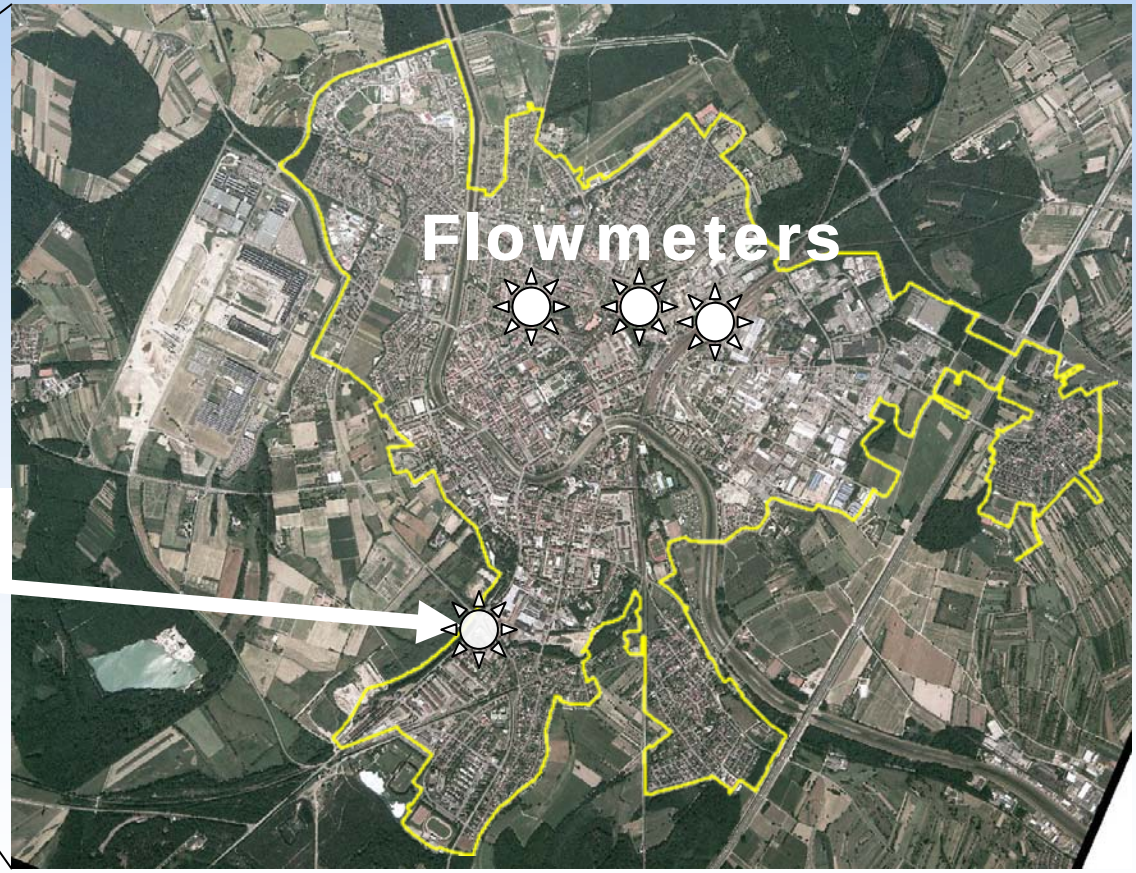


Urban area Rastatt

Test site



Test site Kehler Straße

Leak 2: investigatio
soilwater budget

Measuring program
•TDR: Soil moistur
•Tensiometer: wat
tension
•Suction cups: wat
samples

1: measurement
filtration

uring program:
ntity: Exfiltration rate
lity: On-site
meters, main elements,
maceuticals, HM, etc.
wage and leakage

Control panel (TDR)

Instrumentation

Crack: 120cm²

Collector tank

Suction cups

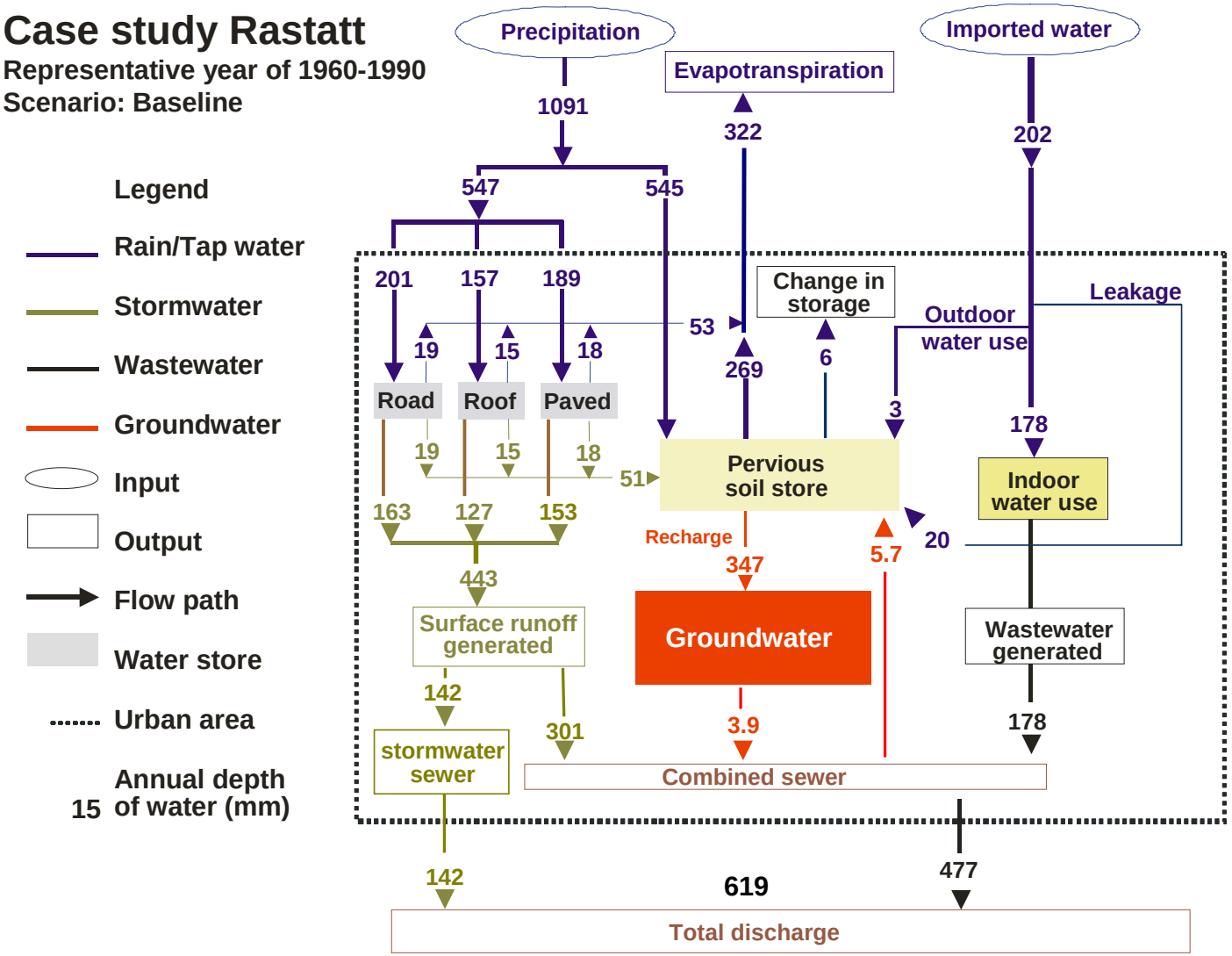
Test site

Drop
counter

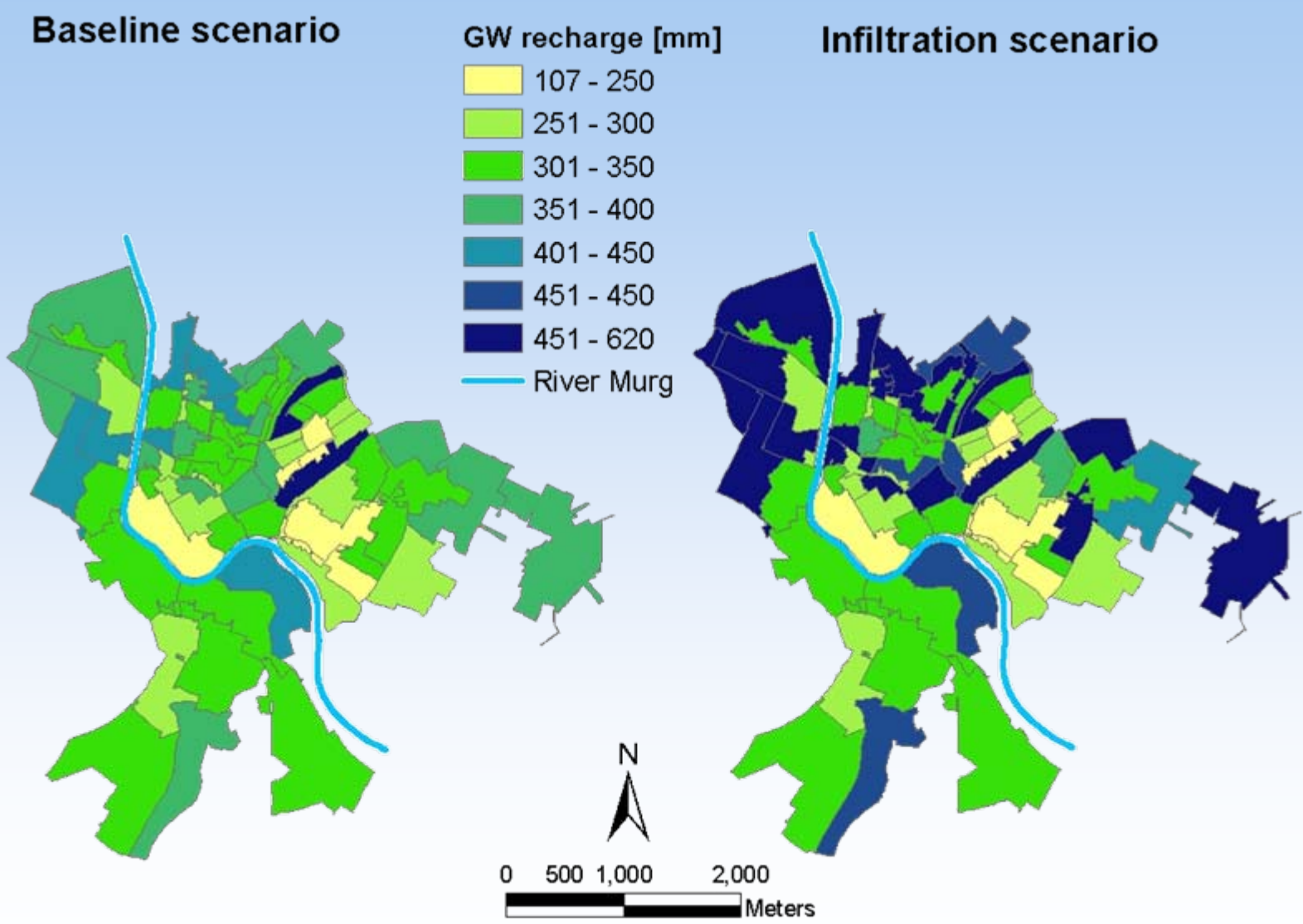
Results: total model chain

Case study Rastatt

Representative year of 1960-1990
Scenario: Baseline

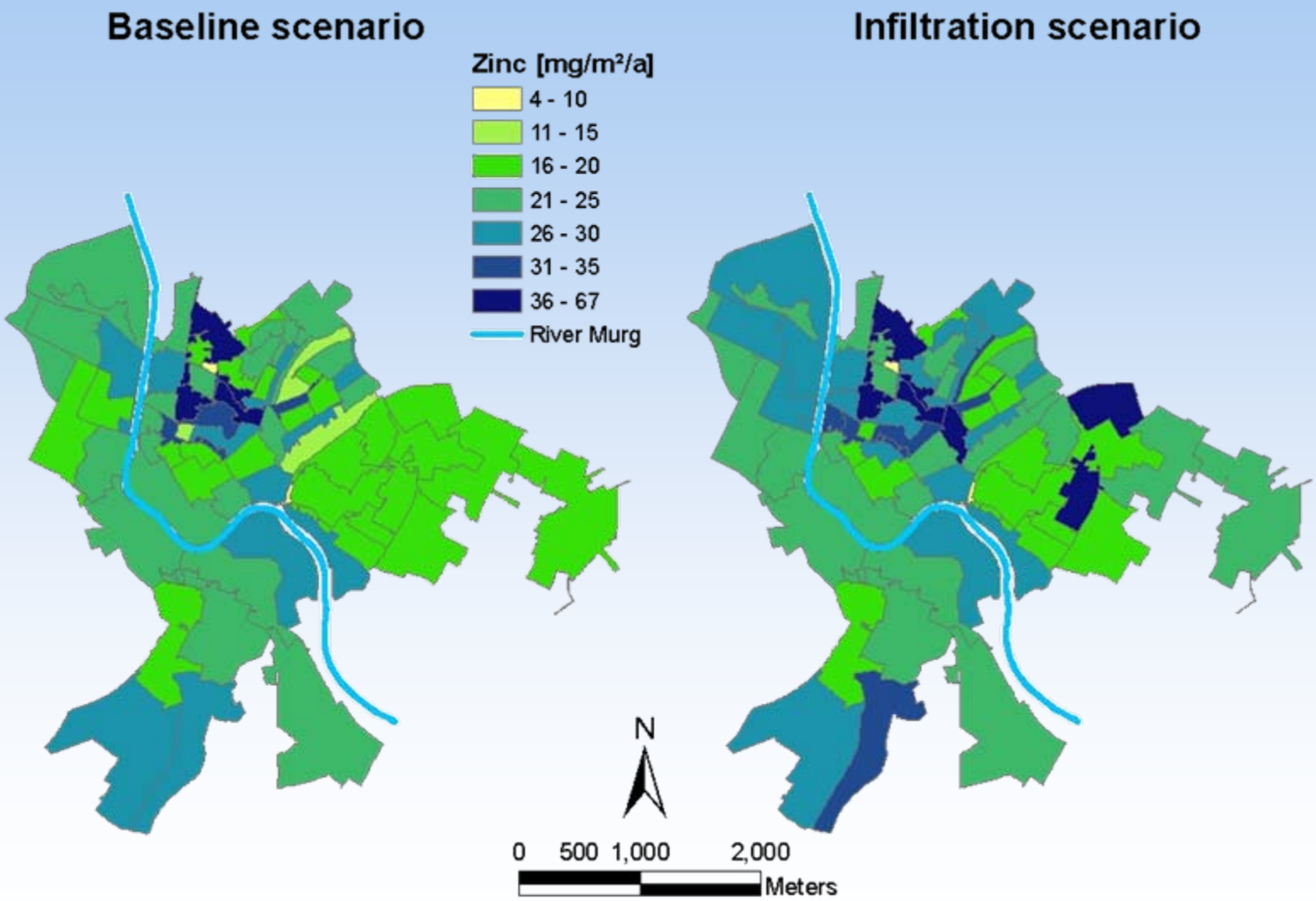


Results: total model chain



gw-recharge

Results: total model chain



Zn-load to gw

Results: NEIMO

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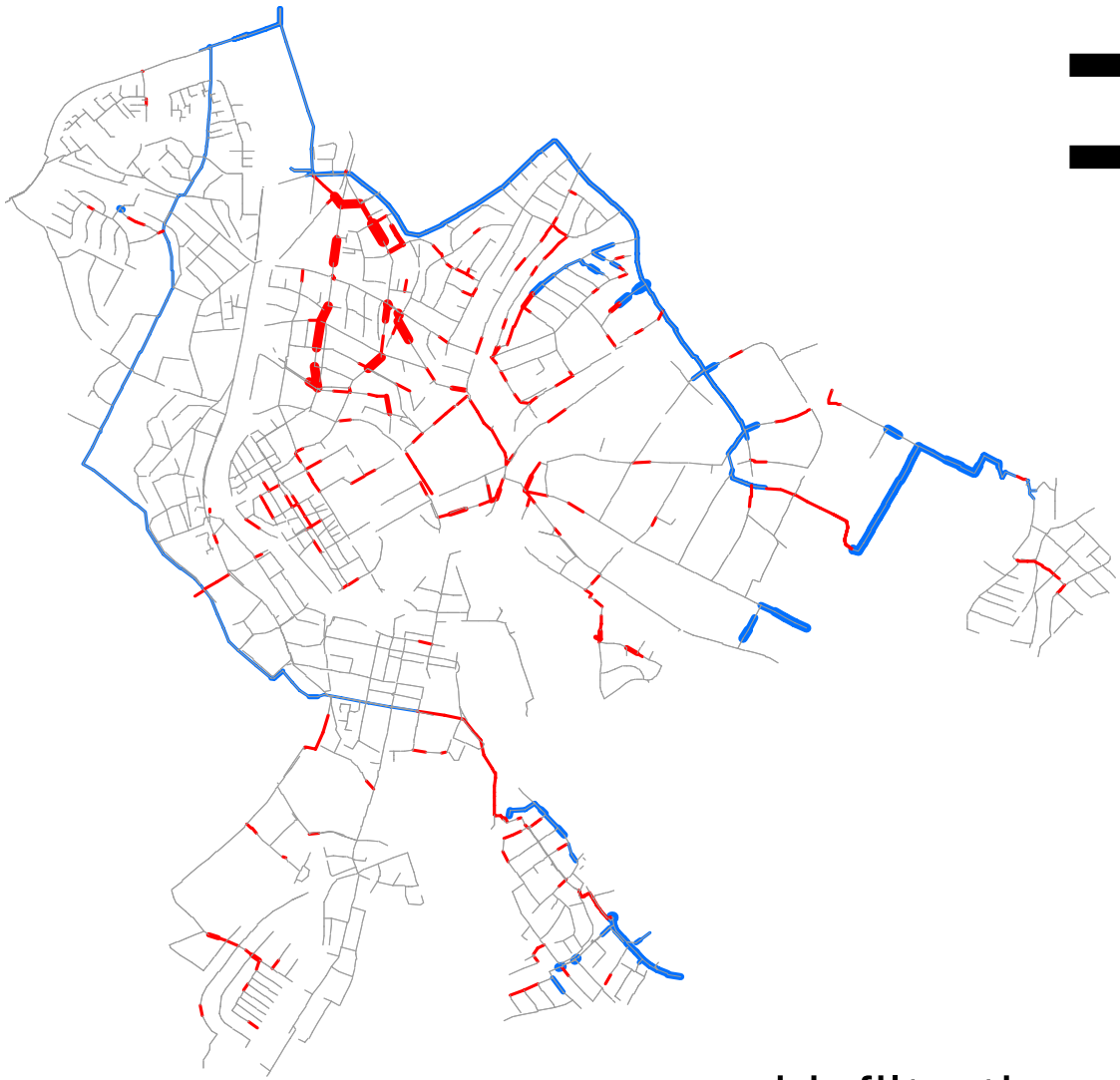
Ex- and Infiltration for the year 2003



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- All defetct of the sewer database included
- Groundwater recharge through leaky sewers: 0.8mm/a

Infiltration [m³/a]	Exfiltration [m³/a]
0 - 1	0 - 1
2 - 20	2 - 20
21 - 100	21 - 100
101 - 200	101 - 200
201 - 1000	201 - 1000
1001 - 6000	1001 - 6000

ex- and infiltration

Summary and Conclusion

- Application of the AISUWRS model chain on existing urban areas
- Illustration and tracking of the urban water and contaminant fluxes
- Spatial referenced area related contaminant loads to the groundwater
- Tool for sustainability analysis (actual state, scenarios)
- NEIMO gives estimates for sewage exfiltration (quality and quantity), risk assessment, decision aid
- AISUWRS tool box as planning tool

Thanks for your attention.

Questions, suggestions?

All results for download at:

www.urbanwater.de

Project description available.

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