

Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

HYDRO_AS-2D Anwendertreffen 2020

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Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

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Kanalnetzmodell



Kanalüberstau 2018 Wuppertal (Quelle: youtube.com)

Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

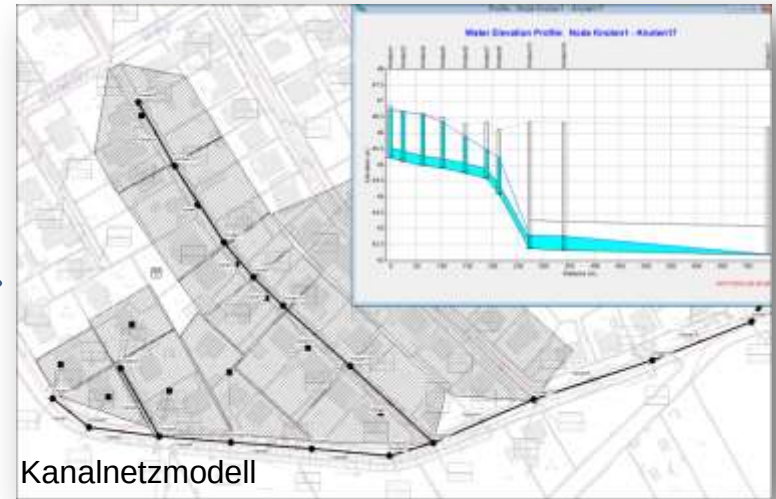
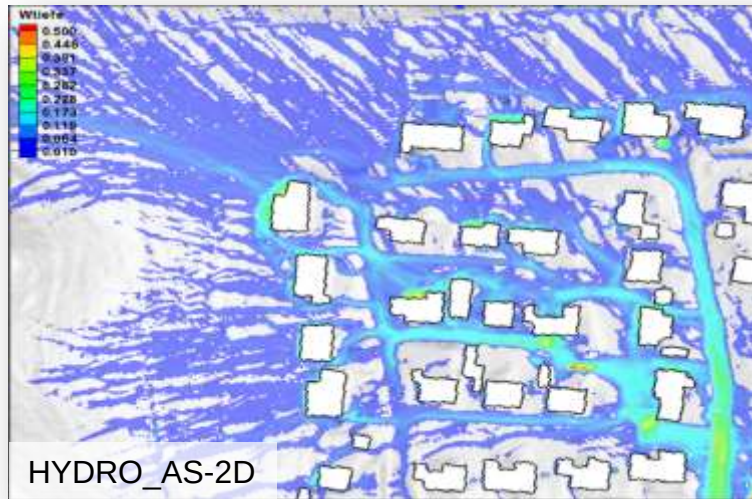
Bidirektionale Kopplung von HYDRO_AS-2D und EPA-SWMM während der Simulation (Kanalnetz-Online-Kopplung):

- was HYDRO_AS-2D schon kann:
 - Offline-Kopplung (Überstau-ZR einlesen aus vorh. Kanalnetzberechnung)
 - Straßenabläufe (LF vorgeben)
- neu für HYDRO_AS-2D:
 - Online-Kopplung mit EPA-SWMM 5
 - für urbane dicht bebaute Gebiete
 - für Wiederkehrzeiten 2 bis 30 a
 - Überstaunachweise nach DIN EN 752
 - hydrodynamische Berechnung langer Verdolungen



Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

Konzept: Bidirektionale Kopplung von HYDRO_AS-2D und EPA-SWMM



Quelle: LZonline

Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

United States Environmental Protection Agency Storm Water Management Model

Introducing EPA SWMM

The EPA Storm Water Management Model (SWMM) is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of subcatchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators. SWMM tracks the quantity and quality of runoff generated within each subcatchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps.

Urban Wet Weather Flows

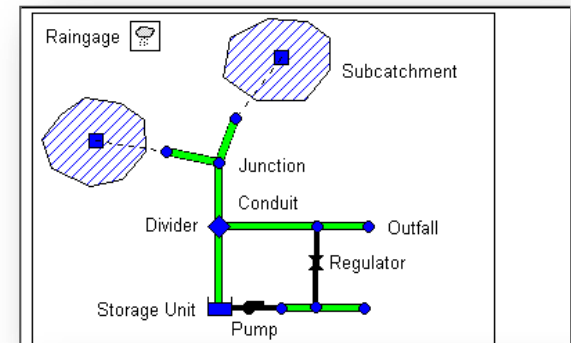
The diagram illustrates the flow of water in an urban environment during wet weather. It shows residential and industrial areas contributing to sanitary and industrial wastewater. Stormwater is collected from streets and basins. These flows are managed through a combined sewer system, which includes pumps, control devices, and interceptors. The system can handle overflow, leading to erosion or bypassing treatment. The final destination is a wastewater treatment plant, which produces fully treated effluent.

“SWMM was first developed between 1969–1971...”

SWMM was first developed in 1971 and has undergone several major upgrades since then. It continues to be widely used throughout the world for planning, analysis and design related to storm water runoff, combined sewers, sanitary sewers, and other drainage systems in urban areas, with many applications in non-urban areas as well. The current edition, Version 5, is a complete re-write of the previous release. Running under Windows, SWMM 5 provides an integrated environment for editing study area input data, running hydrologic, hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded drainage area and conveyance system maps, time series graphs and tables, profile plots, and statistical frequency analyses.

This latest re-write of SWMM was produced by the Water Supply and Water Resources Division of the U.S. Environmental Protection Agency's National Risk Management Research Laboratory with assistance from the consulting firm of CDM, Inc.

EPA SWMM

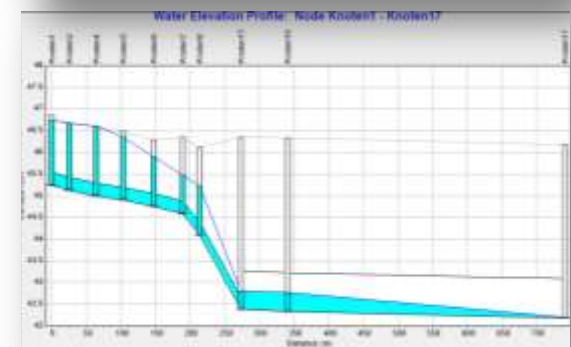


LID Controls are low impact development practices designed to capture surface runoff and provide some combination of detention, infiltration, and evapotranspiration to it. They are considered as properties of a given subcatchment, similar to how Aquifers and Snow Packs are treated. SWMM can explicitly model the following generic types of LID controls:



Bio-retention Cells are depressions that contain vegetation grown in an engineered soil mixture placed above a gravel drainage bed. They provide storage, infiltration and evaporation of both direct rainfall and runoff captured from surrounding areas.

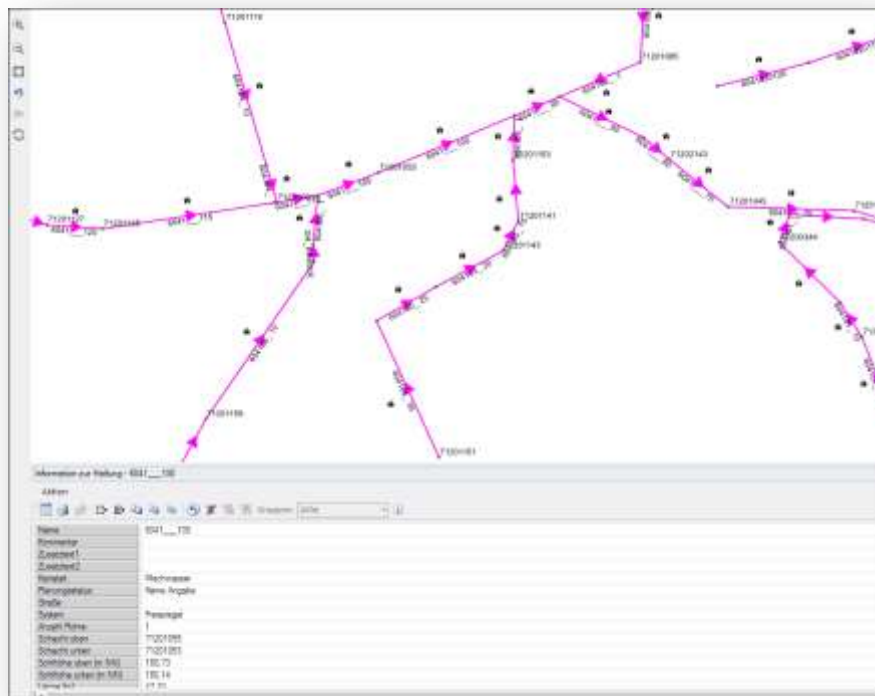
Rain Gardens are a type of bio-retention cell consisting of just the engineered soil layer with no gravel bed below it.



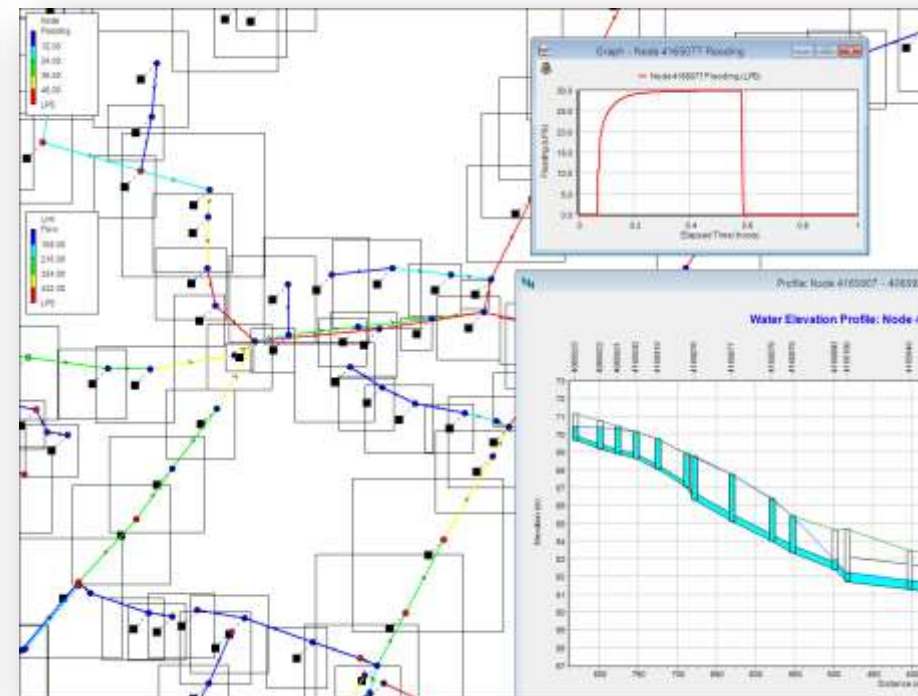
Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

Hydrotec-Kanalnetzmodell-Konverter:

- HYSTEM-EXTRAN → EPA SWMM 5
 - idbf (Version 7)
 - sqlite (ab Version 8)
- später evtl. auch Kanal++, DHI Mouse etc. konvertieren möglich



Kanalnetzmodell HYSTEM-EXTRAN 8.2



Kanalnetzmodell EPA SWMM 5.1

Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

Abflussbildung unbefestigte Flächen:

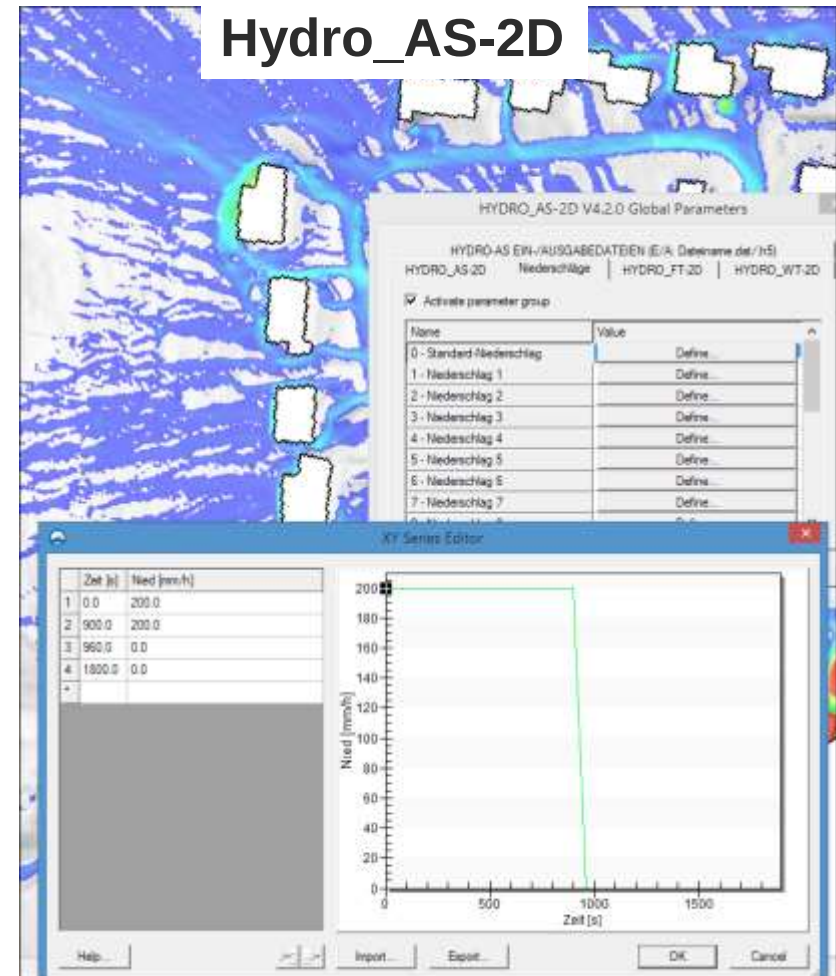
EPA-SWMM

The screenshot displays the EPA-SWMM interface. On the left, a 'Property' list for a subcatchment is shown, with 'Infiltration' highlighted by a red circle and set to 'MODIFIED_HORTON'. Below this, a 'Rain Gauge: Regen1' properties window is open, showing 'Rain Format' as 'INTENSITY', 'Time Interval' as '0.05', and 'Data Source' as 'TIMESERIES'. The 'TIME SERIES' section shows 'Series Name' as 'Regen2014'. The 'DATA FILE' section shows 'File Name' as '*' and 'Station ID' as '*'. The 'Rain Units' are set to 'mm'.

Property	Value
Name	Regen1
X-Coordinate	306718.882
Y-Coordinate	5176750.292
Description	
Tag	
Rain Format	INTENSITY
Time Interval	0.05
Snow Catch Factor	1.0
Data Source	TIMESERIES
TIME SERIES	
- Series Name	Regen2014
DATA FILE	
- File Name	*
- Station ID	*
Rain Units	mm

n. Horton

Hydro_AS-2D



Effektivniederschlag
+ Versickerung

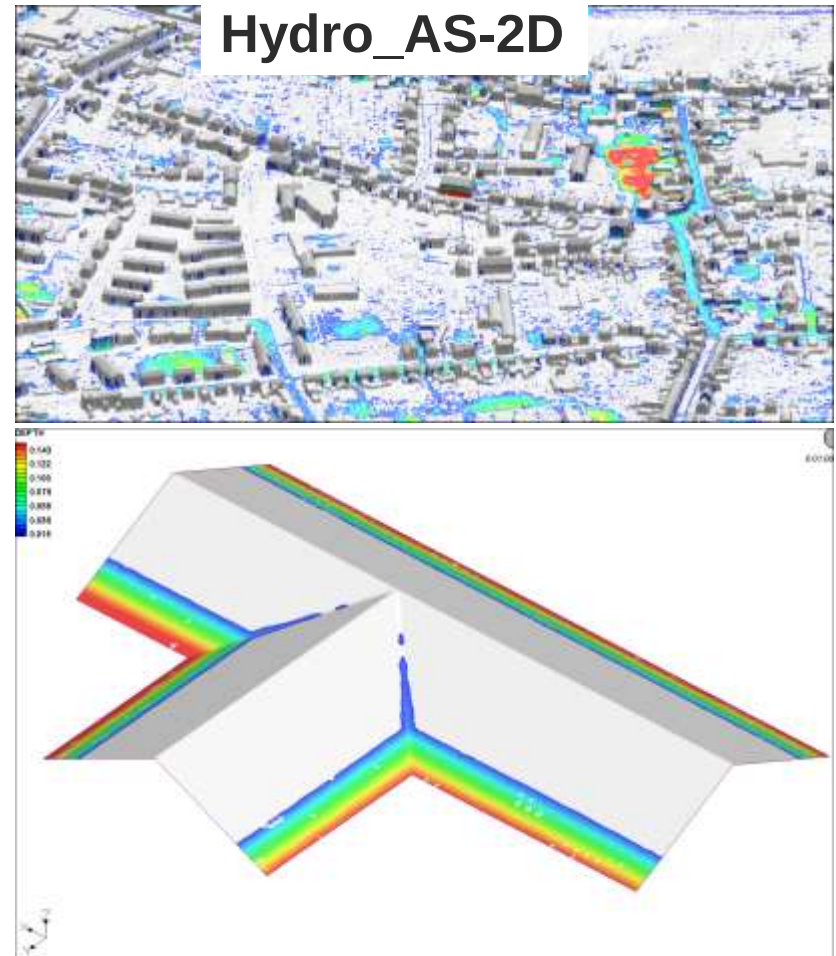
Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

Abflussbildung befestigte Flächen:

Subcatchment	
Name	Subcatchment name.
X-Coordinate	Horizontal location of the subcatchment's centroid on the Study Area Map. If left blank then the subcatchment will not appear on the map.
Y-Coordinate	Vertical location of the subcatchment's centroid on the Study Area Map. If left blank then the subcatchment will not appear on the map.
Description	Click the ellipsis button (or press Enter) to edit an optional description of the subcatchment.
Tag	Optional label used to categorize or classify the subcatchment.
Rain Gage	Name of the rain gage associated with the subcatchment.
Outlet	Name of the node or subcatchment that receives the subcatchment's runoff.
Area	Area of the subcatchment, including any LID controls (acres or hectares).
Width	Characteristic width of the overland flow path for sheet flow runoff (feet or meters). (More...)
% Slope	Average percent slope of the subcatchment.
% Imperv	Percent of the land area (not including any LIDs) which is impervious.
N-Imperv	Manning's n for overland flow over the impervious portion of the subcatchment (Typical Values).
N-Perv	Manning's n for overland flow over the pervious portion of the subcatchment (Typical Values).
Dstore-Imperv	Depth of depression storage on the impervious portion of the subcatchment (inches or millimeters) (Typical Values).
Dstore-Perv	Depth of depression storage on the pervious portion of the subcatchment (inches or millimeters) (Typical Values).
% Zero-Imperv	Percent of the impervious area with no depression storage.
Subarea Routing	Choice of internal routing of runoff between pervious and impervious areas: IMPERV: runoff from pervious area flows to impervious area PERV: runoff from impervious flows to pervious area OUTLET: runoff from both areas flows directly to outlet
Percent Routed	Percent of runoff routed between subareas.
Infiltration	Click the ellipsis button (or press Enter) to edit infiltration parameters for the subcatchment.

EPA-SWMM

Hydro_AS-2D

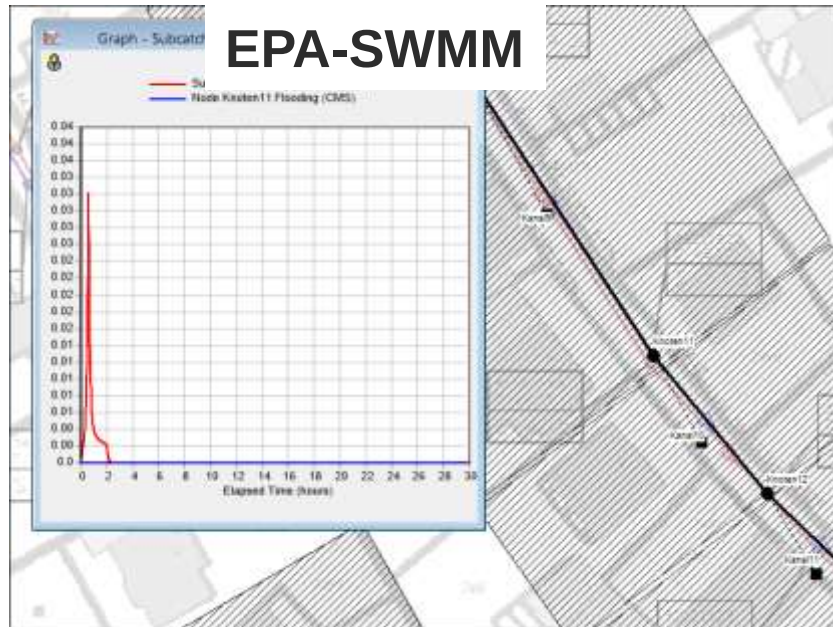


Berechnung von Dachflächen möglich (Dachrinnen)
Straßen (-> StrE)

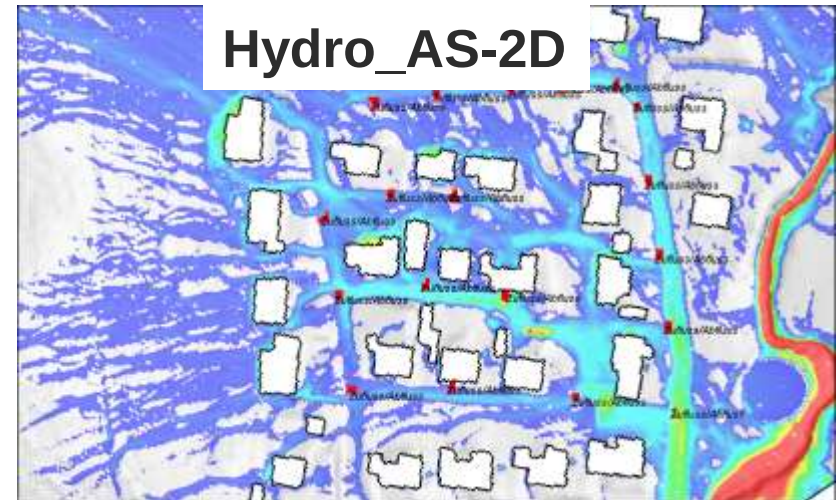
über Befestigungsgrad und Gefälle

Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

Schächte und Regeneinläufe (Gullys):

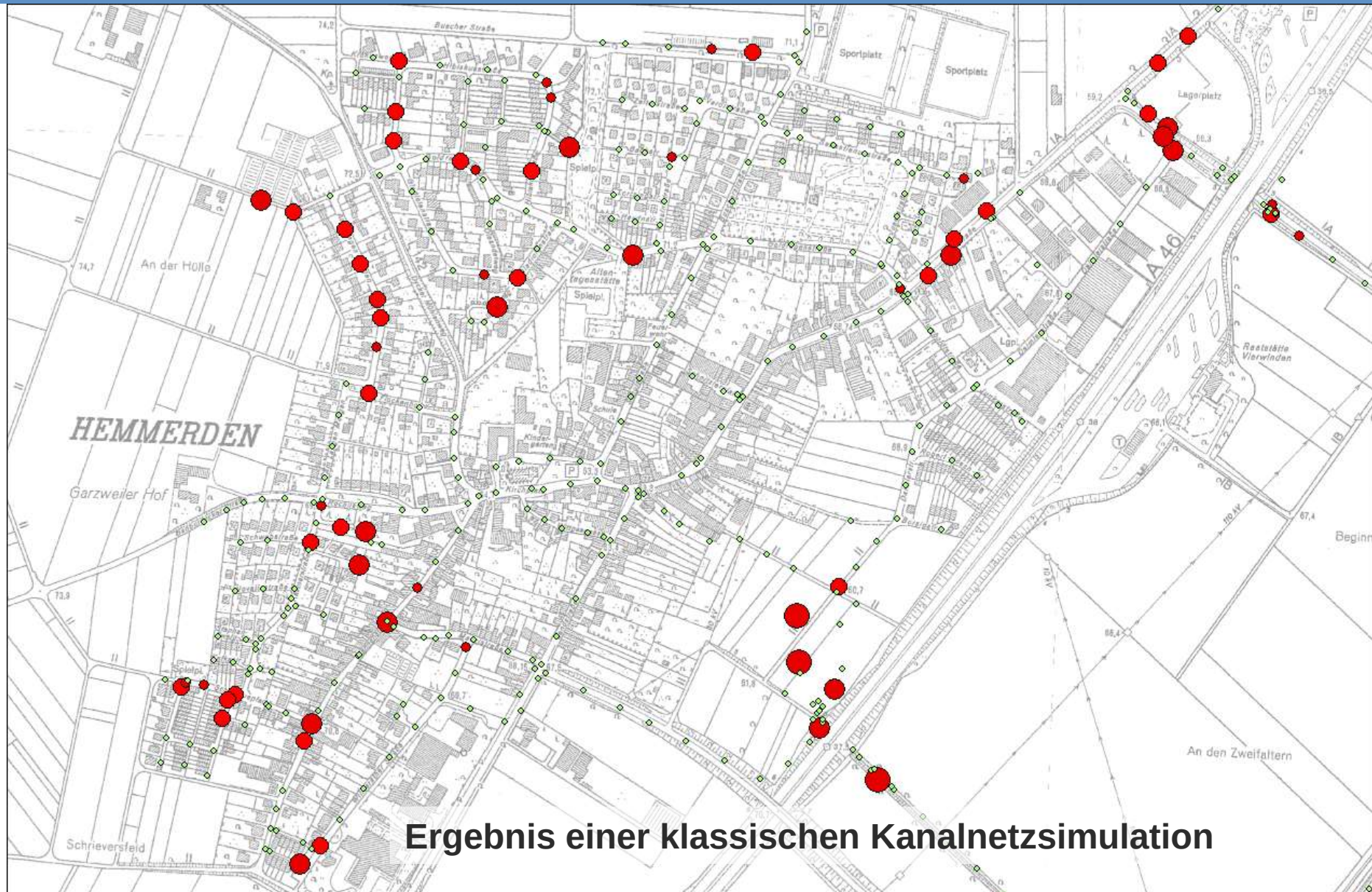


- Node (Schacht)
 - flooding, sealed, spilling



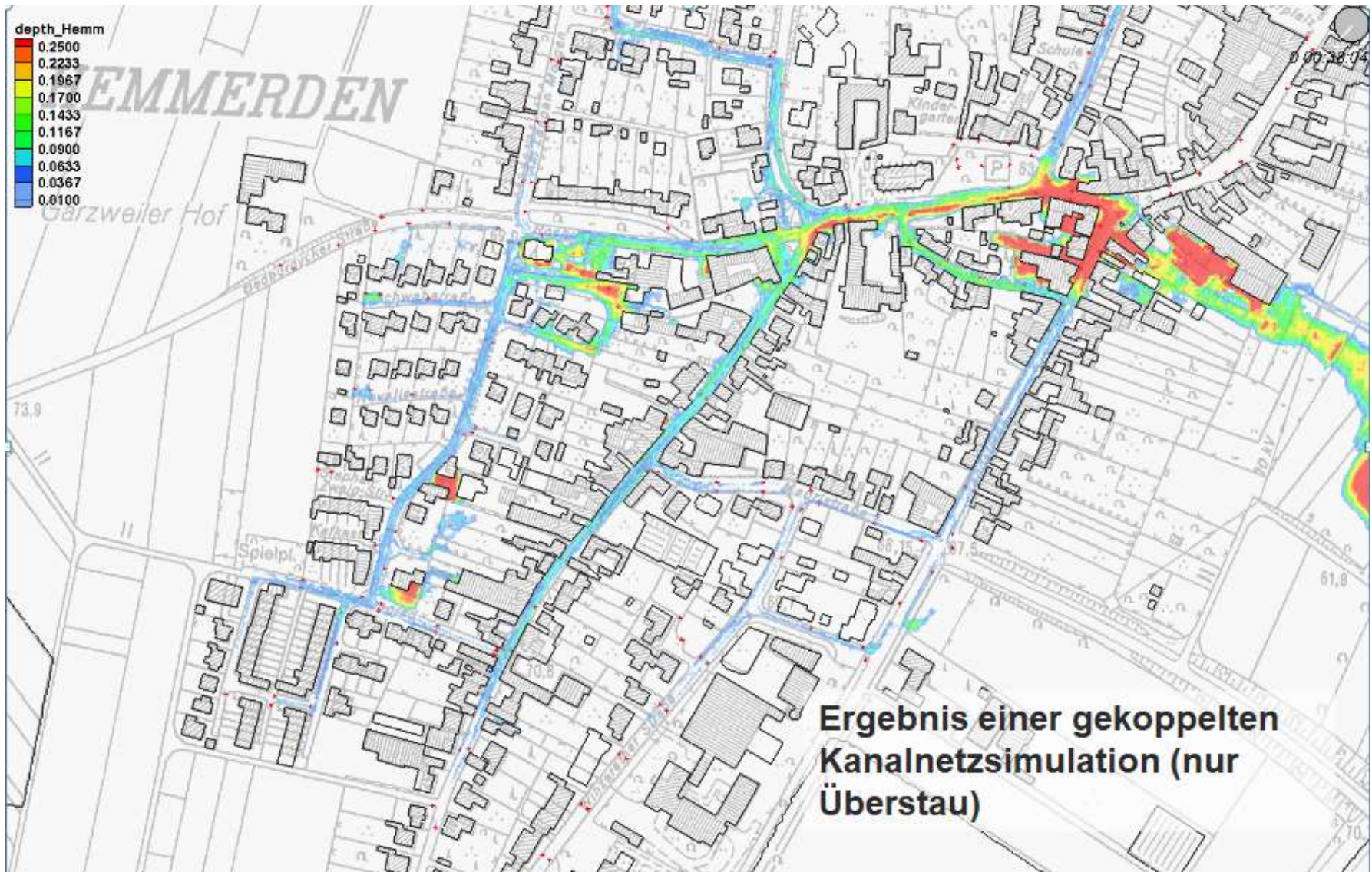
- Straßeneinläufe (Gullys):
 - Berechnung nach RAS-Ew
 - geometrische Abbildung
- Schächte:
 - Überstau

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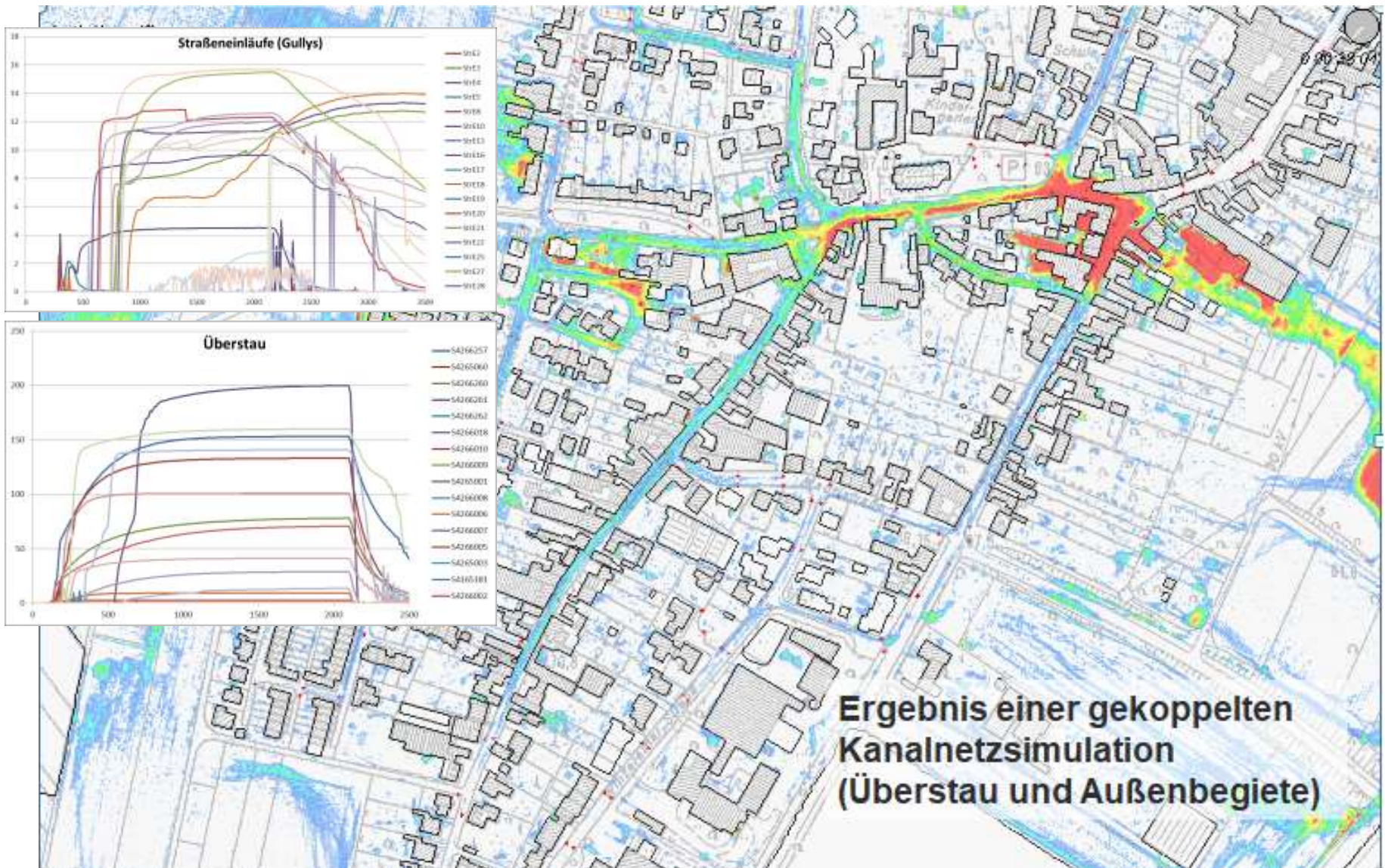


Ergebnis einer klassischen Kanalnetzsimulation

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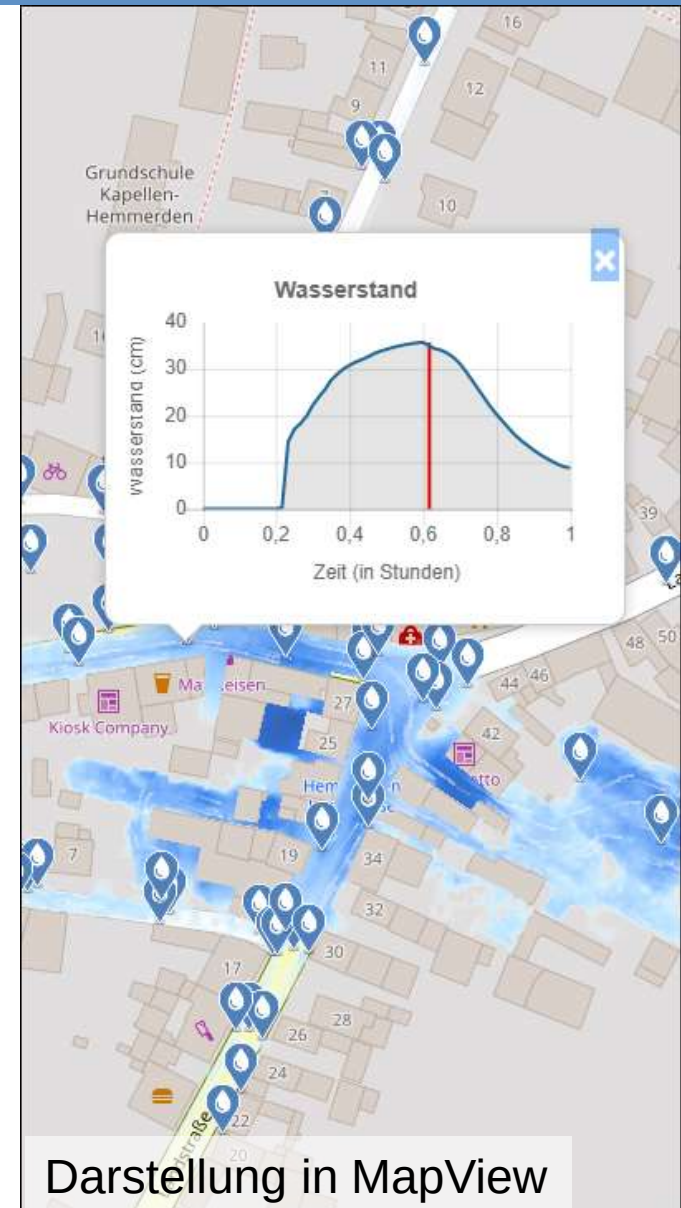
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Kopplung von HYDRO_AS-2D mit einem Kanalnetzmodell

Zusammenfassung/Fazit:

- ▶ Beispielmmodell ca. 1,5 Mio. Knoten, 60 Minuten werden simuliert, 30 Minuten Niederschlag
 - ▶ Hydro_AS-2D ohne Kanalkopplung: ca. 40 min
 - ▶ Hydro_AS-2D mit SWMM-Kanalkopplung: ca. 70 min
- ▶ Kanalnetzberechnung ohne Kopplung
Oberfläche: Unterschätzung der Auslastung/Überstau Kanal in tiefer liegenden Bereichen
 - ▶ Klassisch: Außenbereiche müssten mit simuliert werden
 - ▶ Überstau kann nicht zum nächsten freien StrE laufen
- ▶ Vorteil Kanalnetzkopplung: Zeit- und Ortsgenaue Berechnung Überstau und Wiedereinschöpfung
- ▶ Vorteil Flächenaufteilung Abflussbeitrag
- ▶ Kopplung eher für $T_n < 20$, danach kaum Unterschiede



Vielen Dank für Ihre Aufmerksamkeit!

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