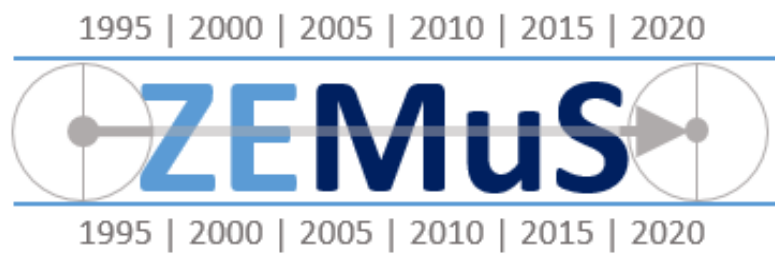


# Condition assessment and modelling

*- an overview of current projects of IKT -*



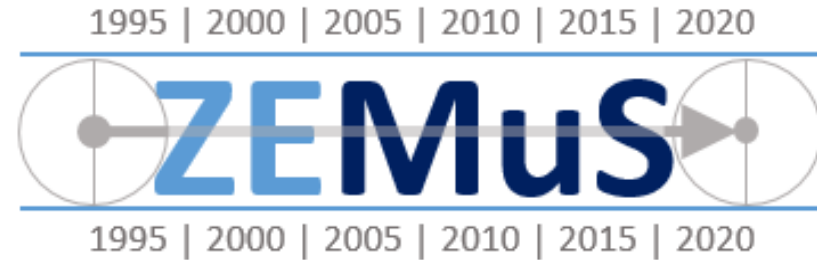
**Deterioration of sewer assets**



**Co-UDlabs**

**WP 7: Asset Deterioration**

**Transnational Access: How to get involved?**



## Research Project **ZEMUS**

Zustandsentwicklung von Abwasserkanälen und -  
bauwerken, datenbasierte Prognosen, bautechnische  
Modelle und risikoorientierte Strategien

**Deterioration of sewer assets, data-based forecasts,  
structural models and risk-based strategies**

## - background -



## North Rhine-Westphalia



### Regional Water Legislation: „Self-Monitoring Ordinance for Sewer Assets“

- since 1995
- first inspection period (within 10 years the whole network)
- then: period of 15 years

## - project partners -



Funded by Ministry of Environment of  
North Rhine-Westphalia

Attending Municipalities	Population	Length of sewer system
Cologne	1 Mio.	2.400 km
Essen	500.000	1.495 km
Duisburg	500.000	1.495 km
<b>Gelsenkirchen</b>	<b>260.000</b>	<b>716 km</b>
Hagen	190.000	675 km
Leverkusen	160.000	670 km
Neuss	160.000	840 km
Arnsberg	70.000	500 km
Sankt Augustin	57.000	230 km
Schwerte	48.000	250 km
Burscheid	18.000	130 km

Attending Municipalities:

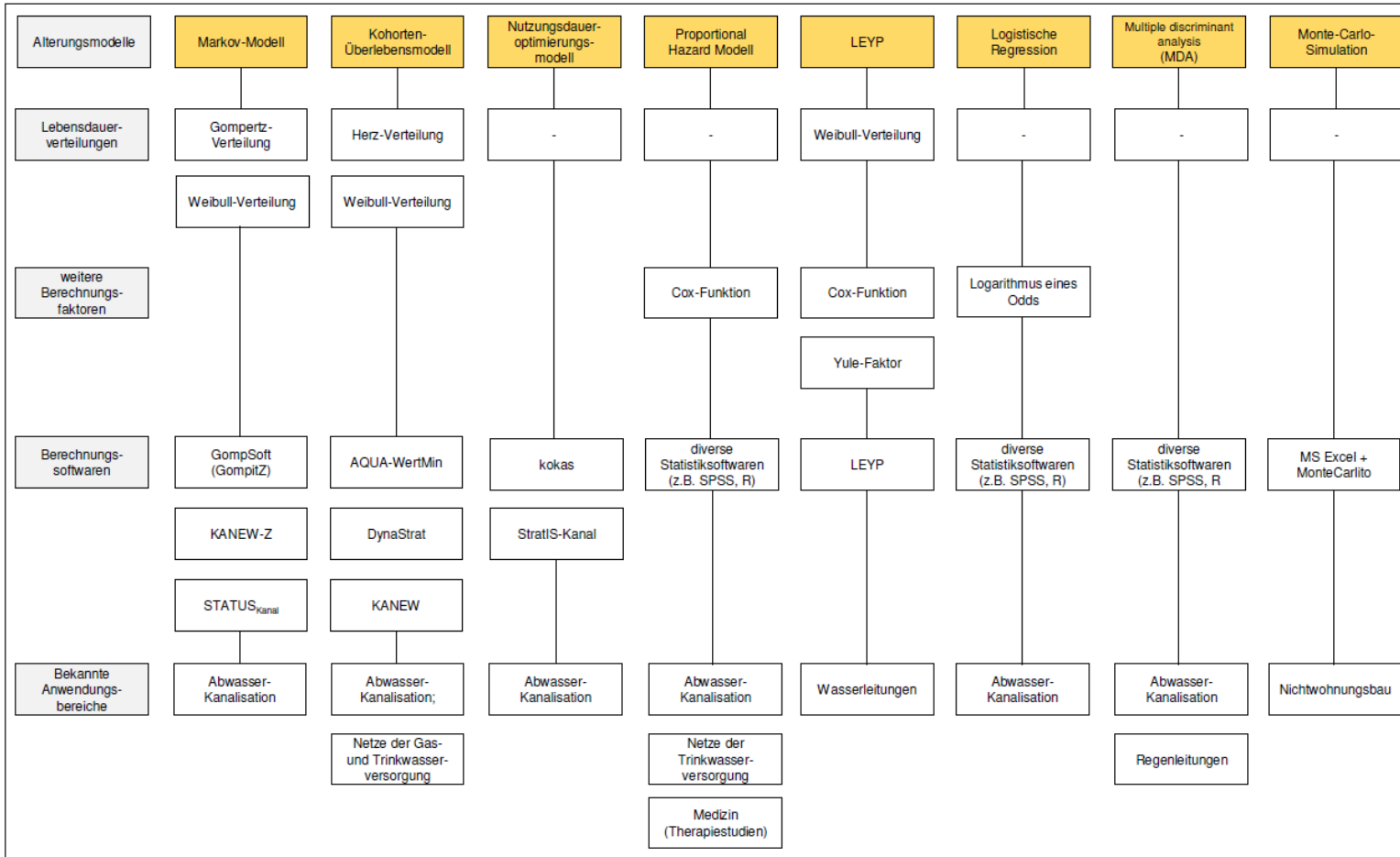
- members of project steering group (leader: Gelsenkirchen)
- providing data from 1., 2. and 3. inspection (videos) and ...

## - overall aims -

- supporting the **determination of the durability of sewers**
- ensuring the **remaining useful life for sewer assets**
- developing **appropriate investment and depreciation strategies**

=> Identifying critical areas with faster deterioration and non-critical areas with slower deterioration => damage-related graduation of the Inspection intensities for the Municipalities /network operators

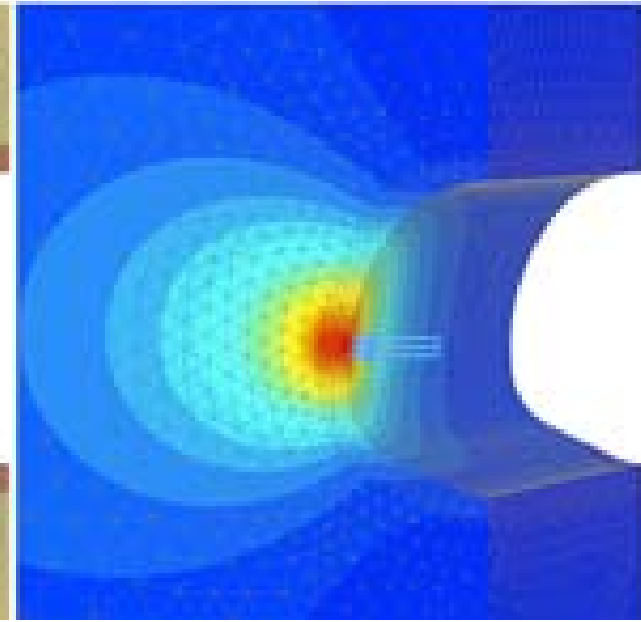
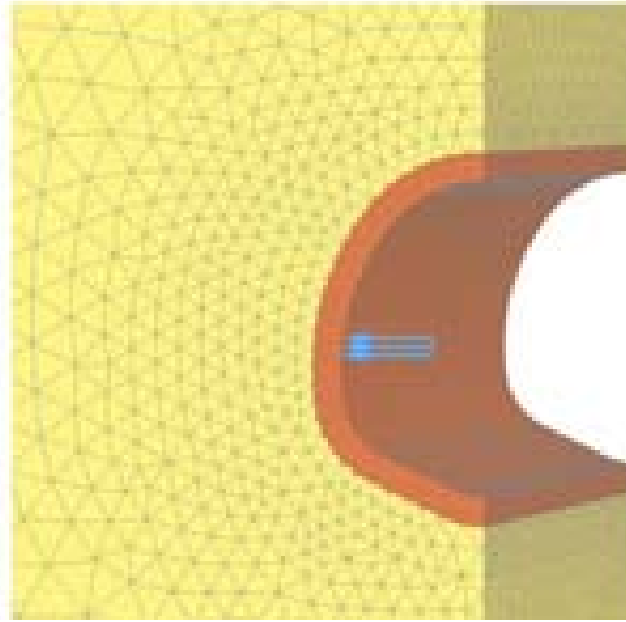
# - empiric models, overview -



Many different empirical models and software tools are used in practice!

Source: Master-Thesis Luisa Brandl: "Beschreibung, Modellierung und Prognose der Zustandsänderungen von Bauteilen der Abwasserkanalisation". 2017.

## - physical models, examples -

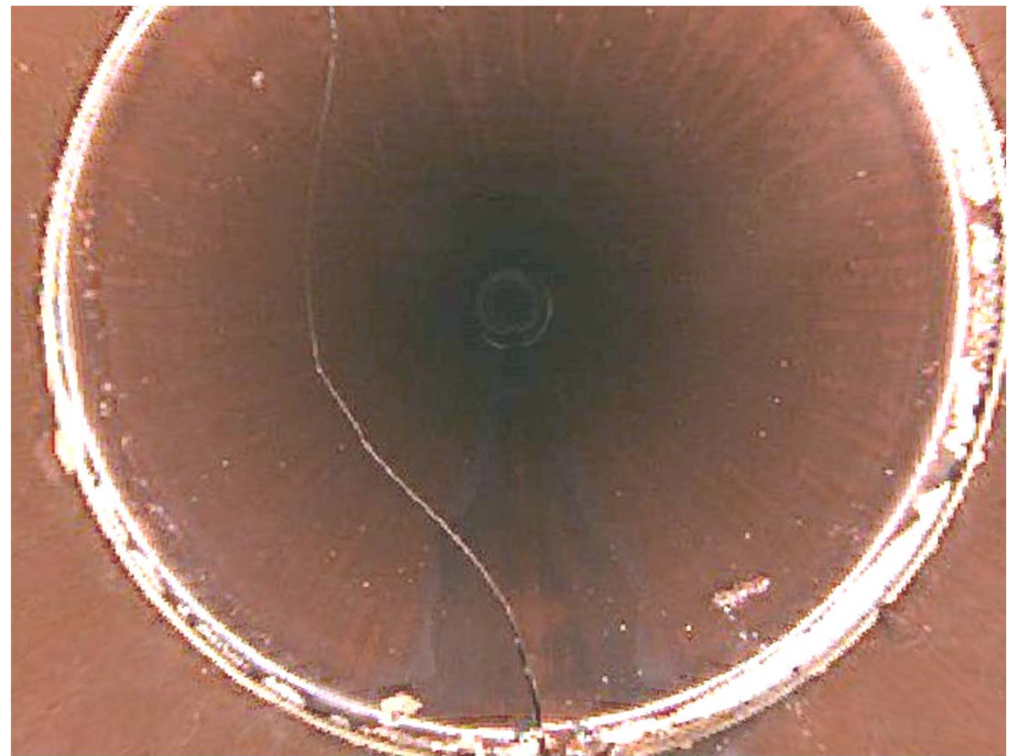


Quelle: The MAC system | <https://www.ikt-online.org/blog/non-destructive-assessment-of-the-stability-of-large-diameter-sewers-examining-the-stability-of-both-pipe-wall-and-bedding-with-the-mac-system/>

## - repeating inspection, examples -



2006  
(36a)



2015



## - repeating inspection, examples -

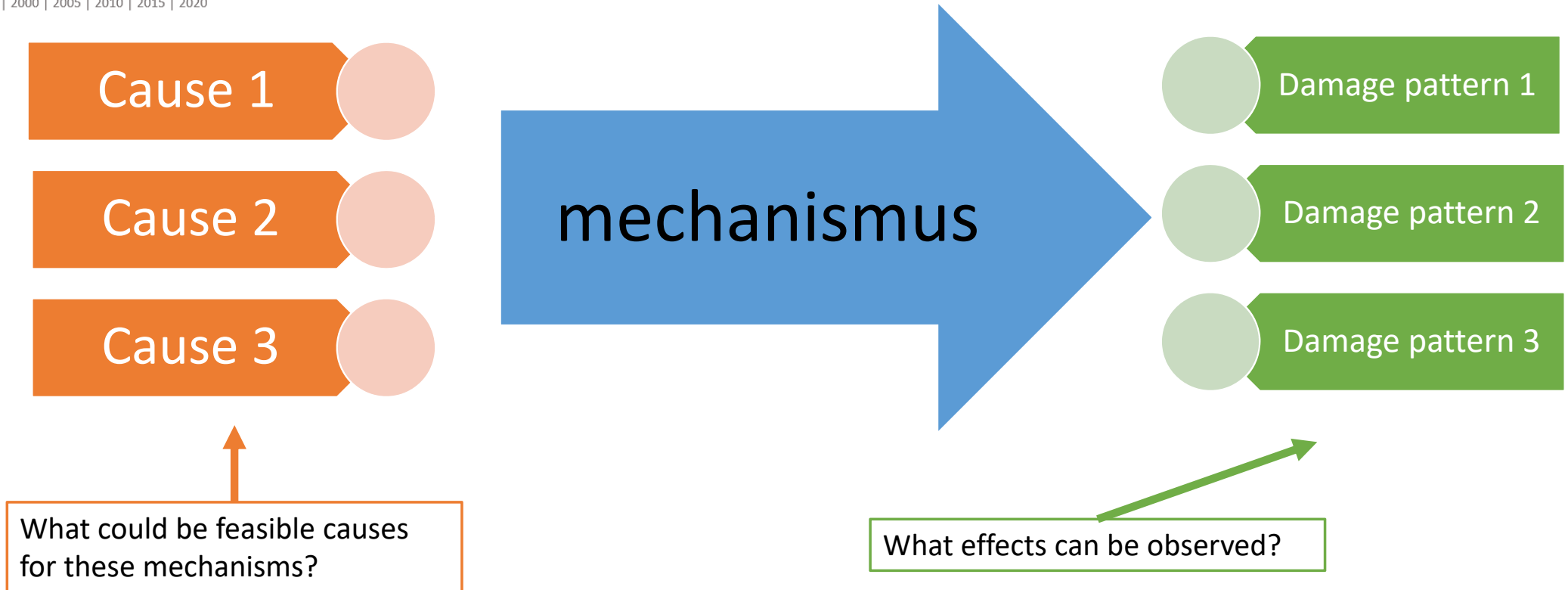


1999  
(65a)



2015

## - mechanism of failure -



**Objective: Avoiding damages and repairing damages as best as possible**

## - solution approach, damage mechanisms -

**Causes/mechanisms of damage** can be grouped:

- **Installation errors** (e.g. inadequate bedding, missing pipe sealing)
- **Improper handling during the service life**  
(e.g. misconnection, damage due to excavation)
- **Continuous external attack processes**  
(e.g. settlements, root penetration)
- **wear**  
(e.g. corrosion, abrasion, fatigue due to cyclical loads)
- **Individual external loads**  
(z.B. increase of traffic load, earthquake, mining subsidence)
- **material aging** (change in chemical and physical properties under normal operating and environmental conditions)

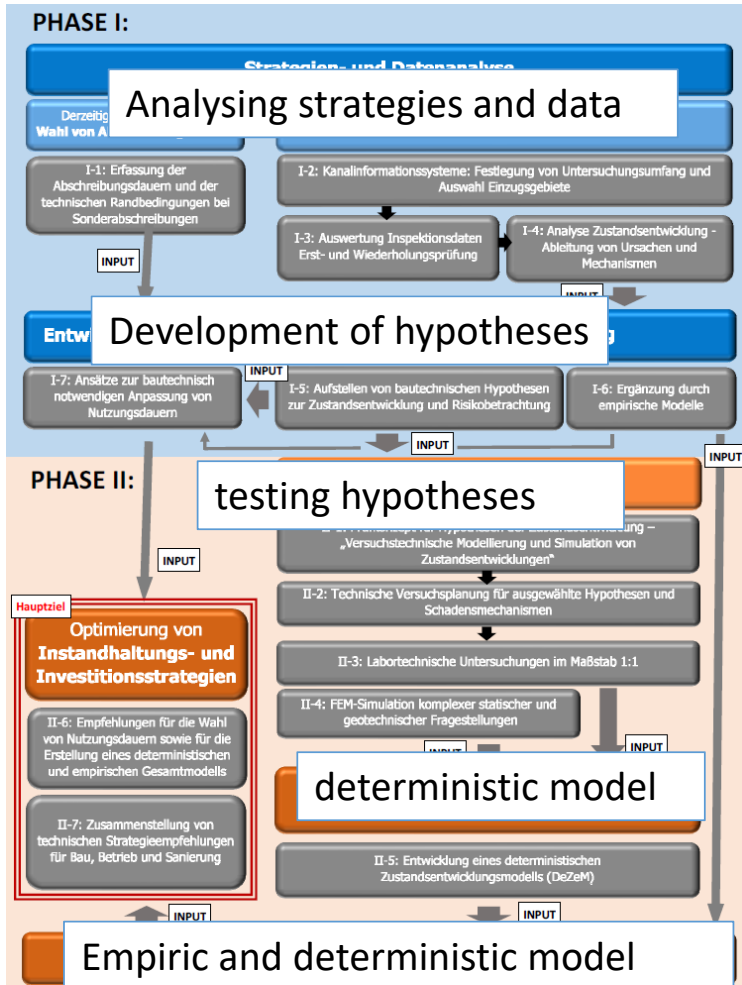
## - defects / damage mechanisms to be investigated -

**Most frequent/questionable** damage patterns  
(„gut feeling“ of the network operators in start-up talks):

- **cracks, shards**
- **corrosion**
- **misconnections/nozzles**
- roots
- missing seals

} combination!

# - work programme -

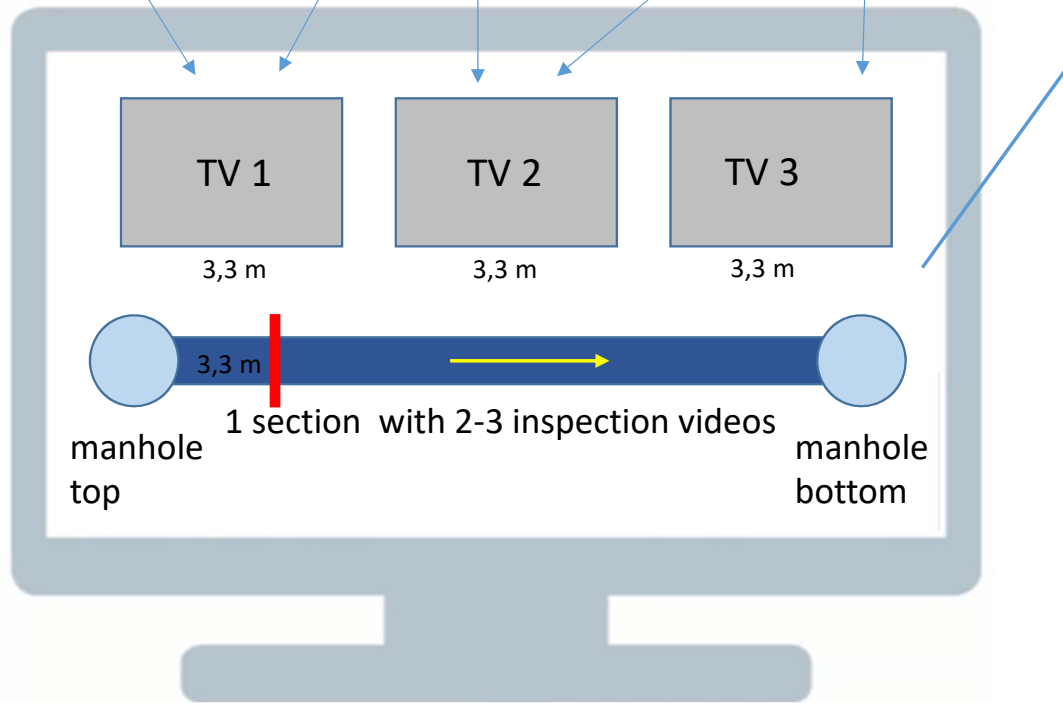


Data quality (Phase Ia) on deterioration: damage, failure modes, loads, rehabilitation, boundary conditions, special depreciations

1. Inspection  
1995

2. Inspection  
2006

3. Inspection  
2021



- Collecting  
data, requirements -



Collect further boundary conditions!

## - Collecting data, requirements -

### Focus on the study and boundary conditions

**focus:** Damage (e.g. ZK I-IV (DWA)) that endangers stability and operational safety.



Investigation of the technical boundary conditions

1. Risk assessment
2. Identify mechanisms by clustering damage or types of certain pipe materials, depths, bedding, types of wastewater, etc.

Baujahr
Rohrwerkstoff
Entwässerungsart
Profilart
Tiefenlage, Gefälleneigung
geologische Randbedingungen (Bodenverhältnisse)
Grundwasserstand, Grundwasserüberdeckung
Beeinflussung durch Rückstau
Abwasserart (Schmutz-, Misch- oder Niederschlagswasser)
Verkehrseinfluss
Einfluss Vegetation
zeitlicher Abstand von Erst- und Zweitbefahrung 15

## - ZEMUS: summary -

- Initiating „North Rhine-Wesphalian data treasure“
- ZEMUS project to ensure temporal/empirical approaches
- Data collection Phase Ia, diversity of source/techniques!
- Damage in focus: crack patterns, corrosion, connections, also in combination, also rehabilitation results
- Extraordinary depreciation: only rarely structural case
- Objective: hypotheses, physical models (FEM, 1:1 tests)
- Further development of investment and depreciation strategies





9 partner, 17 research facilities

# Co-UDlabs – Building Collaborative Urban Drainage research labs (05/2021 – 04/2025)



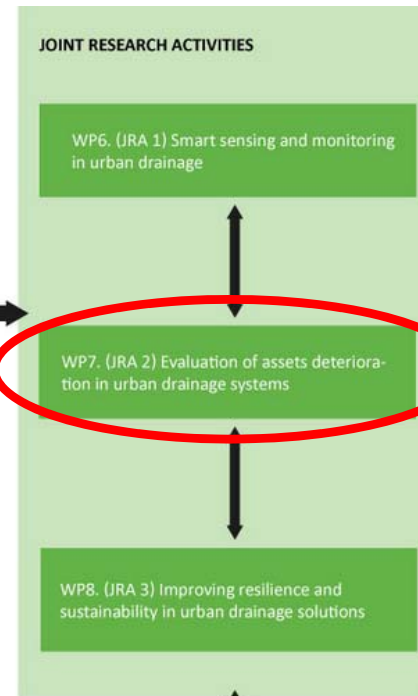
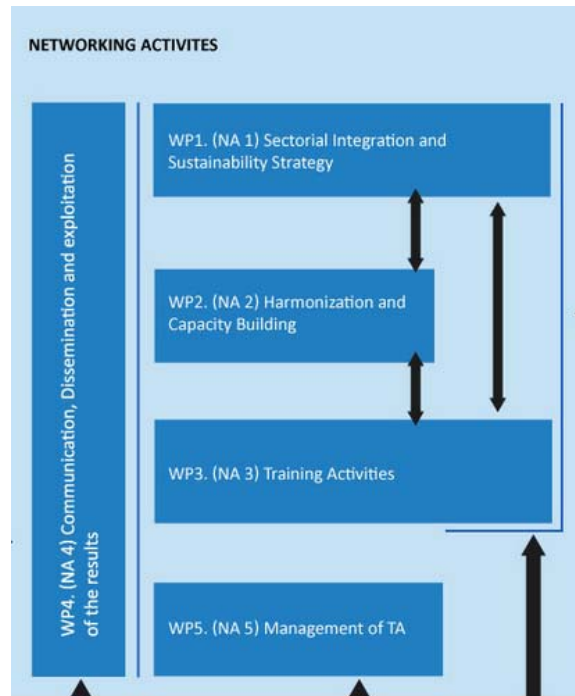
The Co-Udlabs project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101008626.

## - overall aims -

- Foster a culture of **co-operation between RIs and the urban drainage community**
- Enlarge and strengthen the quality and quantity of the services offered at European level through a combination of interconnected **Joint Research Activities**.
- Facilitate free of charge **Transnational Access** !!!  
to 17 European facilities by two open call

# - work programme -

**Networking  
Activities**



**Joint Research  
Activities**

**WP 7: Assets  
deterioration**



**Transnational  
Access**

## - WP 7: Assets deterioration -

- Coding: literature review of different European standards
- Construction of European CCTV files database
- developing a catalogue on typical defects and how to create them for lab tests (*based on experience of IKT*)
- further development of AI (*University of Sheffield*)
- Failure scenarios for defects: first lab tests (*not yet defined*)

# Co-UDlabs - Transnational Access - How to get involved?

COLLABORATIVE URBAN DRAINAGE  
RESEARCH LABS COMMUNITIES

## 1. Call in Oct 2021



*Countries of user-group leading institutions highlighted in green; countries of user-group members highlighted in blue*

2. Call in Oct 2023 !  
further information on <https://co-udlabs.eu>

## Using facilities for free!

### Our Research Facilities



1:1 street model  
(STREET)

[Read more](#)



Scientific platform for  
urban runoff tests  
(BLOCK)

[Read more](#)



Bens WWTP flume  
facility  
(BENS)

[Read more](#)



IKT Large Test Facility  
(IKT LTF)

[Read more](#)



IKT Hydraulic Test  
Stand  
(IKT TEST)

[Read more](#)



Above/Below Ground  
Urban Drainage Scale  
Model  
(A/B FLUME)

[Read more](#)



Temperature  
controlled Annular  
Flume  
(ANNULAR)

[Read more](#)



Full Scale Buried Cell  
Flume  
(BURIED  
INFRASTRUCTURE)

[Read more](#)



Real Time Control  
Testing Facility  
(RTC RIG)

[Read more](#)



Green ROOF  
experimental Facility  
(GROOF)

[Read more](#)



Django Reinhardt  
detention and settline



OTHU SuDS research  
facilities



Alpha loop



Beta loop



The Urban Water  
Observatory - Dieital