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2nd IWA Leading-Edge Conference & Exhibition on

Strategic Asset Management

Strategy for the development of optimized flushing plans

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LESAM 2007 – Lisbon 17-19 October 2007

Goal of flushing of drinking water pipes

- Removal of loose deposits to avoid discoloration events
- Removal of bacteria growing in the deposits (plate counts, coliforms)
- Removal of nutrients for higher organisms (Assellus)
- Replacement of poor quality water (refreshing)

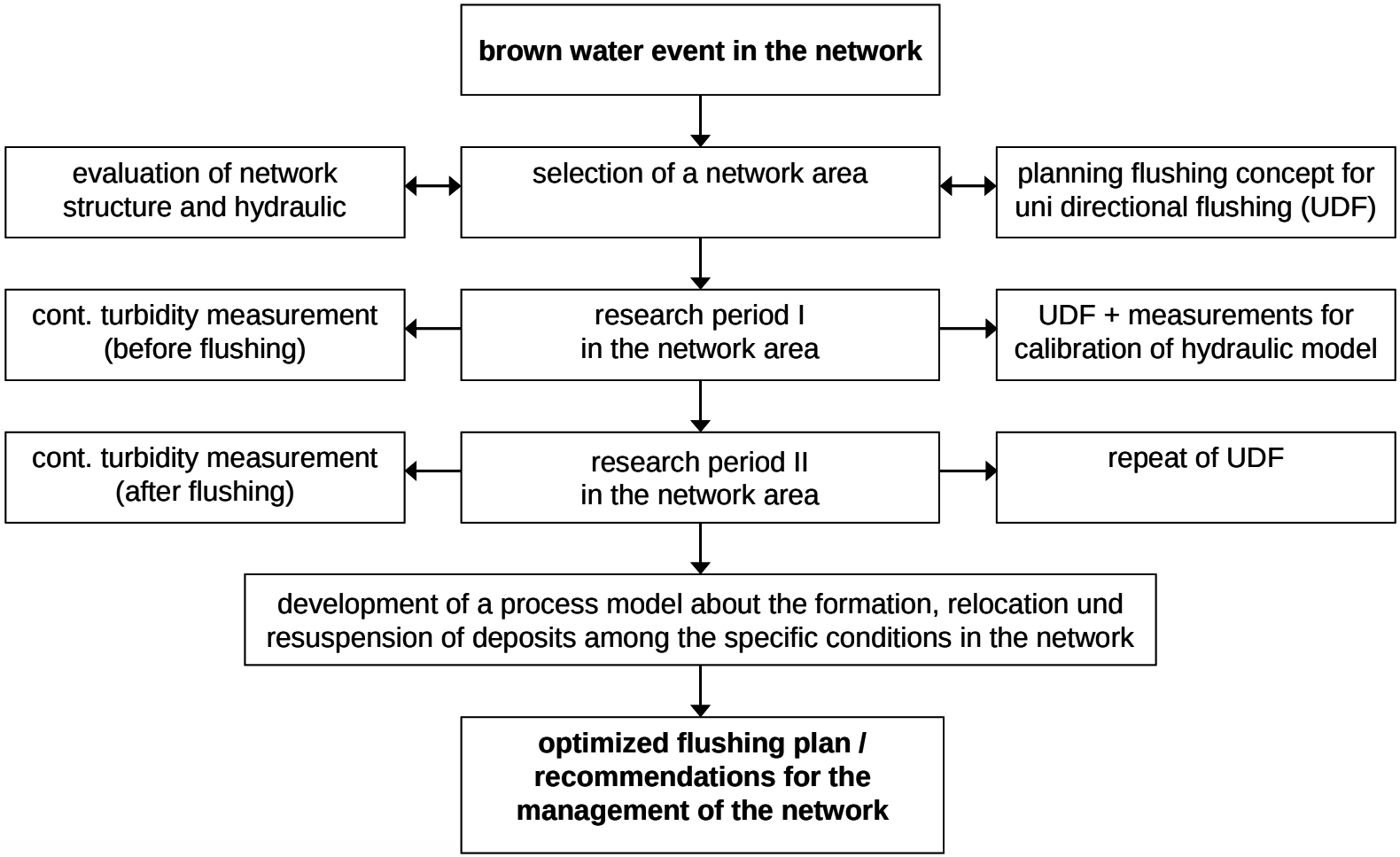
Paths of deposits in a network

- Input of particles due to insufficient treatment
  - Iron flocks, aluminium flocks, sand, algae
- Input of dissolved compounds via treatment plant
  - Iron(II), manganese(II), calcium, organic compounds
- Corrosion in unprotected cast iron and steel pipes
  - Iron(II) from the corrosion process forms iron(III) hydroxids
- Relocation of deposits
  - Movement of deposits due to disturbances in the hydraulic condition

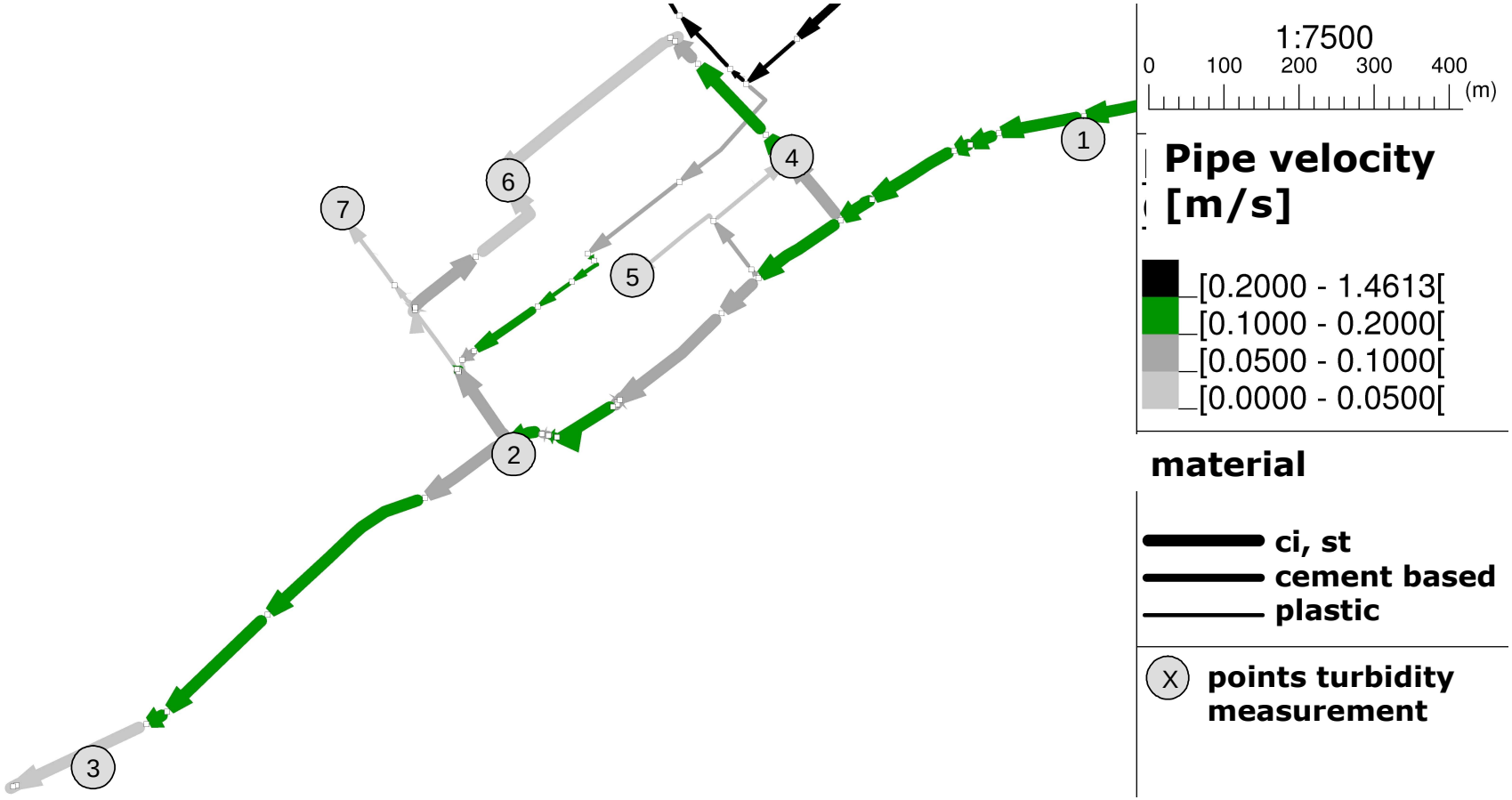
Flushing methods

- Conventional flushing (End pipe flushing)
  - Common in Germany because it is very easy
  - Often to low velocities for the effective removal of deposits
  - Just a small number of pipes in an area is cleaned
  - High risk of brown water events during flushing
- Unidirectional flushing (UDF, with clear water front)
  - Not common in Germany
  - Effective because of high velocities
  - Low risk of brown water events during flushing
  - High expenditures for the water supplier
  - Eventually clean pipes are flushed
- Optimized flushing
  - UDF + knowledge about deposit formation process in the pipes (flushing just the pipes with high amounts of deposits)
  - Development of a process model about the behaviour of deposits in the network is necessary

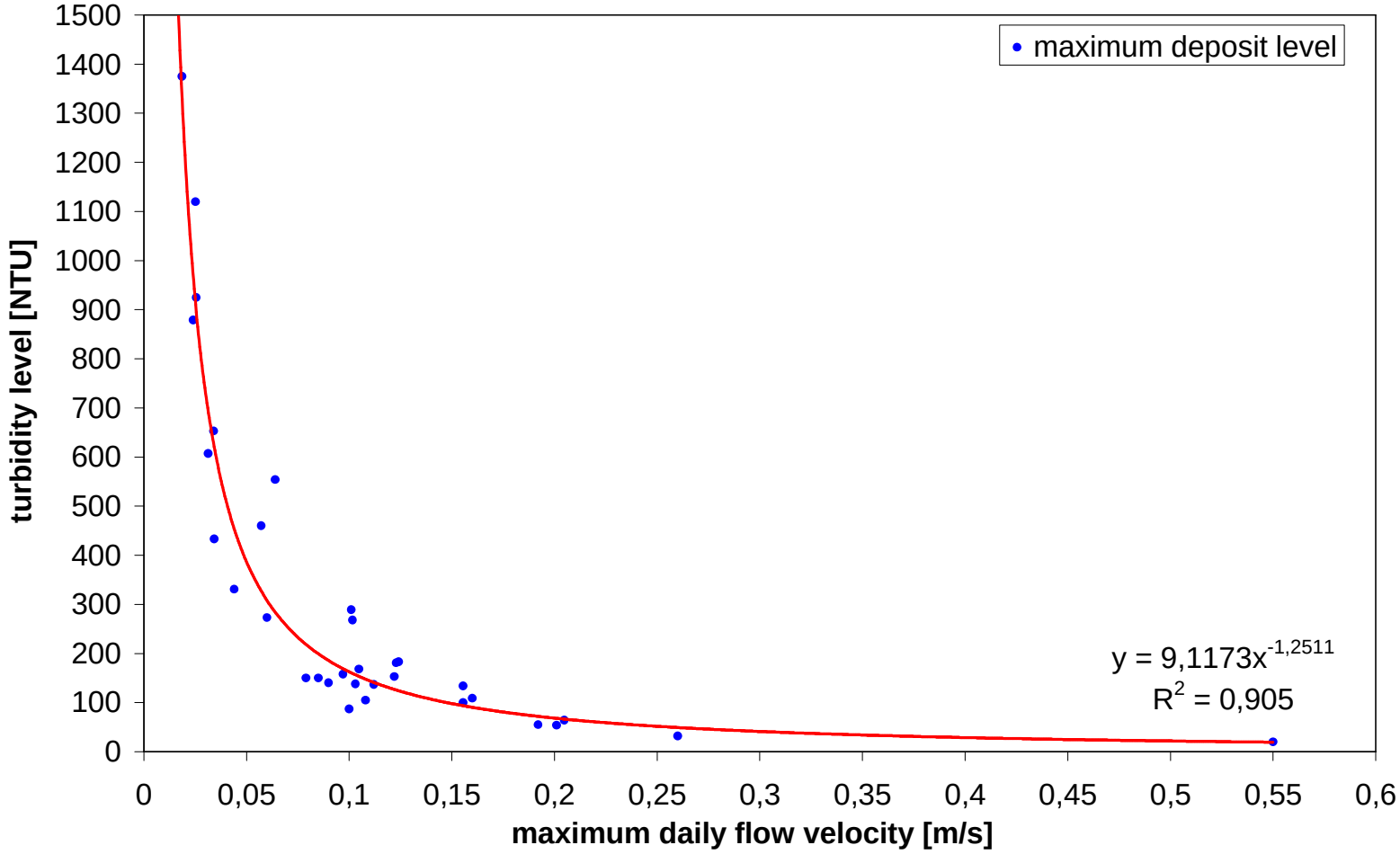
Procedure for the development of the optimized flushing plan



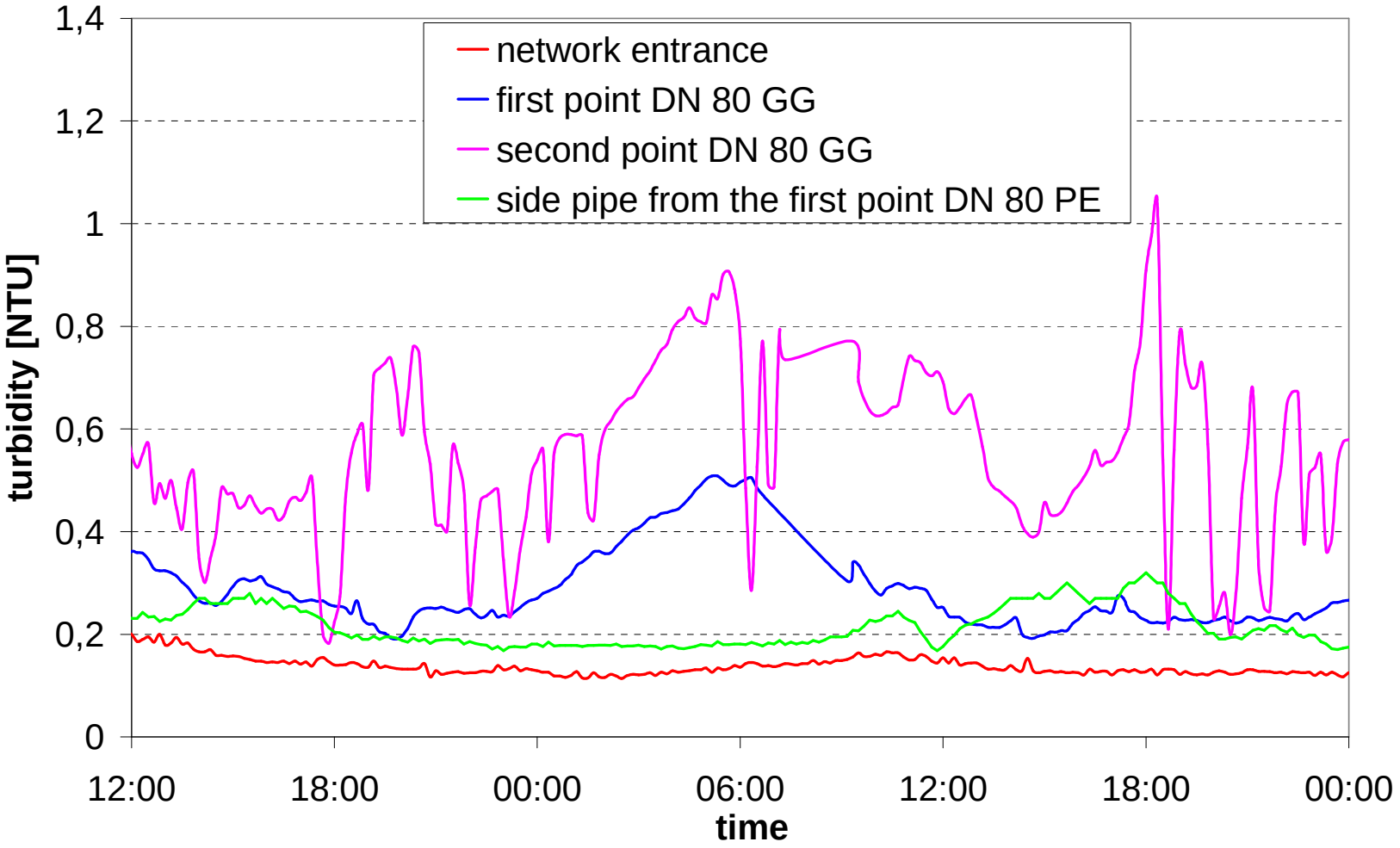
Network analysis



Maximum deposit level in pipes



Change in turbidity in a network



UDF of the network area (two times)

First flushing: Basic cleaning

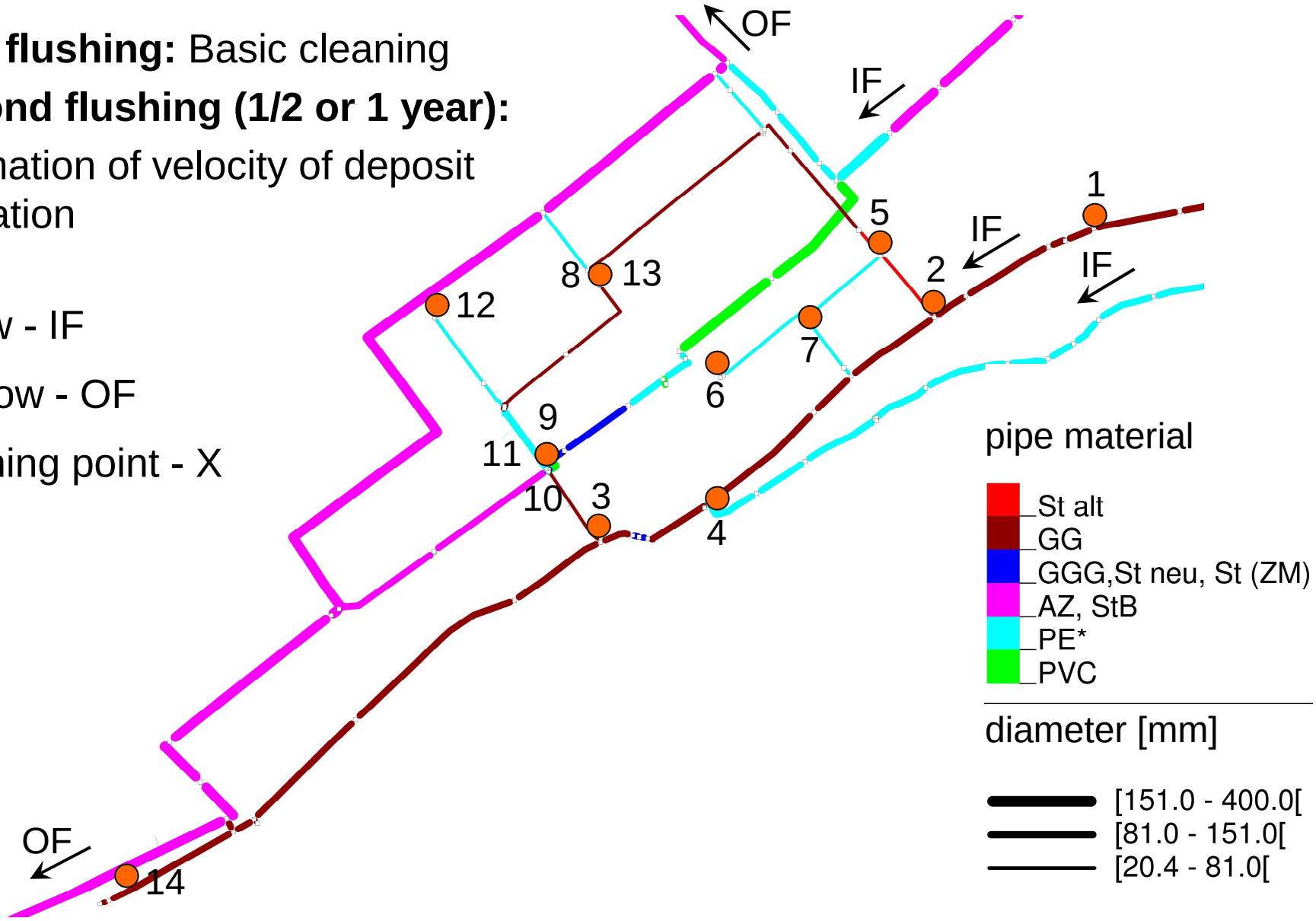
Second flushing (1/2 or 1 year):

Estimation of velocity of deposit formation

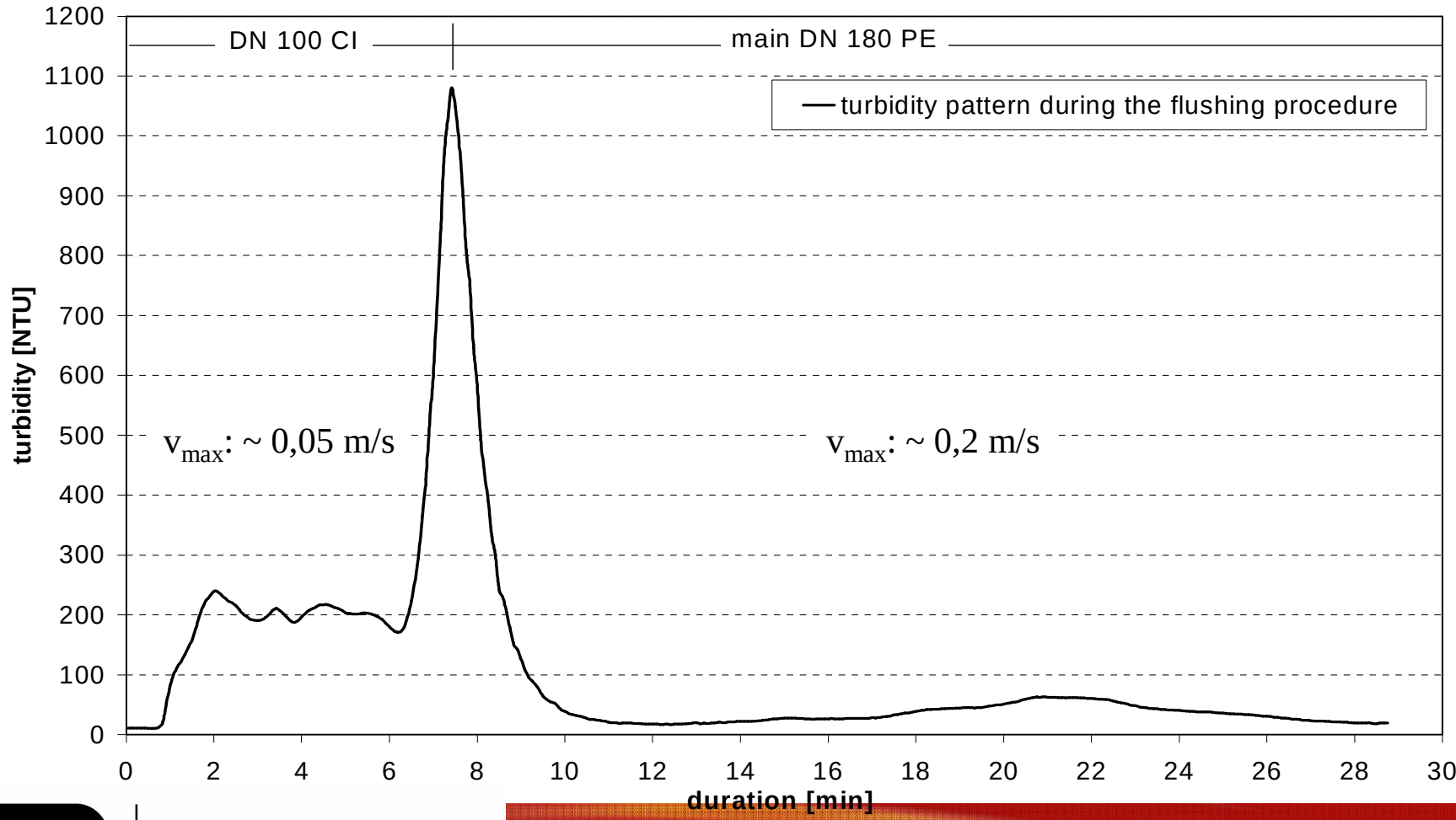
Inflow - IF

Outflow - OF

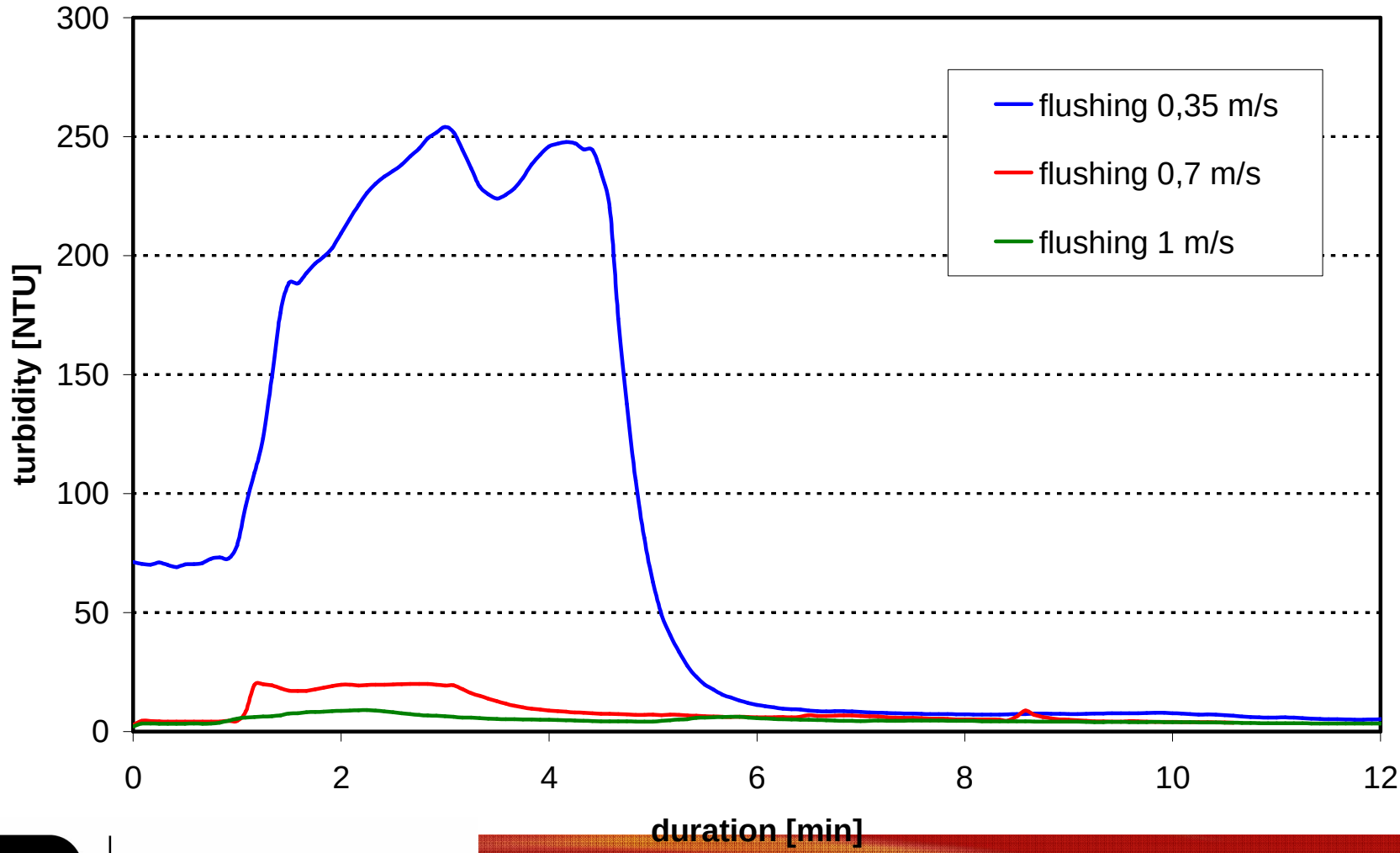
Flushing point - X



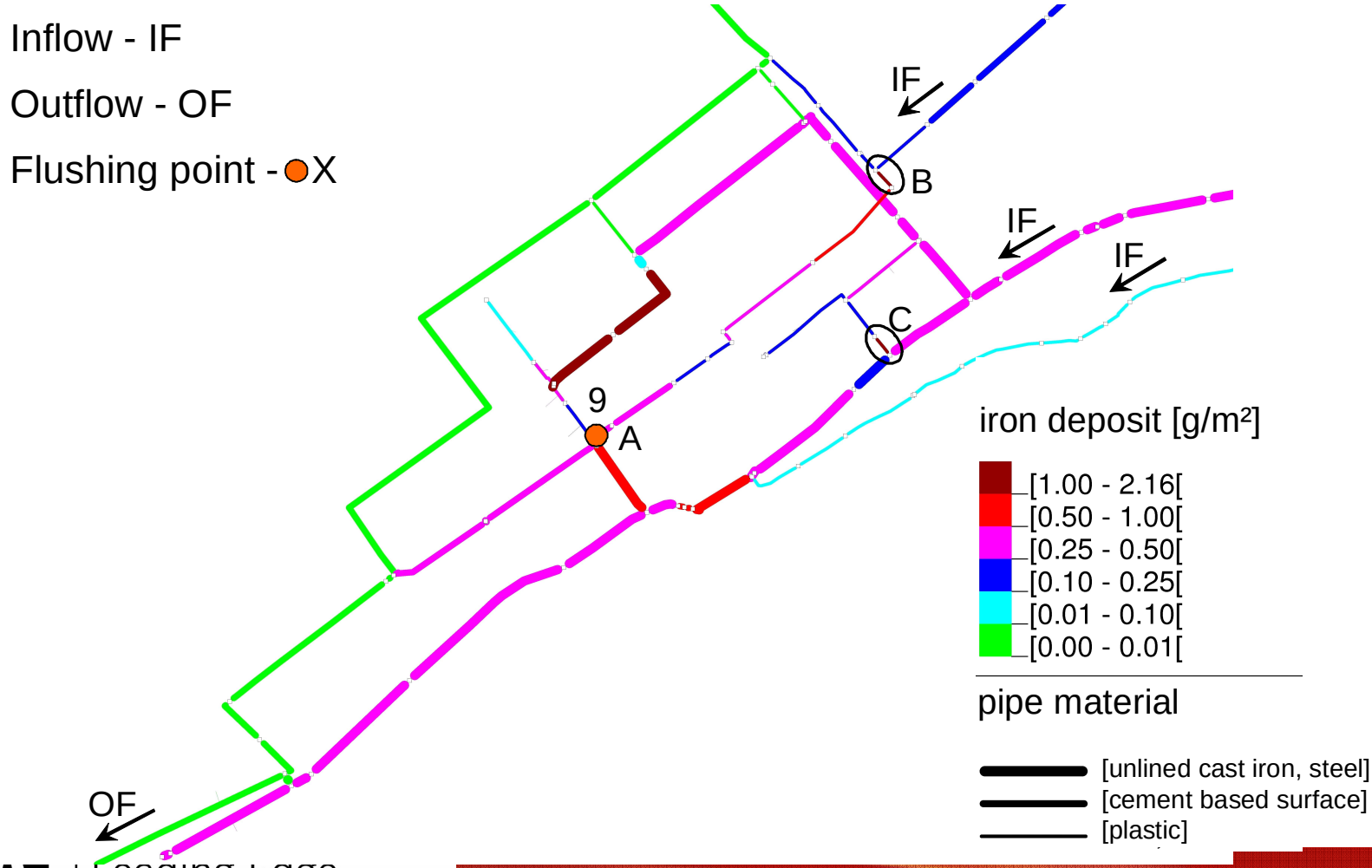
Turbidity pattern during flushing of different types of pipes



Stepwise flushing of a pipe



Calculation of deposit situation in the net (from flushing water)



Utilization of the results

Structure and hydraulic analysis

Turbidity measurements

UDF with turbidity and deposit measurements

Process model:

- **Source of deposits**
- **Behaviour of particles**
- **Velocity of fouling**

Results for water supplier:

- **Flushing plan**
- **Recommandations for hydraulic optimization**
- **Recommandations for rehabilitation**

Extract of a flushing plan

No.	DN	material	street	min. fl. velocity	hydrant	Valves			
						closed all the time	have to been closed	close before fl.	open after fl.
1	100	GG	Rosenstraße	1 m/s	334	S250/ S237	S239 / S64 / S37 / S240 / S211 / S209 / S197 / S77 / S23 / S91 / S93 / S82 / S84	S84/ S87	S23/ S84/ S87
2	100	GGG ZM	Nelkenweg	0,7 m/s	334	S250/ S237	S239 / S64 / S37 / S240 / S211 / S209 / S197 / S77 / S91 / S93 / S82 / S83 / S86	S83/ S86/ S85	S91/ S93/ S83/ S85
3	100	GG	Am See	1 m/s	405	S250/ S237	S239 / S64 / S37 / S240 / S211 / S209 / S197 / S77 / S82 / S86 / S89 / S20	S89/ S20/ S92	S20
4	100	GG	Uferhain	1 m/s	427	S250/ S237	S239 / S64 / S37 / S240 / S211 / S209 / S197 / S77 / S82 / S86 / S89 / S92 / S93	S93	S239/ S64/ S37/ S240/ S92

Acknowledgement

- DVGW (The German Technical and Scientific Association for Gas and Water)
- BMBF (Federal Ministry of Education and Research)
- EU (Techneau project)