A novel approach to tracking sewer inflow and infiltration

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HSY water sector in a nutshell

- **HSY**: We produce and organise water services, waste management services and environmental regional information
- **Water services**: raw water treatment and distribution, waste water collection and treatment, investments required by city growth
- **Operation area**: Espoo, Helsinki, Kauniainen, and Vantaa, and some other municipalities via separate agreements (1,1 Million inhabitants)
- **Net revenue**: 240 Million Euros
- **Investments**: 135 Million Euros
- **Infrastructure**:
  - 2 Water Treatment Plants
  - 2 Waste Water Treatment Plants
  - Pipeline networks 8500 km (water 3100, waste water 2800, storm water 2600)
  - 550 Waste Water Pumping Stations
  - 12 Watertowers

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SmartWater (ÄlykäsVesi) as a part of HSY’s REPA project

- HSY’s own consortium of projects
- SmartWater (ÄlykäsVesi) is focused on data management of the networks
- Goal is to produce new tool in collaboration with companies

- Almost 3 years execution time
- Budget 660 000 €, under the auspices of Tekes
- Innovatiiviset Julkiset Hankinnat (IJH) – financing program
SmartWater (ÄlykäsVesi), goals and filosopy in long term

• Reliable and adequate data from the network (flow, pressure, etc.) should be as the basis
• Integrated data systems -> integrating existing data sources -> new knowledge
• New knowledge -> new tools:
  – Identifying leakage and I/I
  – Allocating renovations
  – Managing network’s capacity
  – Scenario tools
  – Compensating to the climate change
Sewer condition management in HSY

- Sewer pipe lines approx. 2800 km
  - Only a small proportion is renovated (less than 0.5 % annually)
  - Slow process with currently used methods

- Traditional CCTV inspection
  - Appr. 120 km annually
  - Manually operated and analyzed
  - Slow
  - Subjective

- Need for tools to get a faster overview of the network
  - Data analysis
  - Digitalizing the inspections
  - Machine learning techniques
  - ...
Objective

• A novel approach to tracking sewer inflow and infiltration

• Develop and demonstrate an approach for automate quantification and tracking of sewer inflow and infiltration components.

• Approach:
  • Uses operational data already being collected
  • Combines existing and published data analysis methods
  • Automated and continuous
Pumping station (first analysis)
Data flow

Precipitation rate (via web service)

Hourly

Analysis

Pumping station data:
• level measurements
• pump activations
• cumulated pumping time (via ftp)

Improved information for wastewater asset management and operations.

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Analysis approach and automation

- Input data
  - Precipitation data
  - Pump operation or flow measurements
  - User input (network configuration)

- Pre-treatment and initial analysis/modelling

- Modelling
  - Model 1
  - Model 2
  - Model 3
  - Model X
  - Model Y

- Validation and comparison

- Best result selected for reporting

- All rejected

Manual analysis and modelling

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Results (1/2)

Observed flow = f( Level )

Precipitation

- Ground water
- Wastewater
- Indirect runoff
- Direct runoff

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Results (2/2), results in *InflowGo*

**Inflow and Infiltration Assessment**

Station: JVP3073 (Rantapolkku)

*Volume Composition*

- Wastewater: 22%
- Ground water: 42%
- Drained runoff: 17%
- Direct runoff: 20%

*Peak Composition*

Analysis period: 2017-03-10 to 2017-03-31 (20 days)

Non-wastewater: 78%

Estimated inhabitants: 64 persons (assuming 115.0 litres/person/day)

Total precipitation: 16 mm

Direct runoff area (mis-connections): 9240.0 m², 144.0 m² per person

Drained runoff area (e.g. via soil): 7910.0 m², 124.0 m² per person

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Preliminary conclusions

• Inflow and infiltration components found using existing data sources
• Preliminary results promising

Further work

• Experience from more pumping stations
• Experience from longer periods
• Add snow/slush-melt processes
• Long term ground water variations
• Alternative modelling approaches and model structures
• Trend detection and rehabilitation impact assessment
• …