



# Modeling the Fate of Heavy Metals in Integrated Urban Wastewater Systems



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## Problem:

No model available to describe the fate of heavy metals in an integrated urban wastewater system (sewer – wwtp –river).

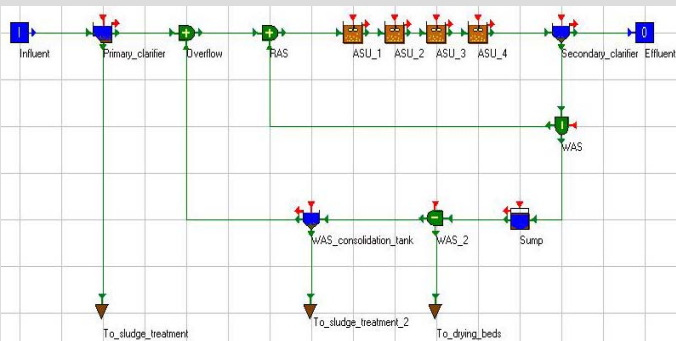
## Objective:

Create a model able to simulate the dynamics of heavy metals next to traditional pollutants (COD, N, P).

## Case study

Norwich Sewage Treatment Works, Norwich, UK

- 55,000 m<sup>3</sup>/d
- Four primary clarifiers
- Six aeration lanes
- Four secondary settlers



WEST® configuration

## Sorption model

$$\frac{dS_{\text{Metal}}}{dt} = \frac{Q_{\text{in}}}{V} (S_{\text{Metal,in}} - S_{\text{Metal,out}}) - k \cdot \left( S_{\text{Metal}} \cdot X_{\text{TSS}} - \frac{X_{\text{Metal}}}{K_D} \right)$$

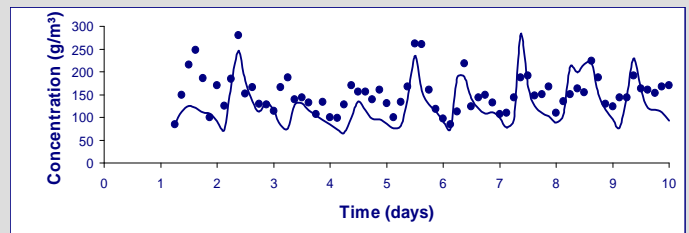
$$\frac{dX_{\text{Metal}}}{dt} = \frac{Q_{\text{in}}}{V} (X_{\text{Metal,in}} - X_{\text{Metal,out}}) + k \cdot \left( S_{\text{Metal}} \cdot X_{\text{TSS}} - \frac{X_{\text{Metal}}}{K_D} \right)$$

The model considers sorption on total suspended solids (TSS) as the only occurring process next to advective transport.

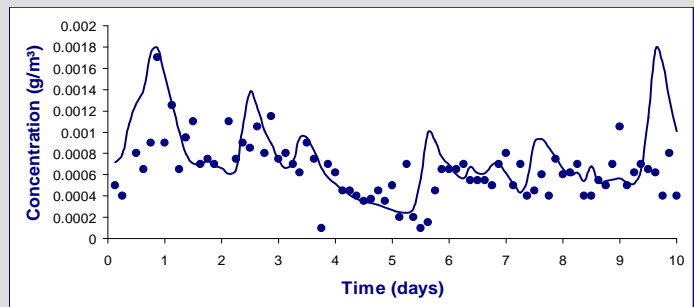
TSS should be modeled accurately as it is the basis of the sorption process

## Results

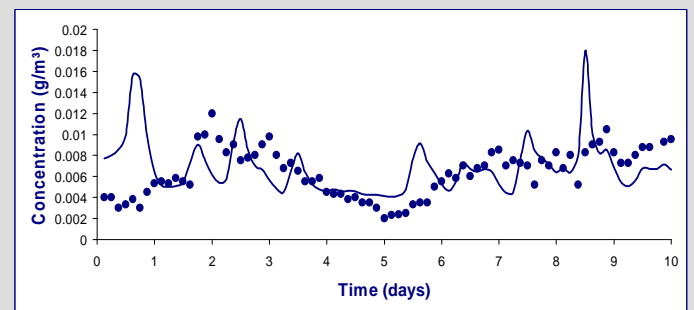
### Primary clarifier overflow – fit of TSS to experimental data



### Effluent – fit of Cadmium concentrations to measured data



### Effluent – fit of Chromium concentrations to measured data



## TAKE HOME MESSAGE

- The model describes the fate of heavy metals in WWTP
- It only considers sorption on TSS as the occurring process
- TSS model should be sufficiently accurate