

# Urban stormwater projects in Belo Horizonte

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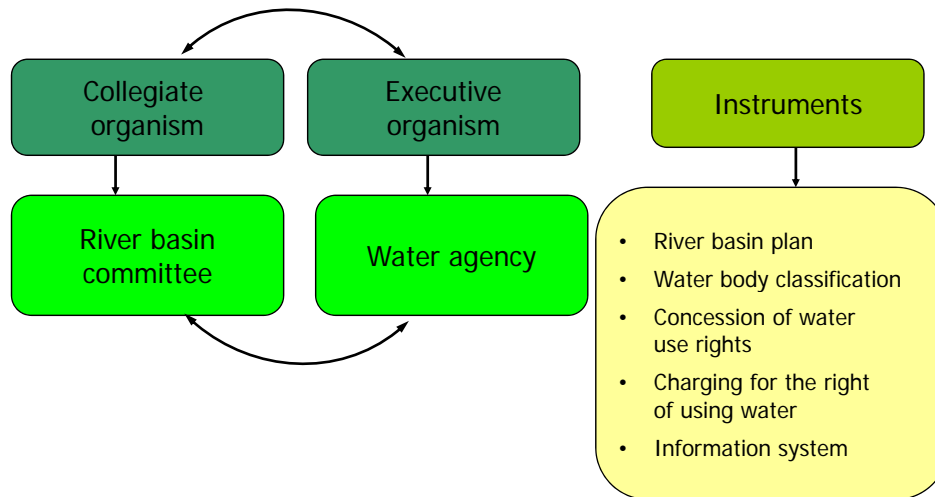
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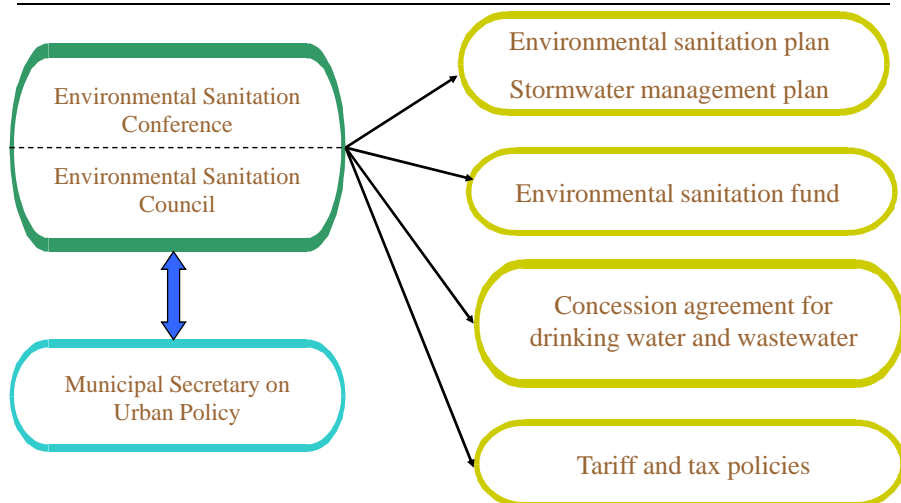
## Outline

- Main SWITCH contributions to IUWM in Belo Horizonte
- Objectives of the research and demo activities
  - WP 2.1
  - WP 2.2
- Ongoing and planned activities
- Integration with other SWITCH WPs

## The example of the water resources management at the river basin sphere



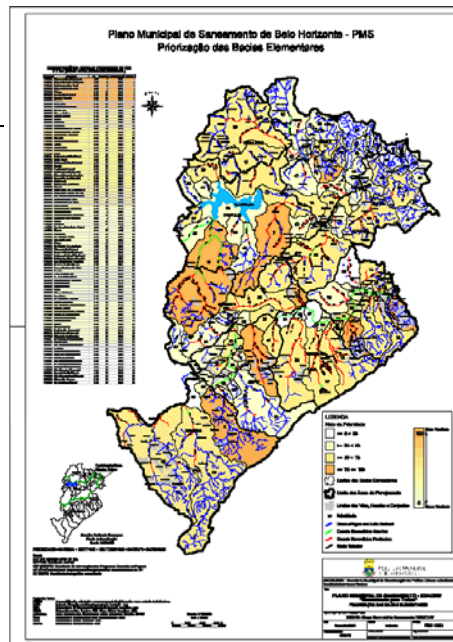
## Water management in Belo Horizonte



## Priorities

Priorities stated according to:

- ISA
- Population density
- Special programmes
- Participatory budgeting
- Resources available



## The DRENURBS programme

- Main focus: river restoration
- Pollution control
- Flood control
- Housing:
  - Removing people from risky areas
  - Relocating people in the neighbourhoods
- Creation of green areas and leisure facilities





## The water management in BH

- A comprehensive and well stated institutional process
- It takes into account different territorial and institutional scales
- The current participatory process contributes to:
  - Social inclusion
  - Citizen involvement into the urban management
  - Citizen identification and appropriation of the local environment, particularly the
  - Sustainable management of urban waters

## SWITCH contributions

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- SWITCH points out to the need of taking into account emerging issues not clearly considered in the BH planning process:
  - Climate change, e.g.: impacts on water supply and on stormwater
  - Wet weather diffuse pollution
  - Socio-economic issues: demography, economic growth and water consumption
- IUWM is currently adopted at the BH municipal scale. SWITCH can contribute to scaling up this approach, promoting integration with other territorial scales:
  - The metropolitan area (BHMA)
  - The river basin (Velhas and Paraopeba River Basins)

## SWITCH contributions

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- Sustainability aspects of urban water management are not clearly stated in the BH planning process – e.g.:
  - Drinking water:
    - Demand management;
    - Possibilities for reusing of water and rainfall harvesting
  - Energy issues related to the use o water
  - Use of ecohydrology on river restoring and water pollution control
  - Sustainability assessment, e.g.: indicators of sustainability

## SWITCH contributions

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- Concerning the DRENURB programme
  - DRENUBS focus more on creeks than on catchments
  - Therefore, SWITCH can contribute to evolve from creek management to catchment management
    - e.g.: use of SUDS
  - There is a lack of knowledge and experience on river restoring techniques in BH - SWITCH can contribute on subjects like:
    - river bed protection against erosion,
    - river engineering + ecology ...

## SWITCH contributions

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- Concerning floods
  - Floods are one of the main issues in BH, relating to risk management
  - SWITCH can contribute to improving the association of structural to non-structural flood control measures, including:
    - Improving modelling (hydrology and hydraulics)
    - Integrating land use and flood management
    - Flood forecasting and emergency planning regarding flash floods



## WP-2 objectives in BH

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- ❑ Provision of sound scientific basis for the application of BMPs under different conditions:
  - physical and climatic characteristics in catchment
  - take into account the views and needs of local communities.
- ❑ Establish potential levels of flood, water pollution and health risks related to USWM



## WP-2 objectives in BH

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- ❑ Development of professional skills on stormwater management in relation to:
  - ✓ criteria for identifying when/where and which type of BMP may be appropriate for use
  - ✓ establishing procedures for design, implementation and operation of BMPs
  - ✓ establishing procedures for monitoring water quality and quantity performance
  - ✓ defining operational and maintenance requirements;
  - ✓ assessing building and maintenance costs and life cycle costs.



## WP-2 on-going and planned activities

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- Experiments with:
  - Infiltration and detention trenches
  - Detention basin retrofitting
    - Flood control
    - Diffuse pollution control
    - Recreation equipments
  - Rainfall haversting



## WP-2 on-going and planned activities

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- Experiments with infiltration and detention trenches:
  - At the campus of UFMG
  - At NS Piedade catchment
  - At Primeiro de Maio catchment (retrofitting)



## WP-2 on-going and planned activities: infiltration trenches – UFMG Campus



Contributing area



Inflow measurement

## WP-2 on-going and planned activities: infiltration trenches – UFMG Campus



Infiltration trench



Detention trench

## WP-2 on-going and planned activities: infiltration trenches – UFMG Campus

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- What is measured:
  - Rainfall (Tipping bucket rainfall sensors)
  - Inflows (Parshall flume and water pressure sensors)
  - Soil moisture (gypsum blocks)
  - Water levels at the detention and infiltration trenches (water pressure sensors)
  - Water quality: inflow and outflow: conductivity, pH, temperature, turbidity, total suspended solids, metals (Cu, Ni, Zn, Cd, Mg) and PAH
  - Contaminants in the soil after 3 operational years (samples collected at different depths before and after the experiment)
  - Costs: capital and maintenance costs

## WP-2 on-going and planned activities: infiltration trenches – UFMG Campus

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## WP-2 on-going and planned activities: infiltration trenches – UFMG Campus

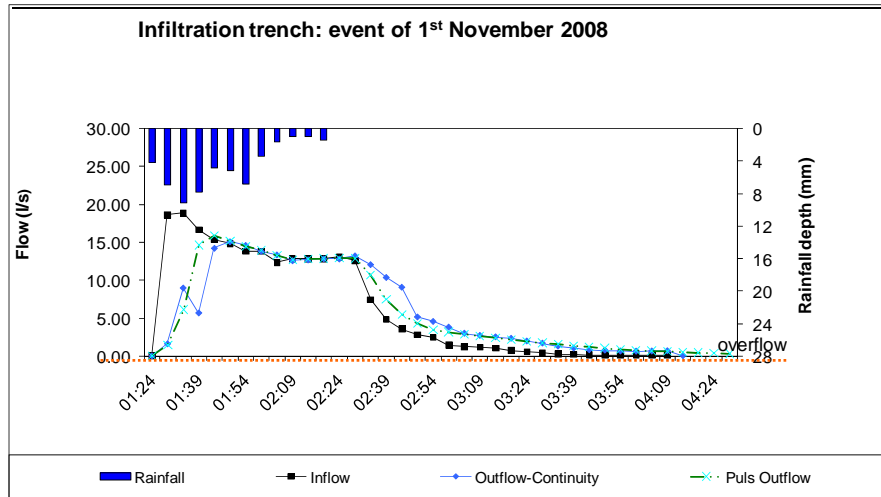
Parameters		Concentration (mg/kg)				Lim (Cetesb)
		Depth (m)				
		0.5	1.0	1.5	2.0	
Pb	6	5.54	7.7	5.25	17	
Cr	9.07	10.61	10.35	10.72	40	
Ni	1.44	2.04	1.36	2.15	13	
Zn	9.64	12.96	10.41	12.35	60	
Mg	15.4	17.99	17.79	17.05	not available	
P	147.56	178.7	210.28	88.33	not available	

## WP-2 on-going and planned activities: infiltration trenches – UFMG Campus

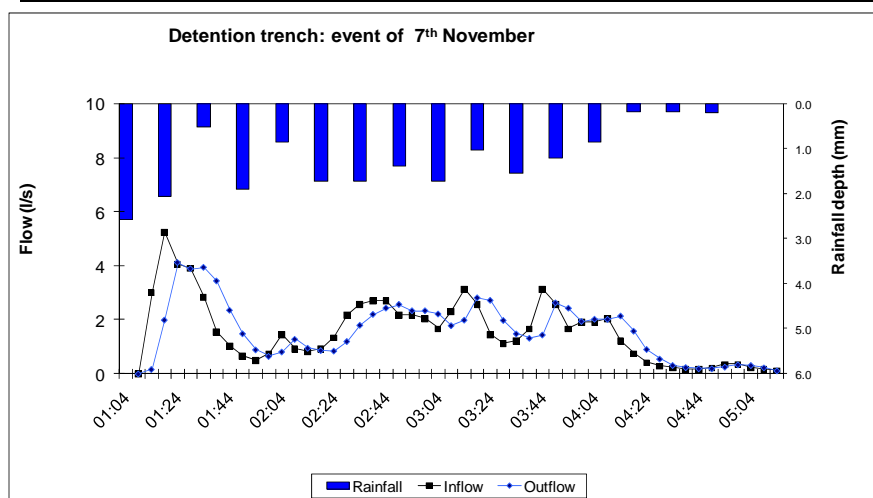
$$k = 1,5 \cdot 10^{-4} \text{ cm/s}$$

$$K = 5.21 \cdot 10^{-5} \text{ cm/s}$$

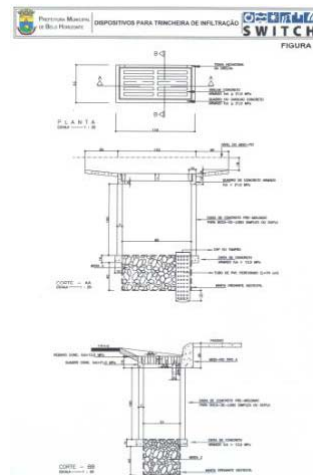
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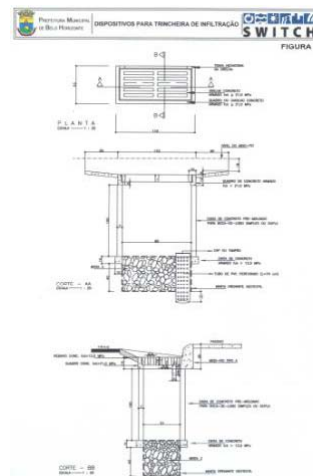
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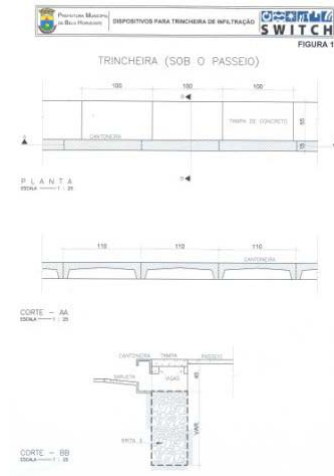
## WP-2 on-going and planned activities: infiltration – retrofitting in Primeiro de Maio catchment



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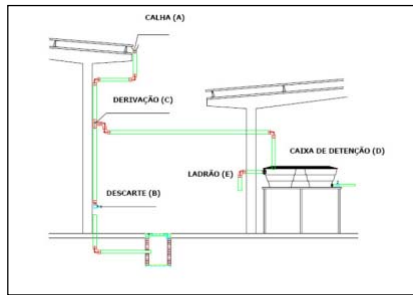


## WP-2 on-going and planned activities

- Rainfall harvesting (RH) and water reuse (WR):
  - Anne Frank High School – RH: design finished
- Main objectives:
  - Demonstrate the techniques
  - Educational purposes addressed to high school students
  - Water quality control
  - Assessment of water supply failure risk
  - Cost-benefit evaluation

## WP-2 on-going and planned activities

Anne Frank High School



## WP-2 on-going and planned activities wetlands

### ■ Wetlands:

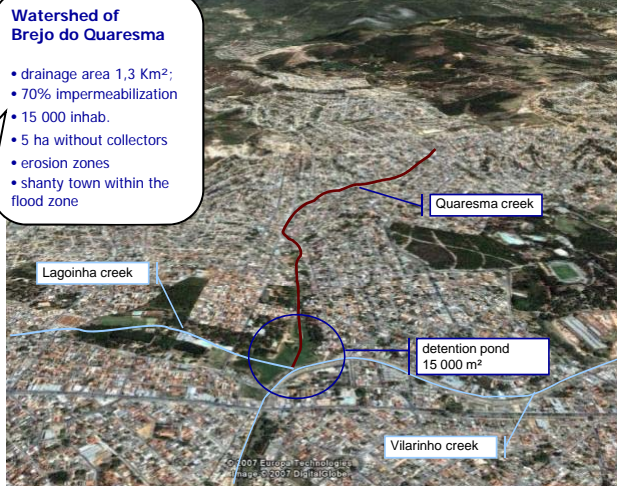
- Vilarinho detention basin:
  - Monitored during one hydrologic year
  - Rainfall-runoff modelling concluded
  - Wetland design: concluded

### ■ Main objectives:

- Demonstrate the techniques
- Characterise hydrologic processes: water quality and quantity
- Evaluate opportunities to adopt decentralised treatment facilities (wet weather diffuse pollution + wastewater contamination)
- Maintenance requirements and other operational aspects
- Costs: capital and maintenance costs



## WP-2 on-going and planned activities wetlands

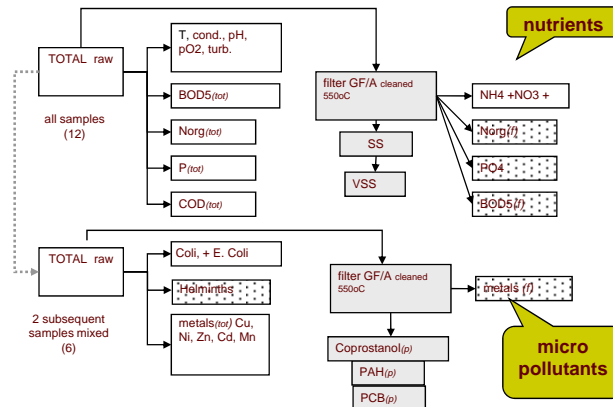


## WP-2 on-going and planned activities wetlands

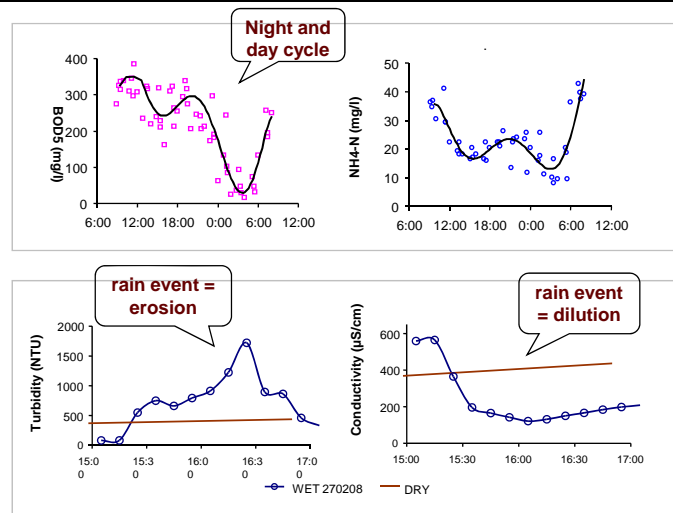


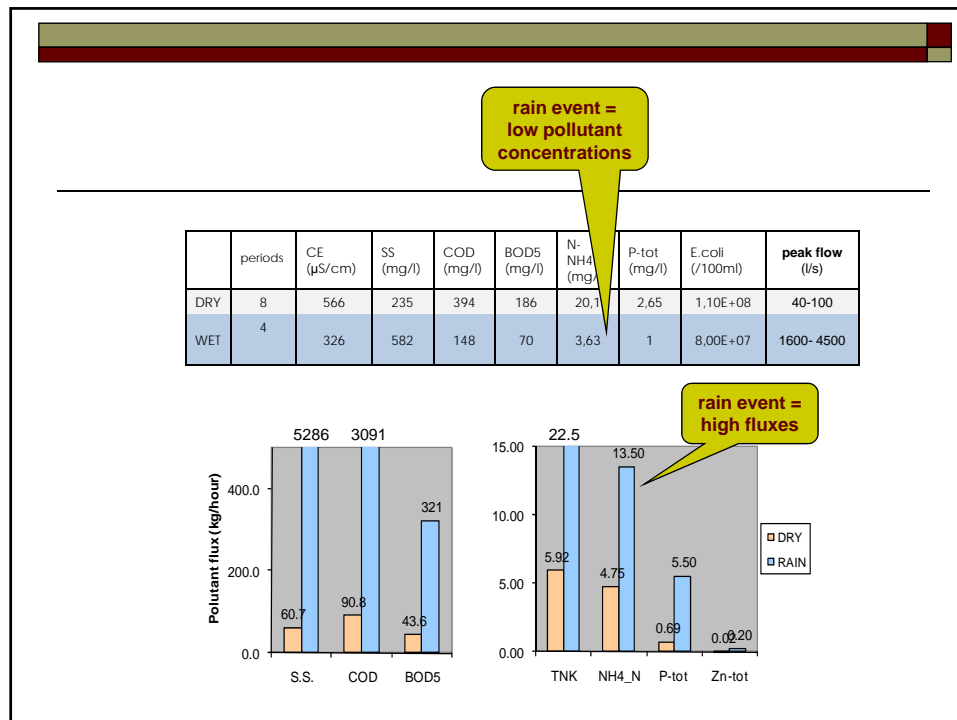


## WP-2 on-going and planned activities wetland (planned)



## WP-2 on-going and planned activities wetland (planned)





## WP-2 on-going and planned activities

- Flood studies under SWITCH in BH:
  - Assessment of flood damages adopting an agent based modelling approach –PhD thesis
  - Developing indicators of vulnerability to floods – PhD thesis
  - Emergency planning under flash flow conditions in urban areas –PhD thesis
  - Assessment of flood risk perception by people living in flood prone areas – MSc thesis

## WP-2 on-going and planned activities

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- Deliverables on stormwater management strategies and methods already prepared
- Studies regarding stormwater governance under WP 2.2 started
- Ongoing studies on the use of indicators on alternatives to employ SUDS and on river restoration:
  - 1 MSc thesis and possibly 1 PhD thesis

## Integration with other WPS

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- Demos provide rich possibilities for integrating all the WPs in which BH is involved:
  - Public participation and educational+training activities planned for all the demos, some already implemented (WP 2 and WP 6)
  - Modelling applied to all the demos (WP 1 and WP 2)
  - Use of indicators for different purposes (choice of BMPs, sustainability assessment, flood vulnerability analysis) (WP 1 and 6)
  - Assessment of public acceptance of BMPs (WP2 and WP6)
  - Governance studies according to SWITCH methodology and objectives (WP 2 and WP 6)
  - Assessment of capital and maintenance costs (WP2 and WP6)