Infiltration basin, Sao Paulo

SuDS used

- *Infiltration Plan*
- *Water quality and quantity management*

Benefits

- *Encourage the regulation of low-impact local planning and development;*
- *Encourage the prevention of soil and groundwater pollution;*
- *Preserve the areas of vegetation cover so that there is an increase of the resistance in the flow, reducing the speed of flow and increasing the time of course of the roof and the roads to the drainage system;*
- *Conduct runoff to ensure clean water enters the natural drainage system;*
- *Reduce costs of construction and maintenance of drainage infrastructure.*

1. Location

Infiltration basin at Federal University of Sao Carlos, Sao Paulo, Brazil

2. Description

The University Federal of Sao Carlos campus is sectorized in North Area and South Area and in its northern area there is a space destined for the expansion of the university. In the same locality there is a weather station that performs the monitoring of the rains. Because of this two characteristics, was delimited a microbasin for study with 4,65ha, where a set of Best Managment Pratices (BMPs) were implemented to promote a sustainable urban development and to reduce the urbanization impact of the campus (Figure 1).

The microbasin is chacaracterized for a medium rainfall of 1500mm/year, own a protection area in your surroundings, take a 56% waterproofed area and has the traditional drainage system directly conected. Being located at upstream for the campus, the expansion of the buildings brought downstream impacts. For this reason, the microbasin is a important area for researches of Master and PhD, looking innovation in engineering, urban planning, hydraulic and hydrologyc disciplines.

For defined the possibilities implantation for BMPs at microbasin, were verified the following characteristics: the physical aspects, including topography, the permanent water supply, the existence of a permanent exudate and the level of the water table; the urban and infrastructure aspects, with the space availability and the existence of underground infrastructure; and the environmental and sanitary aspects, where were verified the pollution and sanitarian risk beyond the custs of implantation. This way was defined two infiltration plan, as it accommodate big volums and need large areas, and wich in this project will be connecteds through of a lawn canal.

Until this moments, were executed the lawn canal, with a extension of 80m and deep of 0,50m and one infiltration plan with a elipse arc form, with de semi axis bigger of 25,85m and the semi axis smaller of 19,90m, supporting a total volum of 111,34m³ (Figure 2).

3. Main SuDS components used

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4. How it works

At first, tests were carried out that verified a high degree of surface compaction of the soil, which prevented the infiltration of rainwater. Double ring tests were performed, which confirmed the infiltration rates practically null before the construction of the plane. Thus, the recovery of the infiltration capacity was predicted by lowering the surface of the land by 0,30 m for water storage and decomposition of the soil with scarification of 0,50m.

The first stage of the construction of the infiltration plan was the location of the project. To achieve the desired levels of design, it was necessary, with an excavator, to lower the ground by 0,30m. After the terrain cut, a topographic survey was carried out to verify the required quotas. Then, the soil was subsoiled up to 0,50m, with subsequent manual adjustment to avoid compacting the soil, because the subsoil increased the terrain level and caused the loss of project quotas. The connection of the building with the plan was made by a canal. After these steps the grass was planted and a bottom drain pipe was installed as an alternative drainage drain.

The operation of the Infiltration Plan takes place following the following steps: step 1 - the water precipitated on the roof is directed by the pluvial building installation to a channel; step 2 - Connection of the rain installation with the plane and measurement of the inlet flow; step 3 - the water is then directed to a channel, filled with gravel, with the function of distributing it and avoiding the preferential path in the plane; step 4 - After passing through the channel of gravel (0,40m by 0,30m), the water is distributed to the plan, where it will be stored temporarily until its infiltration into the ground; step 5 - if necessary, the excess volume of the infiltration plane capacity is exhausted by the ridge of the bus. In relation to the lawn channel, the rainwater coming from the roof of the Medicine Department building, with 1.501,5m², is drained by a vertical tubulation and then directed to the lawn channel (Figures 3, 4 and 5).

5. Specific project details

The infiltration plan was dimensioned to receive the water coming from the roof of the building of the Physiotherapy Department and the expansion area located between the building and the plan, totaling an area of 3.001,30m².

The method adopted for the design of the structure was that of the envelope curve, using the rainfall equation of the city of Sao Carlos. The payback period used was 10 years. The sizing was done with the constant saturated K rate of 125mm/h of site at 100m. After recovery procedure, made during construction, infiltration rates were compared by means of triplicate double ring assay results.

The design rain has an intensity of 41,1mm/h, duration of 70 minutes and water height of 48,0mm. The calculated storage volume was 106,5 m³ and the available volume after construction is 111,34 m³.

In the lawn channel five solids discharges were simulated, with duplicate tests for each event, changing the input concentration, totalizing ten tests. For this purpose, a reservoir of 5m³ of useful volume was used. The initial level (t = 0) inside the reservoir was kept constant for each initial test condition, corresponding to a 1,34m blade, which refers to a volume of 4,2 m³. At the outlet of the reservoir was installed a short PVC pipe of 75mm, connected to a sphere register and to a 90° elbow. The flow rates were calibrated at the Hydraulics Laboratory of UFSCar, Sao Carlos - SP.

The soil used to simulate particulate matter present in the rainwater was collected from an area near the lawn channel to represent the particulate material present in the rainwater. Subsequent to the collection, the soil was separated sieve with a diameter equivalent to 0,074 mm, weighed and stored in plastic bags, for later introduction into the unloading tank. The suspension was constantly shaken to prevent background deposit. No deposits were found on any component of the unloading system.

The remaining residual concentration of particulate material was evaluated at different points along the extension of the grass channel by installing collectors at different positions along the length of the channel

The results indicate that there is a front of removal of particulate material with a tendency to increase upstream efficiency. The higher the initial concentration of particulate material (Co), the greater the extension of the path required for its removal, with a maximum observed limit of around 80 m, for concentrations above 196 mg.L-1.

The results explain that there was a greater dispersion of the experimental data for Co of 65 mg.L-1, when compared to the other investigated situations. It is believed that the lower concentration is more susceptible to experimental errors, being more influenced by transport of material deposited in the past.

6. Maintenance & operation

Details of maintenance and operation

The plan was implemented in 2012. Since then, further research has been carried out in the area. Because it is basically a grassy area, its maintenance requires simple care such as cleaning leaves and removing debris loaded with water.

7. Monitoring and evaluation

The monitoring of precipitations, tributaries and water levels in the infiltration plan were performed between December 16, 2013 to March 18, 2014. During this period, thirty-two rain events were recorded, of which seven had water level recorded by the level sensor inside of the plan.

It was verified that the event with the highest value of Tr recorded between the trials (6.1 years) had a maximum water depth of 0,24 m, not exceeding the maximum depth of 0,59 m.

8. Benefits and achievements

The implementation of the infiltration plan allowed:

Encourage the regulation of low-impact local planning and development;

Encourage the prevention of soil and groundwater pollution;

Preserve the areas of vegetation cover so that there is an increase of the resistance in the flow, reducing the speed of flow and increasing the time of course of the roof and the roads to the drainage system;

Conduct runoff to ensure clean water enters the natural drainage system;

Reduce costs of construction and maintenance of drainage infrastructure.

9. Lessons learnt

Working in a public area of study has the advantage of being able to innovate and propose solutions wich in an extremely urbanized area, such as urban centers, we would have space difficulties. However, these characteristics also indicate that the choice of structure should be thought directly with the type of customer, in addition to the construction issues already mentioned. One of the challenges faced was the lack of knowledge of this type of drainage by campus managers and executing companies.

10. Interaction with local authority

In relation to the authorities with whom we worked along the process, the greatest difficulty was the issue of ignorance, since the local authorities did not obtain knowledge of this type of drainage and felt distrusted in relation to the efficiency of the techniques. Nevertheless, after meetings about the existing research and the possibilities of intervention on campus, we were given authorization to research, implement and execute the project in the area of the microbasin.

11. Project details

Construction completed: -

Cost: -

Extent: Microbasin area: 4,65ha

12. Project team

Funders	• Prof. PhD Ademir Paceli Barbassa • Prof. PhD Luciana Márcia Gonçalves
Clients	• Federal University of Sao Carlos (UFSCar)
Designers	• Architects: Luana Fernanda da Silva Baptista

	Luciana Márcia Gonçalves
Other	• Engineers: Ademir Paceli Barbassa e Mayara Caroline Felipe • Tecnologist: Natália Tecedor

13. Project images and illustrations

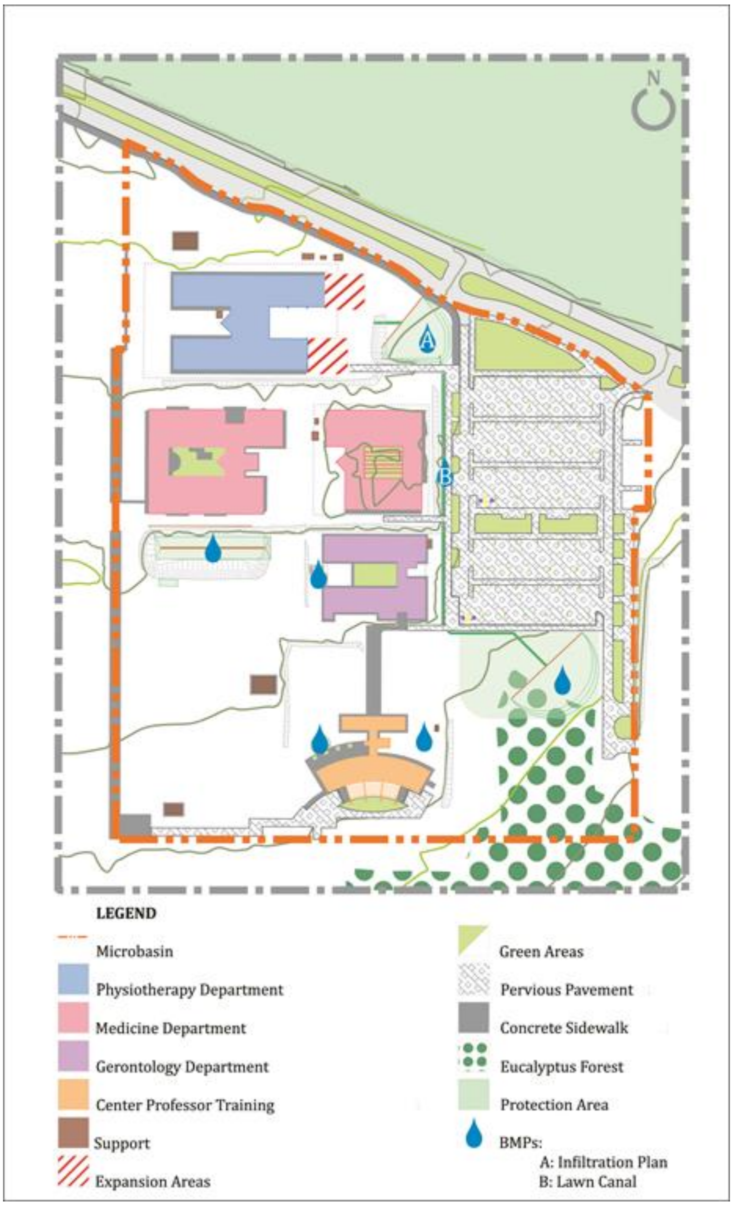

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5