# EFFECTS OF PREFERENTIAL FLOW ON INFILTRATED FLOW AND STREAMFLOW IN THE GRANITE AREA OF THE THREE GORGES, YANGTZE RIVER, CHINA

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## INTRODUCTION

The pores in soil formed by cracks, fissures, worm burrows and root channels are named preferential paths. Soil water movement in preferential flow paths is named preferential flow, which can result in an increase of the water-moving flux downwards along the slope, and then the increase of duration of flood and the flood flow discharge.

The Yangtze River is by far China's longest river and the third longest in the world. The Three Gorges are the most spectacular section of the Yangtze River, which are mainly composed of Qutang Gorge, Wu Gorge and Xiling Gorge. The Three Gorges is famous for their precipitous terrain and beautiful scenery. The Three Gorges area is rich in water resources, which can also bring flood disaster such as that occurred in 1998. So the water management in the Three Gorges area is very important.

In the granite area of the Three Gorges, preferential flow is common. So studying the effects of preferential flow on soil water flow and surface runoff in the granite area of the Three Gorges, Yangtze River, will be helpful and useful to study the flood process in the area.

In order to assess the effects of preferential flow on soil water flow and streamflow in forested watershed, precipitation, amount of preferential flow, infiltrated flow and streamflow were measured respectively for 4 years at a forested watershed (Quxi watershed) in the Three Gorges, Yangtze River, China. The physical properties and infiltration characteristics of the soil were also measured to evaluate their influence on preferential paths.

## SITE DESCRIPTION

The field site, Quxi watershed, is located in Zigui County, Hubei Province, China, 8km away from the Three Gorges Dam on the Yangtze River, (E 30°51′15′′, N 111°57′20′′). The total area of Quxi watershed is 9.8 km2. The highest elevation is 632.1m, and the lowest is 133.2m. The watershed belongs to the first branches of the Yangtze River.

In the Quxi watershed, most of the area is on a slope. The Quxi watershed is located in a sub-tropical area, and has a continental monsoon climate. The annual mean precipitation is approximately 1150 mm, occurring mainly from May to October. The annual mean temperature is 17.4℃.

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## RESULTS AND DISCUSSION

Soil properties have great influence on preferential flow. The lowest soil bulk density was found in the 83~110 cm soil layer because of more non-capillary pores there. Preferential paths existed mainly in this soil layer. So it can be derived that most non-capillary pores in this layer were preferential paths. In the studied area, the percentage of coarse soil particles was the least in the 0~ 15 cm soil layer and the highest in the soil layer below 110 cm (figure 1). The percentage of coarse soil particles increased with soil depth. In the deeper soil layers, the coarse soil particles helped the formation of preferential paths. The greatest steady infiltration rate was found in the 83~110cm soil layer where most pores were non-capillary pores. It can be inferred that it was related to the preferential paths.

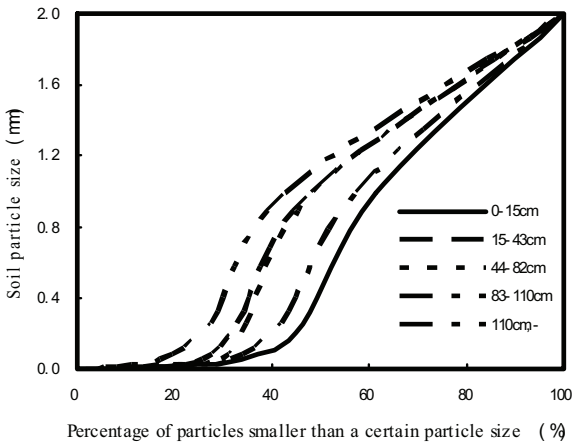


**Figure 1 Accumulative curves about the distribution of soil particles of different soil layers**

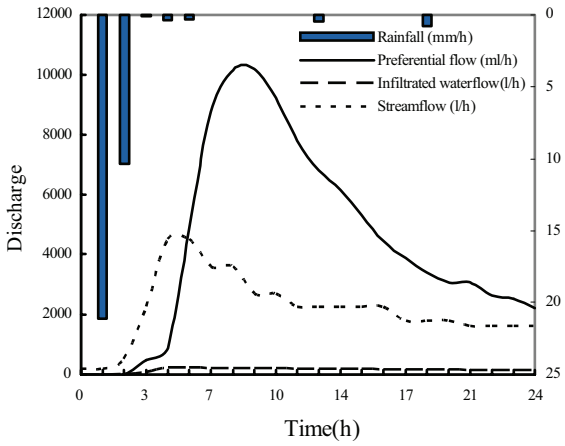


**Figure 2 The hydrograph of preferential flow, infiltrated flow and stream flow in rainfall 1998-07-28**

In the granite area of the Three Gorges, Yangtze River, and during the same rainfall, streamflow always appeared first. The three kinds of runoff are sensitive to rainfall intensity. For the five rainfall events analyzed in this paper, the curves of preferential flow in different rainfalls were similar, with a shorter rising time and longer recession time (figure2).

In the same rainfall, preferential flow appeared later and stopped earlier than infiltrated flow did. The proportion of preferential flow discharge to the soil water can reach 2.40%~8.72%. The maximal preferential flow flux can reach 5600 times of that of infiltrated flow, which could increase the soil water flux to a great extent..The results in this paper was little different from the results that Uchida et al (1999) got. It was inferred that the larger ratio of preferential flow in the Three Gorges area was because of the more preferential flow paths than the research area Uchida selected.

Compared with streamflow, preferential flow reached its peak discharge 4~9 hrs later than streamflow did. The appearance of preferential flow postponed the appearance of the peak streamflow and prolonged the duration of streamflow. The influence of preferential flow on streamflow was affected by the summation of rainfall and the previously influenced rainfall.

**Keywords**: The Three Gorges of Yangtze River, Preferential flow, Infiltrated flow, Streamflow