

## Impact of Urban areas

### ***Sources of sediment, nutrient, and bacteria in urban areas***

Urban areas are specific in that they can be divided into impervious and pervious areas. The mechanisms of sediment erosion and nutrient and pathogens transport are different for each of these surfaces.

On pervious areas, the mechanisms are similar to those in rural areas. In small and mid-size towns, the diversity of ground cover is likely to be higher than in agricultural areas. However, lawns are the main ground cover. Therefore, we assumed all pervious areas are covered with fescue grass and did not make any distinction for other grass species, flower beds, gardens, and urban forestry. Lawns can be fertilized and they are mowed several times a year. Erosion occurs with strong intensity rains, especially if the condition of the lawn is poor and if the grass is short; this could happen in early March or if it rains shortly after a mowing. Movement of nutrient occurs when it rains shortly after fertilizer application. Bacteria buildup and transport occur if animals spend time on these lawns. Animals could be dogs, geese, or other urban wildlife.

Impervious areas have typically 99% runoff and there is no infiltration. Solid particles accumulate on these surfaces up to a certain limit and concentrate in the street gutter or on the edges of the areas. They come from several sources: car tires, soil particles from lawns, dust fallout from smokestacks, ... In this simulation, all solid particles are assimilated to soil particles and added to soil particles from pervious areas. Nutrient loadings from pervious areas are estimated as a fraction of the solid particles. Numerous monitoring campaigns in the United States have determined that urban runoff from impervious areas often have very large concentration of bacteria. These are due to bird droppings, pets' deposits on the streets, and probably others. There is a lack of information on how bacteria and pathogens survive on impervious areas and how they can be transported by surface runoff. In this simulation, we assumed that runoff from impervious areas would have a constant fecal coliform concentration of 5000 colonies/100 ml.

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### ***Contributions from impervious and pervious areas***

Because the model output does not show the contributions from the two types of surfaces in urban areas, we ran the model twice: once with a buildup on impervious areas and once without it. The difference in sediment and nutrient loadings from the urban HRUs allowed us to partition each area type's contributions. Results are presented in Table 1. To give some references, they are compared to the contributions of pastures in poor and good condition, and to forested non-grazed areas

Table 1. Contributions in sediment and phosphorus from pervious and impervious areas in urban and rural zones.

	Urban impervious	Urban pervious	Pasture poor condition	Pasture fair condition	Ungrazed forest
Sediment (t/ha)	0.5	2.2	5.5	0.1	0.01
Organic P (kg/ha)	0.4	0.5	1.2	0.0	0.002
Soluble P (kg/ha)	0.1	0.7	0.7	0.5	0.001
Sediment P (kg/ha)	0.0	3.0	2.6	0.1	0.001
Total P (kg/ha)	0.5	4.2	4.6	0.6	0.004