### The causes of storm water pollution

*Impacts from an increase in impervious surfaces*

Increased imperviousness (volume, peak flow, duration, stream temperature, base flow, and sediment loadings) leads to flooding, habitat loss (e.g. inadequate substrate, loss of riparian areas, etc.), erosion, channel widening and streambed alteration (Source: Urbanization of Streams: Studies of Hydrologic Impacts, EPA 841-R-97-009, 1997).

## 11.2.2 Increased volume and velocity: the impervious cover factor

### Types of impervious cover

Human-made impervious cover comes in three varieties: rooftop imperviousness from buildings and other structures; transport imperviousness from roadways, parking lots and other transportation-related facilities; and impaired pervious surfaces, also known as urban soils, which are natural surfaces that become compacted or otherwise altered and less pervious through human action.

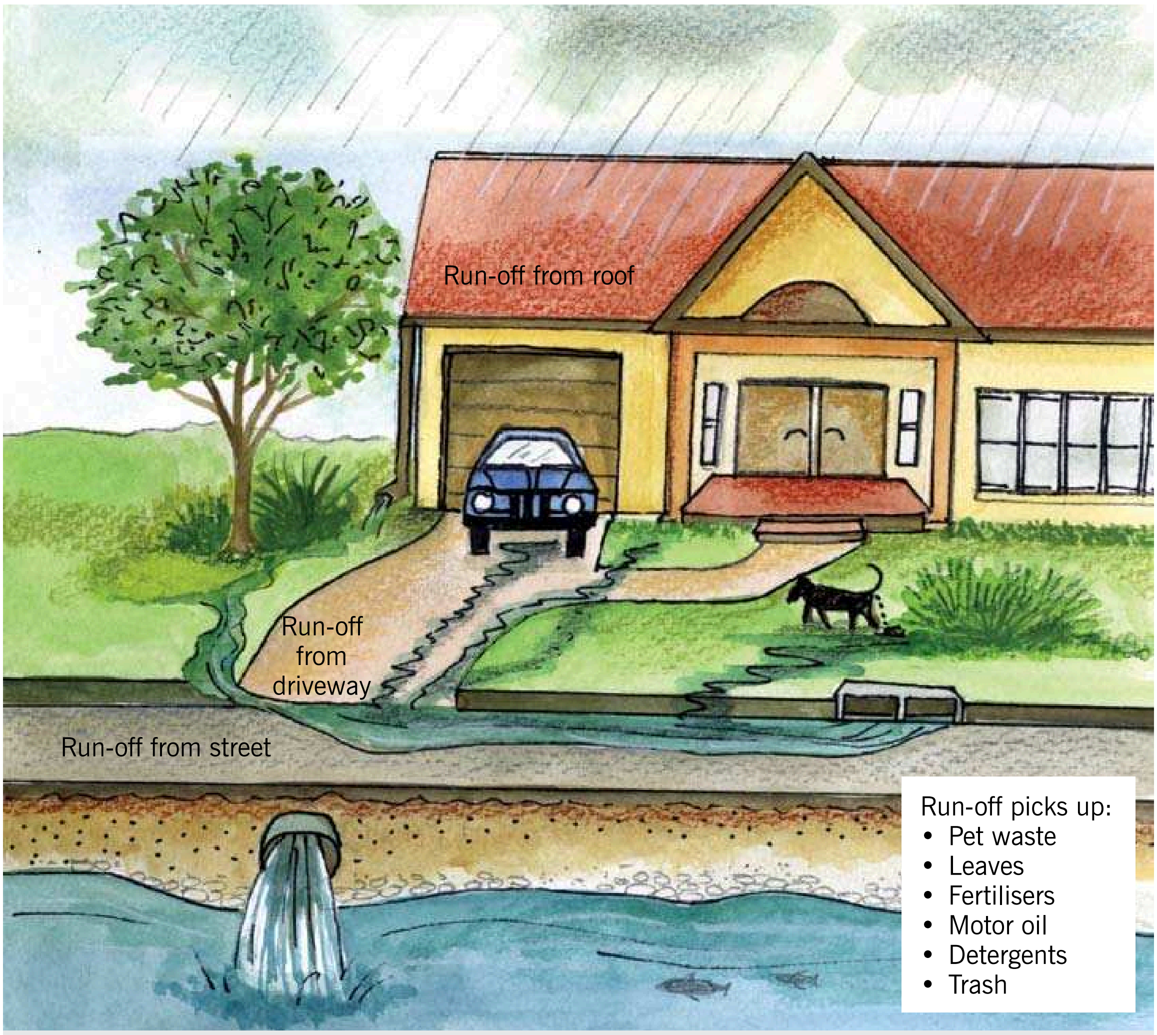


Figure 11.1: Stormwater run-off carries pollutants into our waterways.

Cumulative figures show that worldwide, at least one third of all developed urban land is devoted to roads, parking lots, and other motor vehicle infrastructure. Rainfall on transportation surfaces drains directly to a stream or storm water collection system that discharges into a water body usually without treatment. The creation of additional impervious cover also reduces vegetation, which magnifies the effect of the reduced infiltration. Trees, shrubs, grass and wetlands, like most soil, intercept and store significant amounts of precipitation. Vegetation is also important in reducing the erosional forces of rain and run-off.

Research has shown that when impervious cover reaches between 10% and 20% of the area of a watershed, ecological stress becomes clearly apparent. After this point, stream stability is reduced, habitat is lost, water quality becomes degraded, and biological diversity decreases.

## Increased volume of run-off

The effect of impervious surfaces on the volume of storm water run-off can be dramatic. For example, a 25 mm rainstorm on a 0,4 hectare natural veld would typically produce 0,17 cubic metre of run-off, enough to fill a standard size office to a depth of about 600 mm. The same storm over a 0,4 hectare paved parking lot would produce 2,7 cubic metre of run-off, nearly 16 times more than the natural veld, and enough to fill three standard size offices completely.

Mangrove stream pollution.

## Greater stream and run-off velocity during storm events

Impervious surfaces increases the speed of run-off as it drains off the land. Unlike grassy meadows, hard, impervious cover, such as parking lots and rooftops, offers little resistance to water flowing downhill, allowing it to travel faster across these surfaces. In addition, the faster rate of run-off delivers more water in a shorter time to receiving waters than would occur under natural conditions. The increased velocity and delivery rate greatly magnifies the erosive power of water as it flows across the land surface and once it enters a stream.

## Increased peak discharges

Increased imperviousness not only changes the volume of storm water flows, but also the distribution of flows over time. When land is undeveloped, the initial storm water flow following a rain event is relatively small, since the land absorbs and infiltrates much of the water. However, impervious cover forces rainwater to run off the land immediately, causing a sharp peak in run-off immediately following the rain event. Impervious covers can double, triple, quadruple or even quintuple peak discharge. Streams receiving these increased urban peak flows are described as "flashy," meaning that they are prone to sporadic and unstable discharges including flash floods or sudden high pulses of storm flows. An increase in peak flow can have significant impacts on the human and natural environment. Greater peak flows lead to increased flooding, channel erosion and widening, sediment deposition, bank cutting, and general habitat loss.

## Reduced stream base flow

Impervious cover reduces infiltration and forces storm water to run off the land immediately, so it also typically reduces the amount of groundwater available to recharge streams when there is no rain. Hydrologists often refer to groundwater zones under urban areas as "starved" since they are not replenished. This groundwater-charged stream flow, known as base flow can fall to 10% of the regional average when the level of imperviousness in the stream watershed reaches 65%. Prolonged low flow can have a significant impact on aquatic life and in some cases a greater impact than extreme peak flows.

## Decreased natural storm water purification functions

Municipal storm water departments often replace the beds of creeks, streams, and other drainage ways with concrete open channels, or completely replace those drainage ways with subsurface concrete storm drain lines. These changes degrade or eliminate habitat and dramatically alter hydrology. Canalising disconnects a river from its floodplain and reduces its ability to modify floods naturally. Similarly, this and other development fills, converts, or otherwise eliminates swamps, marshes and other wetlands. Eliminating these natural drainage ways reduces flow storage and detention and soil moisture maintenance and can increase overall flooding and erosion. In addition, natural streambeds and floodplains provide a hydrologic link between groundwater and surface water and can naturally clean waters. By