I-2 IMPACT OF URBANIZATION ON STREAM QUALITY

AT A GLANCE

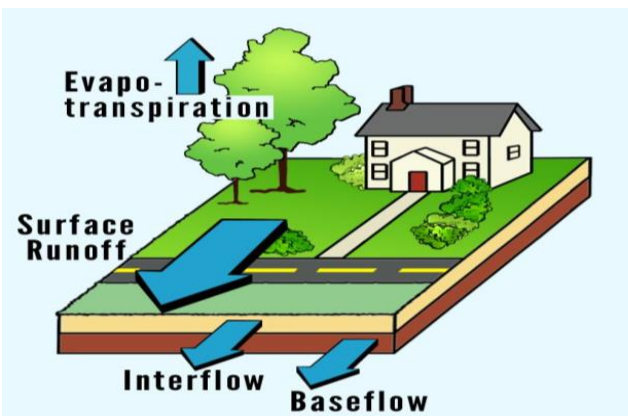
Urbanization alters the natural processes in streams, lakes and rivers.

Urban watersheds produce more stormwater runoff and deliver it more quickly to streams compared to rural watersheds.

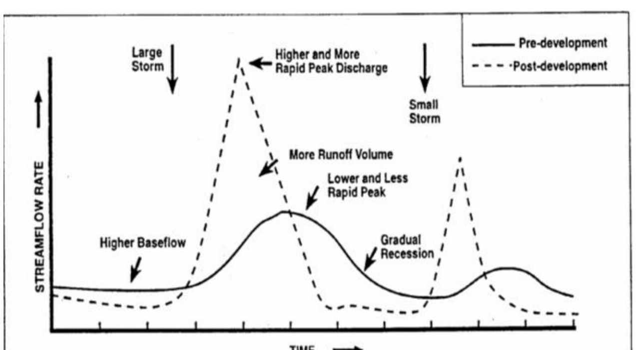
Urban stream channel erosion, loss of riparian buffers warmer stream temperatures and toxic pollutants reduce fish and aquatic insect abundance and diversity.

Understanding the impacts of imperviousness on stream quality can help watershed managers prioritize restoration efforts.

HOW URBANIZATION ALTERS WATERSHEDS



Increased impervious surface means more rainfall is converted to surface runoff.



A hydrograph shows the flow rate in a stream over time after a rain event. Urban streams have higher and earlier peaks than rural streams.

Watersheds are continually transformed by human activities. These changes impact the way water moves through a watershed and ultimately leads to the loss of stream health.

As forests are cleared and farms are converted to housing developments, permeable surfaces are replaced by rooftops, roads and parking lots. This increase in impervious cover fundamentally alters the watershed's hydrology. Rainfall, once intercepted by tree canopy and absorbed by the ground, is now converted to surface runoff. Consequently, urban streams experience more frequent and severe flooding. Meanwhile, stream flow during dry weather often declines over time because the groundwater is no longer being recharged.

Urbanization significantly impacts stream health in six key ways, summarized in the table below. Each impact is interrelated and can range in severity depending on the degree to which the watershed has been developed. Impervious cover is often used as a general index of the intensity of subwatershed development, and can be used to help make watershed management and restoration decisions. More information on this impervious cover model is presented in Fact Sheet I-3.

TABLE 1. IMPACTS OF IMPERVIOUS COVER ON STREAM HEALTH	
Changes in Stream Hydrology	
	• Produces more stormwater runoff volume during every storm event • Increases stream "flashiness" by delivering runoff more rapidly via curbs, ditches and pipes • Increases the frequency of extreme floods in the stream corridor • Increases the frequency of bank full floods that control the shape of the stream channel • Expands the height and width of urban floodplains, putting more people and structures at risk • Decreases stream flow during dry weather conditions, unless flows are augmented by leaks from urban pipe infrastructure
Loss of Stream Corridor Integrity	
	• Buries zero and first order streams and replaces them with a network of storm drain pipes and ditches • Encroaches into the existing floodplain via grading, sewers, buildings and other disturbances • Clearing of intact riparian forests along the stream corridor and interruption of fish and wildlife movement • Increases the number of stream crossings that can become barriers that prevent migration of resident and anadromous fish. • Disconnects the stream from its floodplain and degrades adjacent palustrine wetlands
Changes in Urban Stream Geomorphology	
	• De-stabilizes urban stream channels through enlargement or incision or both • Increases the severity of sediment export from stream bank erosion at the subwatershed level, particularly for headwater streams • May increase floodplain sediment storage in some reaches of larger streams and rivers • Sharply increases downstream sediment delivery especially when urban streams erode through extensive sediment deposits behind old mill dams
Degradation of Urban Stream Habitat	
	• Sharp declines in stream habitat quality scores • Simplifies and degrades stream pool-riffle structure • Reduces the amount of large woody debris found in stream channels • Changes how leaf litter and organic carbon are processed, which forms the base of the stream food chain • Increases stream temperature by 2 to 10 degrees F • Reduces streambed substrate quality by filling, fouling and microbial growth

Diminished Water Quality

- Increases salinity in streams, ponds and lakes due to road salting
- Continuous violations of bacteria standards for water contact recreation after nearly every storm event and occasionally during dry weather
- Sharp increases in nutrient loads that cause symptoms of eutrophication in streams, lakes, rivers and estuaries
- Increases in pesticides, metal and hydrocarbon concentrations that cause toxicity to aquatic life
- Contaminates bottom sediments of urban ponds, lakes, rivers and estuaries with toxic compounds
- Increases loads of trash, debris and micro-plastics delivered to receiving waters

Loss of Stream Biodiversity

- Declines in aquatic insect diversity, especially stoneflies, mayflies and caddisflies
- Decreases the number of fish species, especially "habitat sensitive" ones, such as trout and salmon
- Declines in the abundance and diversity of amphibians along the stream corridor
- Increases toxic accumulation in fish tissue and fish-eating raptors
- Increases in the dominance of invasive plant species along the stream corridor

RESOURCES

Type of Resource	Title of Resource
CSN Webcast	Impervious Cover Model: Revisited
USGS	Effect of Urbanization on Stream Ecosystems
Watershed Restoration Manual Series	An Integrated Framework to Restore Small Urban Watersheds (Manual 1)
CSN Presentation	Impervious Cover, Stormwater Runoff and Stream Health
CSN Webcast	Why Watersheds Matter
CSN Report	Is Impervious Cover Still Important? Review of Recent Research
Report	Impacts of Impervious Cover on Aquatic Systems
Report	Importance of Imperviousness