

# Introduction to Stormwater and Watersheds

## I-1 URBAN WATERSHED BASICS

### AT A GLANCE

Watersheds are land areas that drain surface runoff and groundwater to a downstream water body. Boundaries are defined by high elevation points, some of which are manmade.

Each watershed is drained by a network of streams and rivers. The smallest tributaries are referred to as headwater streams and are critically important to the health of downstream waters.

Water movement throughout a watershed is impacted by a wide range of factors including its climate, topography, soils, land cover and acreage.

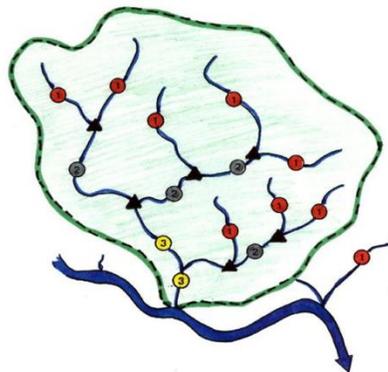
The Chesapeake Bay watershed has multiple physiographic regions, each of which has implications for how water moves throughout the system. Karst terrain and the coastal plain each present particular challenges for managing water quality.

### WATERSHED TERMINOLOGY

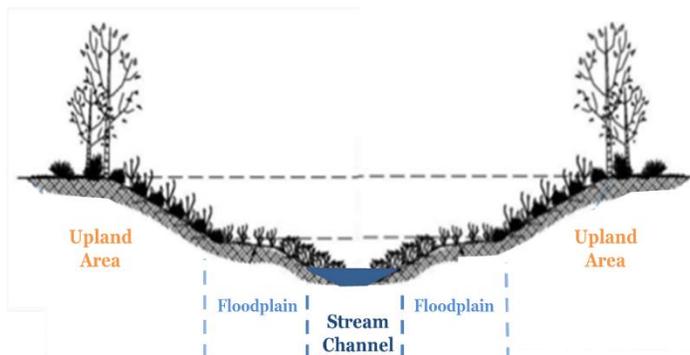
**Watersheds** are land areas that drain surface runoff and groundwater to a downstream water body, such as a river, lake or estuary. Watershed drainage areas can be very large and encompass many political jurisdictions, land uses (forest, agriculture, urban) and pollution sources. Each watershed is made up of a series of smaller **subwatersheds** with drainage areas of five to 10 square miles or less.

#### STREAM ORDER CONCEPT

KEY	
	watershed boundary
	stream
	confluence
  	stream order



Each watershed is drained by a network of streams, each of which can be classified by its relative order in the network. For example, a small stream with no tributaries or branches is called a **first-order stream**. When two first-order streams converge, they form a second-order stream. These smaller, headwater streams are critically important to the health of downstream waters and are the major focus of most restoration efforts.



The **stream corridor** and **upland areas** are the two basic parts of a watershed. Stream corridors are the channels through which the stream flows and the lands that surround them. The **floodplain** is the land adjacent to the stream channel that is inundated by water during high flow events and is considered part of the stream corridor. The upland area makes up the rest of the watershed that drains to the stream corridor.

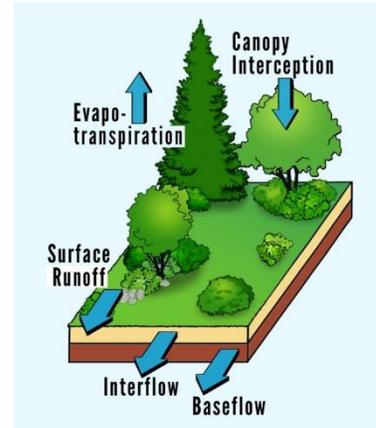
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## WATER BALANCE IN NATURAL SYSTEMS

The way water moves through a watershed is dependent upon many variables, some of which are natural and some which are the result of human development. In a natural system, rainfall either:

- Is intercepted by tree canopy,
- Infiltrates into the soil and slowly moves as groundwater flow,
- Becomes surface runoff

Once rainfall hits the ground, the topography, soils and land cover will impact how quickly it moves. Watersheds with steeper slopes allow runoff to move more quickly, leading to soil erosion. Other watersheds have soils that prevent water from infiltrating into the ground. These soils have clay and silts, impermeable bedrock, or high water tables that prevent water from infiltrating. While the hydrology of undeveloped watersheds can vary widely, stormwater runoff in undeveloped watersheds ranges from 2-5% of the total annual rainfall and the storm flows are easily handled by the stream network.



**Table I-1. Factors affecting surface runoff**

<b><u>Climate</u></b>	<b><u>Physical</u></b>
Rainfall intensity	Impervious Cover and Turf Cover
Rainfall amount	Topography
Rainfall duration	Soil Type
Rainfall location	Vegetation
Previous Rainfall	Watershed size
Rain or Snow	Ponds/Reservoirs

In natural stream corridors, storm flows are conveyed to the stream channel and then overflow into the adjacent floodplain. Flood waters are stored and dissipated within the floodplain, preventing further damage downstream.

## UNIQUE TERRAIN: KARST AND THE COASTAL PLAIN

The Chesapeake Bay watershed includes several kinds of terrain that directly impact how stormwater runoff moves through a watershed: karst terrain and the coastal plain.

### *Karst Terrain*

Karst is a dynamic landscape of sinkholes, springs, caves, and pinnacled rock formations caused by the dissolution of underlying carbonate rocks such as limestone and marble. This geology produces less surface runoff than other watersheds, especially if flows discharge to a sinkhole. Subsurface flows are highly variable and can spring up anywhere.



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## *Coastal Plain*

The coastal plain is a flat, low-lying area in the easternmost part of the Chesapeake Bay watershed. The flat terrain reduces the ability to move floodwaters during the intense storms. The coastal plain also has a high water table – just a few feet below the surface of the soil – which makes it hard to manage stormwater runoff. Some soils in the coastal plain are very poorly drained and do not infiltrate, while others are sandier and extremely permeable. In addition, the

landscape has been altered to drain farm fields, create roadside ditches, and provide mosquito control.

It is important to understand the differences in how water moves through each of these regions in order to plan effective stormwater management. Increased urban development in these regions has impacts that can differ from impacts in other parts of the Chesapeake Bay watershed and restoration practices should be tailored appropriately.

## RESOURCES

Type of Resource	Title of Resource
USGS	<a href="#">Surface Runoff – The Water Cycle</a>
Watershed Restoration Manual Series	<a href="#">An Integrated Framework to Restore Small Urban Watersheds (Manual 1)</a>
CSN Report	<a href="#">Technical Bulletin 1: Stormwater Design Guidelines for Karst Terrain</a>
CSN Report	<a href="#">Technical Bulletin 2: Stormwater Design in the Coastal Plain</a>
EPA	<a href="#">Introduction to Watershed Ecology</a>

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