Chapter 1

GEORGIA'S WATERSHED ECOLOGY

- Watersheds
- The Water Cycle
- Soil, Water and Vegetation
- Ground Water and Surface Water
- Hydrology and the Effects of Development

Watersheds

(Technical definition)
A **watershed** is a system. It is the land area from which water, sediment, and dissolved materials drain to a common point along a stream, wetland, lake or river. For each watershed, there is a drainage system that conveys rainfall to its outlet. Its boundaries are marked by the highest points of land around the waterbody.

(Broader definition)
A **watershed** is more than the physical landscape that is defined by ridges with one outlet for water to flow. Watersheds support a variety of resources, uses, activities and values where everything is linked in such a way that eventually all things are affected by everything else. Most importantly, it contains the history of all that went before us and the spirit of all to come.
- George Wingate, Bureau of Land Management

Ms. Bonnet and her class collected chemical data from their stream site for three years. On the fourth year, Ms. Bonnet's class noticed that the stream was no longer flowing as it had in the past. The flow was minimal with some pooling. Ms. Bonnet called a stream ecologist and asked why this was happening. He asked; "What type of activity is happening in your watershed?" Without knowing what is happening within the watershed, it is difficult to determine what is affecting your stream, wetland or lake.

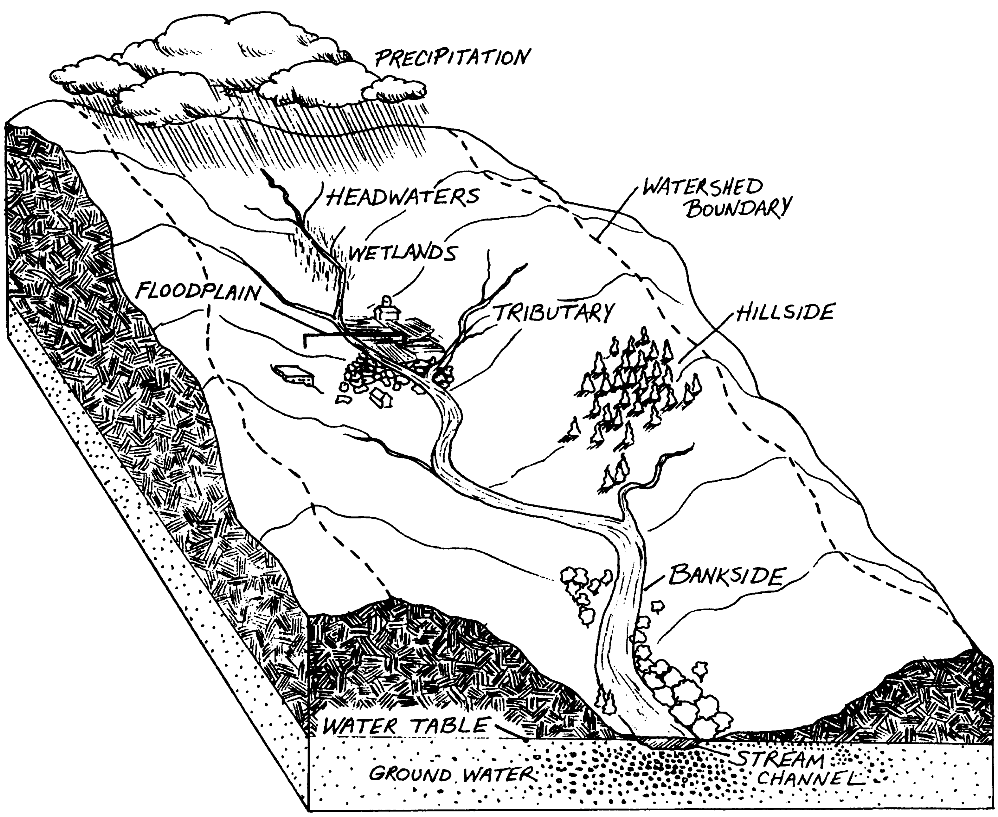

Figure 1.1 Cross section of a watershed

A watershed may be as small as the land area that drains into a small neighborhood wetland or as large as a third of the state of Georgia which drains into the Altamaha River (refer to front cover to see where the Oconee and Ocmulgee Rivers come together to form the Altamaha).

The Water Cycle

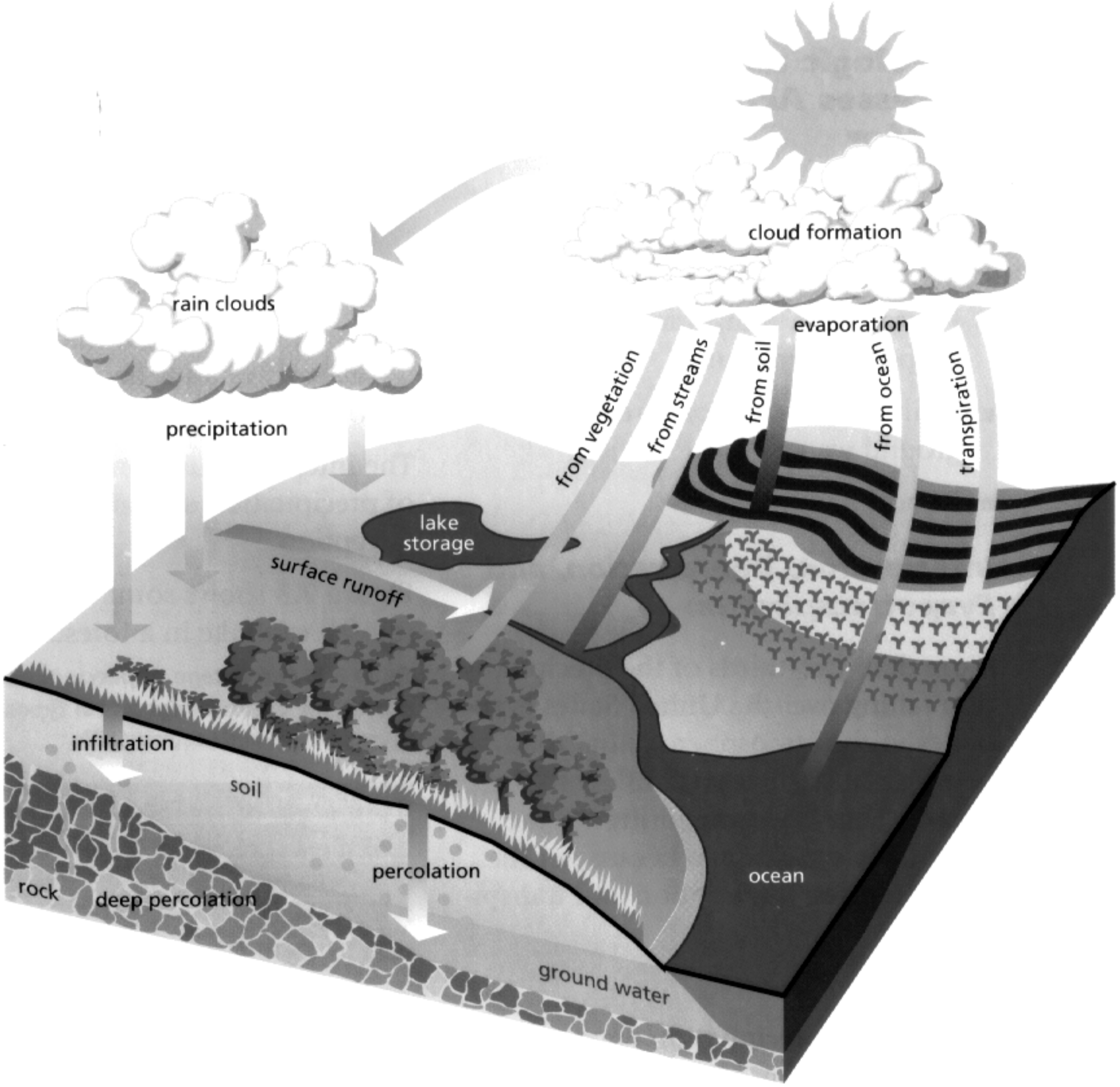

Figure 1.2. The water cycle

The **water cycle** (also called the **hydrologic cycle**) is the continuous movement of water through the air, ground, vegetation and surface water (Figure. 1.2). It is through this movement that water is replenished in the river systems and ground water of Georgia.

Most **precipitation** in Georgia occurs as rain. The rain is either intercepted by vegetation or falls directly on the ground. The rain that falls to the ground either travels over the ground as **surface runoff** or is absorbed into the ground in a process called **infiltration**. Some water is converted to water vapor by plants and returns to the atmosphere. This process is called **transpiration**. Some water from the ground and lakes, rivers and oceans is converted to water vapor by heat from the sun and returns to the atmosphere through **evaporation**.

Soil, Water and Vegetation

In undisturbed Georgia forests, soils evolve in a natural process, to absorb the state's rain and make it part of the ecosystem. Roots of grasses and trees reach into the soil and the root hairs separate mineral particles of worn rock. Ants and beetles excavate the soil and create pores. Leaves fall from the trees each autumn to form mulch over the soil and earthworms pull the leaves into their burrows, where they ingest them and add their organic matter to the soil structure. These processes make mineral soil (figure 1.3).

By accepting and absorbing rainfall, Georgia's native environment maintains its equilibrium and its health. Organic matter and soil pores suspend the water in the soil, making it available to the roots of native plants. Roots filter out passing solid particles and build them into the soil matrix. Microorganisms decompose pollutants and turn them into nutrients for the living system.

In natural areas, water that infiltrates the soil replenishes the ground water where we take our drinking water. Infiltration of water into the soil reduces flooding. The gradual movement of water through the soil and vegetation provides a consistent flow of water to streams and wetlands.

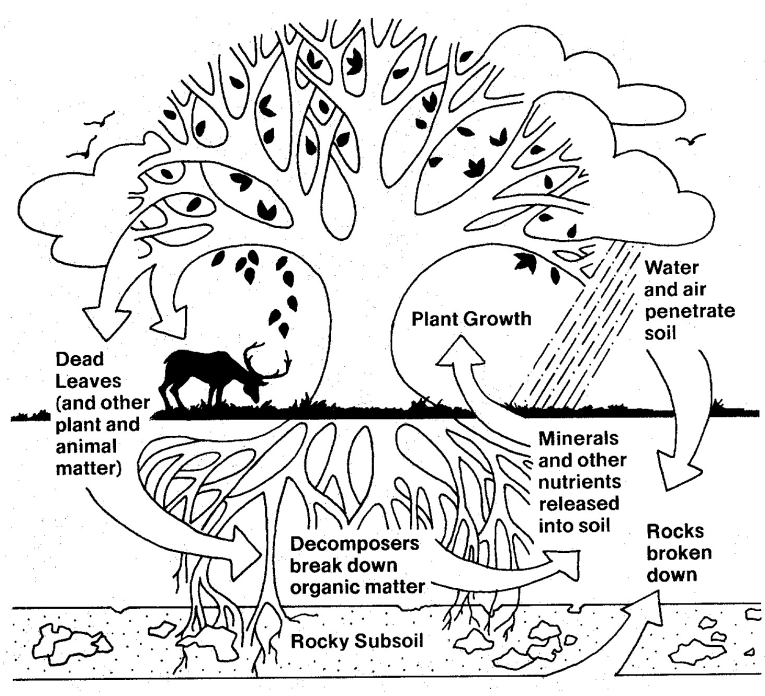

Figure 1.3 Soil, water and vegetation.
Source: USDA Soil Conservation Service

Ground Water in Georgia

Ground water is extremely important to the life, health, and economy of Georgia. For example, in 1995, ground water made up 23 percent of the public water supply, 91 percent of rural drinking water sources, 66 percent of the irrigation use and 45 percent of the industrial and mining use. Total ground water withdrawal in 1995 was approximately 1.2 billion gallons per day. For practical purposes, outside the larger cities of the Piedmont, ground water is the dominant source of drinking water (figure 1.4). Literally billions of dollars could be lost from the economy of Georgia and the health of millions of people could be compromised if Georgia's vast treasure trove of pure ground water was to be significantly polluted.

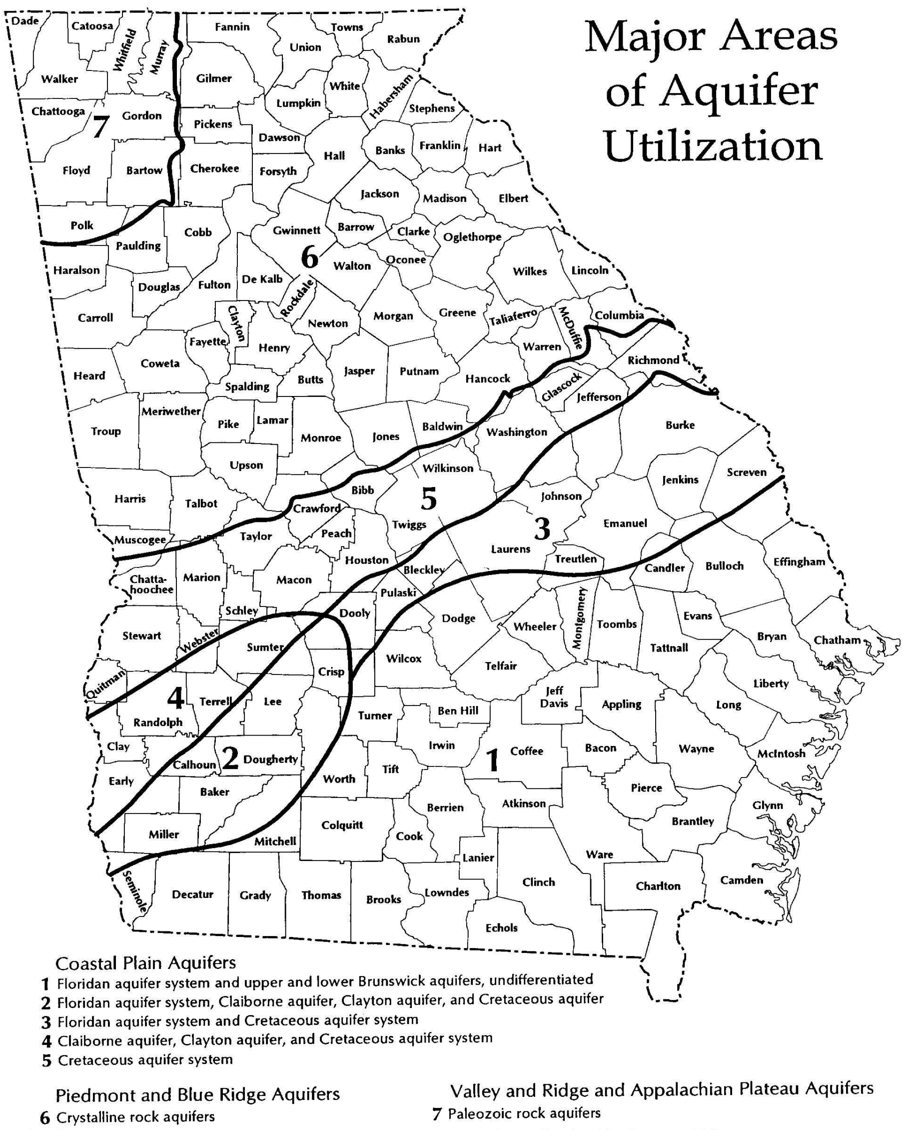

Figure 1.4 Areas in Georgia where ground water is used

The Ground Water and Surface Water Relationship

Ground water is recharged by infiltration of rain into the ground and from streams and wetlands that receive surface runoff (figure 1.5). In turn, ground water can flow into streams as a spring. The combination of ground water flow (**subsurface flow**) and surface runoff to a stream is defined as the stream's **baseflow**. At times when there is no surface runoff from precipitation, the entire flow of a stream might actually be baseflow from ground water (Figure. 1.6).

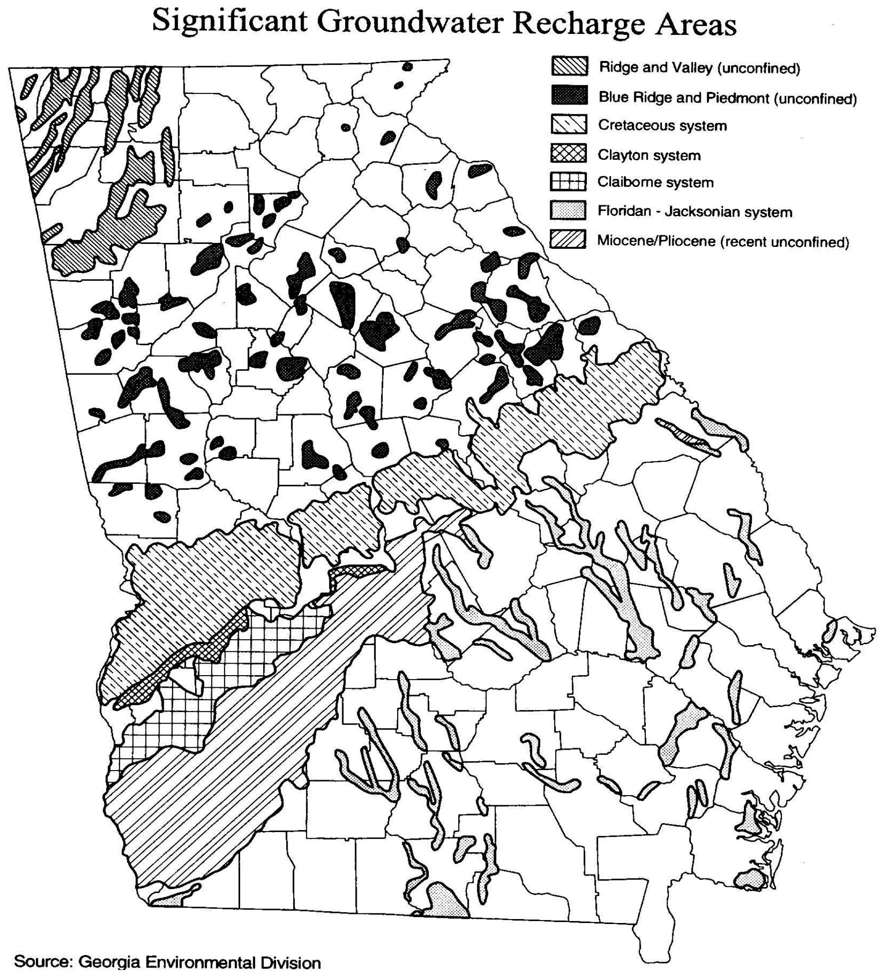

Figure 1.5 Surface water recharges ground water in these areas of Georgia

A **losing stream** is recharging ground water (Fig. 1.6). Stream water percolates down through the soil until it reaches the zone of saturation. **Gaining streams** alternate between losing and gaining water as the water table moves up and down according to the seasonal conditions or pumpage by area wells.

The same principle can be applied to wetlands and lakes.

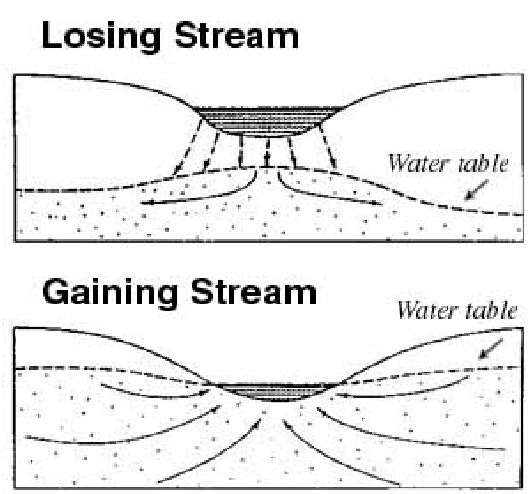

Figure 1.6 Surface and ground water recharge each other.

Hydrology and the Effects of Development

The natural water cycle and the interaction between surface water and ground water changes as naturally forested and vegetated areas are replaced by rooftops, roadways, parking lots, sidewalks, and driveways. Surfaces that do not allow water to infiltrate the ground are called **impervious** surfaces. One of the consequences of impervious surface is that the amount of ground water infiltration is reduced and surface runoff is increased (figure 1.7). As a result, water is quickly delivered to urban streams as surface runoff during storm events and is not given time to infiltrate the soil and recharge ground water; thus, little water is available to replenish streams during the dry season.

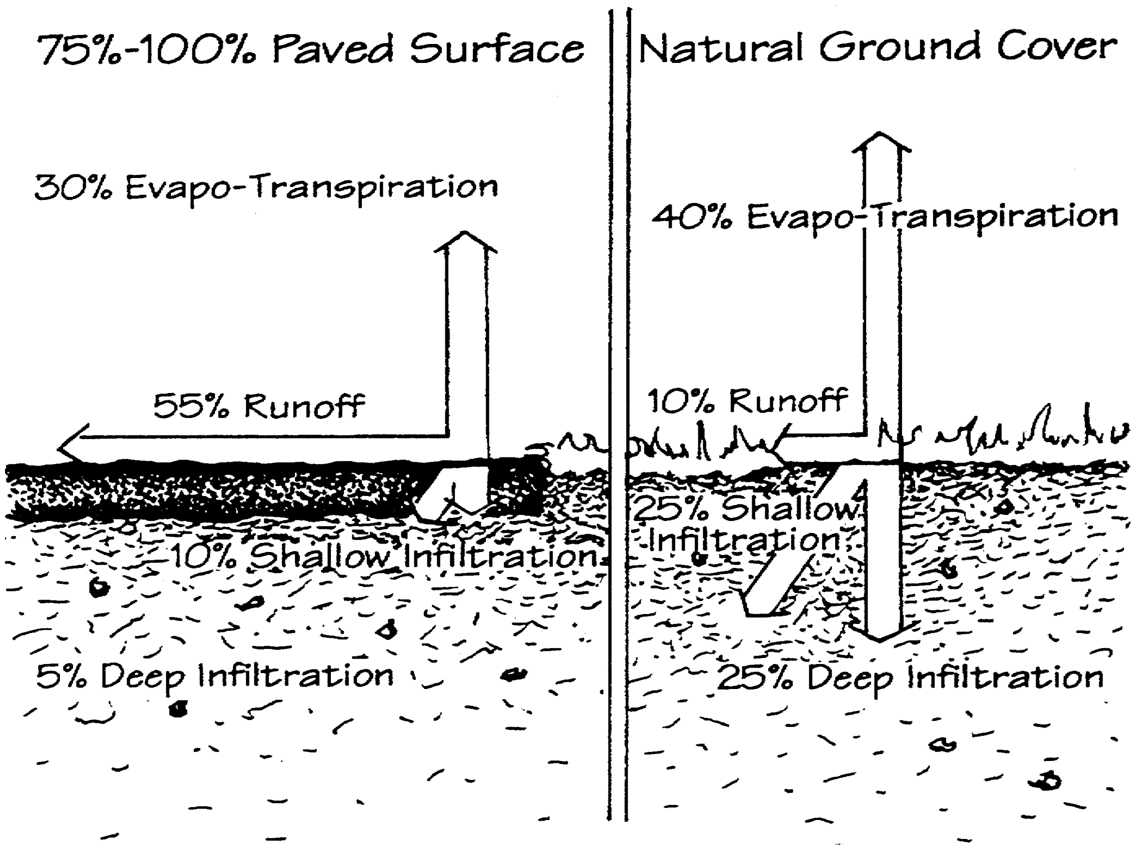

Figure 1.7 Depending on the amount of impervious surface in a watershed, the annual volume of storm water runoff can increase by up to 16 times that of natural areas*

*Schueler, Thomas, 1995 *Site Planning for Urban Stream Protection*, Washington: Metropolitan Washington Council of Governments.

In cities and other urban areas, rain falling on hard surfaces is transported via storm drains or drainage ditches into Georgia waterways. This results in very large increases of flow and volume within streams and rivers. All this water can impact our streams, causing sandbars to shift, covering stream habitat, gouging out steep banks, and causing accelerated erosion (Fig. 1.8). Storm water can also increase flooding within and downstream of developed areas (Fig. 1.9).

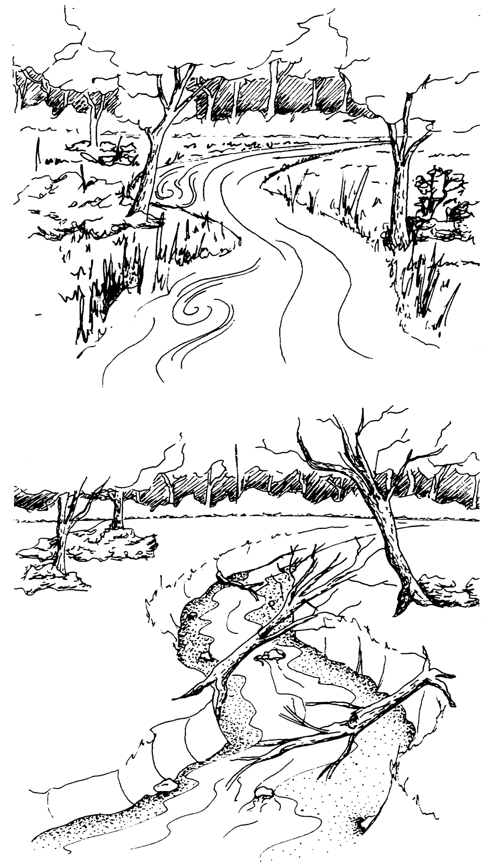

Figure 1.8 Effects of increased runoff on stream sizes and shapes