

Restoring Streams

Carmen T. Agouridis and Evan T. Wesley, Biosystems and Agricultural Engineering

What Do Streams Do?

Streams are all around us. Most of us drive by or over streams every day. Some streams are big—such as rivers—and some are small rivulets; some flow year-round while others flow only a few months of the year or only when it rains. Regardless of their size and flow duration, streams serve a number of important purposes. The water supply for many people, from cities to small towns, is rivers and streams. Streams help transport or move the water, sediment, and nutrients generated in our watersheds to downstream reaches. Streams provide habitat for aquatic organisms such as macroinvertebrates and fish as well as terrestrial ones such as birds, deer, fox, raccoons, and other mammals. Larger streams and rivers serve as transportation routes helping us move crops, manufactured goods, and natural resources to domestic and international markets. Streams also provide us with recreational opportunities such as swimming, fishing, and boating.

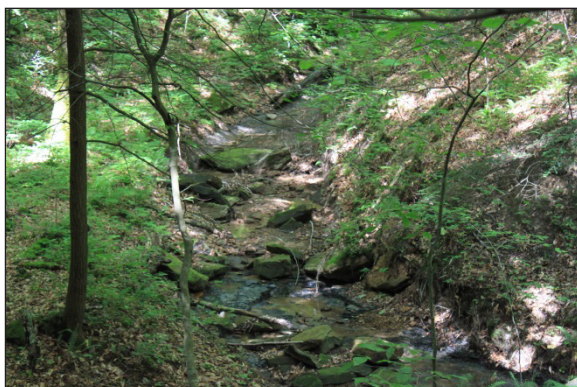
Perennial, Intermittent and Ephemeral Streams

One way to classify streams is by the amount of time that flow is present in a stream. Perennial streams (a) are those with flow in at least part of the streambed year-round. Intermittent streams (b) are seasonal streams that hold water during the wetter parts of the year but cease to flow during drier periods. Ephemeral streams (c) flow only in response to precipitation events such as rainfall and snowmelts.

Photos: Carmen Agouridis



(a)



(b)



(c)

*The health of our waters is the principal measure
of how we live on the land. —Luna Leopold*

Aquatic Macroinvertebrates

Aquatic macroinvertebrates are organisms without an internal skeleton; they are visible with the naked eye. Insects, worms, and mollusks all are examples of aquatic macroinvertebrates that live in streams. You can typically find these organisms living under rocks and logs or in leaf packs. Aquatic macroinvertebrates are a vital part of the food web. They are a food source for higher-order organisms such as birds, fish, and larger insects. Aquatic macroinvertebrates are also indicators of water quality. Because aquatic macroinvertebrates live in streams, cannot relocate very quickly, and have different sensitivities to changes in water quality, sampling the number and types of aquatic macroinvertebrates can provide us with insights into the health of a stream. Mayflies (a), for example, are sensitive to pollution but pouch snails (b) are not.



(a)

Photos: Blake Newton, Entomology, (a) and Evan Wesley (b)



(b)



Photo: Carmen Agouridis

Figure 1. Healthy streams are physically stable and have good water quality and habitat features.

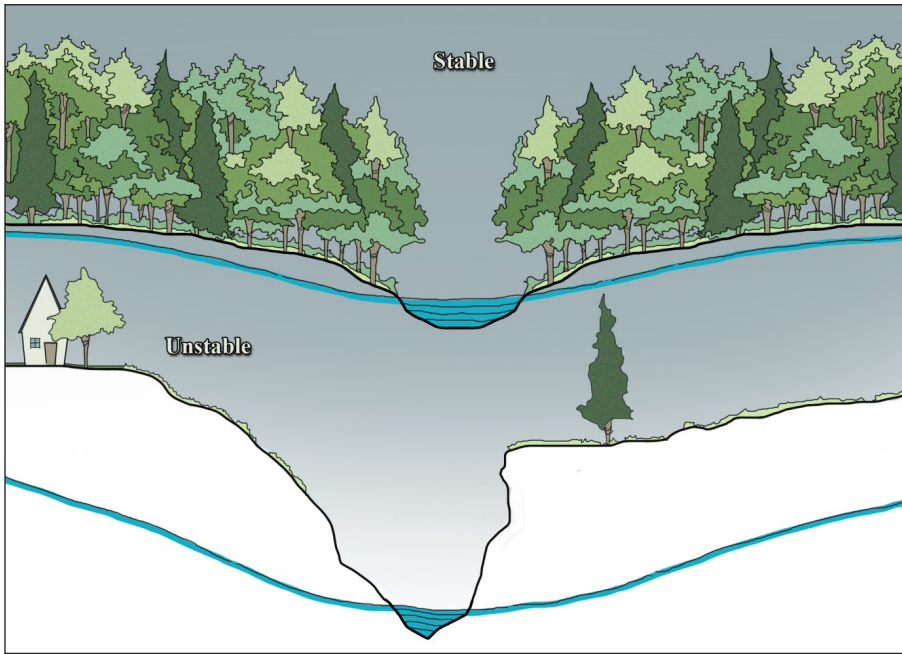
What Are the Traits of a Healthy Stream?

Healthy streams have three main components: physical stability, good water quality, and good habitat (Figure 1). Physical stability does not mean streams are rigid and unmoving. Streams, by their nature, are dynamic systems. Their locations and shapes are expected to change over time. Physical stability means that as streams move, they do so in a way that allows them to maintain their dimensions (cross-section, pattern or plan view, and profile) without filling up with sediment (aggrading) or down-cutting (degrading).

The physical and chemical components of the water in a stream, such as dissolved oxygen, temperature, suspended sediments, and nutrients and metals, reflect its water quality. In turn, a stream's water quality strongly influences habitat. For example, as

water temperature increases, dissolved oxygen levels in the water decrease, thus negatively affecting aquatic life. If the water quality is poor, the types and numbers of fish and macroinvertebrates that can live in the stream will be limited.

Good stream habitat encompasses more than water quality. Good stream habitat refers to both the quality and quantity of instream and riparian (or streamside) spaces that are inhabitable by aquatic life. Aquatic organisms are influenced by a number of habitat features, such as the type of substrate (e.g. sand, gravel and bedrock) present, the depth and velocity of flow, the depth and frequency of pools and riffles, and the amount and types of riparian vegetation present. These features influence factors such as feeding, reproduction, and refuge.



Graphic: Corey Wilson, Landscape Architecture

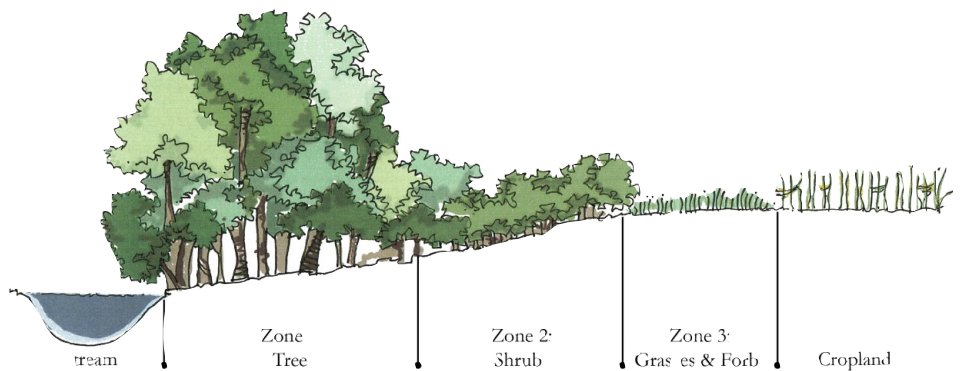
Stable and Unstable Streams

Stable streams are those that maintain their dimension (cross-section), pattern and profile over time. Stable streams have good connections to their floodplains so that flows can frequently overflow the streambanks and spread out onto the floodplain. Stable streams also have thick, deep rooted riparian vegetation which holds streambank soils tightly in place. And since streams act as drains, the elevation of the stream bed in perennial streams will largely control the depth of the water table.

Unstable streams are those that show signs of degradation, such as eroded stream beds and banks, or aggradation, such as pools filled in with sediment. Unstable streams are often incised, meaning flows do not reach the floodplain except for during rare, large storm events. And because of the incision, the water table is lower. In addition, riparian vegetation is often lacking or has shallow roots, such as with mown grass.

Riparian Buffers

Riparian buffers are areas characterized by high levels of interaction between water, soil, and vegetation. These vegetation zones link aquatic environments such as streams to terrestrial ones such as upland pastures. Riparian buffers typically consist of three zones. Zone 1 is adjacent to the water. This zone consists of water tolerant trees. Zone 2 consists of shrubs located next to the trees in Zone 1. Zone 3 is a zone of grasses and forbs next to the shrubs. At a minimum, riparian buffers should be 25 feet wide.



Graphic: Corey Wilson, Landscape Architecture

What Impacts the Health of a Stream?

Streams are ultimately influenced by the land through which they flow. What occurs in a stream's watershed affects its shape, the water quality, and what lives in it. When land use changes occur, streams are inevitably impacted. Without proper land management, changes such as urbanization and development, agriculture, mining, and silviculture can negatively impact streams. With urbanization, for example, development increases the amount of impervious area leading to increased amounts of runoff. Impervious surfaces such as roads, buildings, and parking lots prevent stormwater from naturally soaking into the ground. Instead, stormwater travels as runoff across impervious surfaces, where it picks up pollutants before entering the storm sewer system, where it is then quickly routed to streams through stormwater pipes. Unlike the sanitary sewer system, water in the storm sewer system is not treated. Streams receive this larger amount of runoff, often of poor quality, quickly. This rapid influx of stormwater and pollutants into streams often results in eroded streambanks and beds, degraded water quality, and poor quality habitat (Figure 2).



Photo: Carmen Agouridis

Figure 2. Urbanization can cause streams to widen and deepen.

Each stream restoration project has its own unique characteristics, but most share the same main components:

- Reconstruction of the stream's dimension (cross-section), pattern (plan view), and profile (slope)
- Reconnection of the stream to its floodplain
- Stabilization of streambanks using riparian vegetation or other erosion control measures
- Use of instream structures for grade-control, streambank protection, habitat creation, and/or water quality improvement
- Establishment of a riparian zone, preferably greater than 25 feet on each side of the stream, using native vegetation
- Establishment of habitat enhancement features, such as vernal pools and wetlands, in the riparian zone

What is Stream Restoration?

Stream restoration is the re-establishment of the structure (dimension, pattern, and profile) and function (transport of water, sediment, and nutrients; habitat provision) of a degraded stream as closely as possible to pre-disturbance conditions. Stream restoration projects are often performed to reduce and/or prevent streambank erosion, restore or maintain water quality, restore or maintain aquatic habitat, protect infrastructure (e.g. bridges and utilities) and land, enhance recreational opportunities, and improve aesthetics (Figure 3).



Photo: Carmen Agouridis

(a)

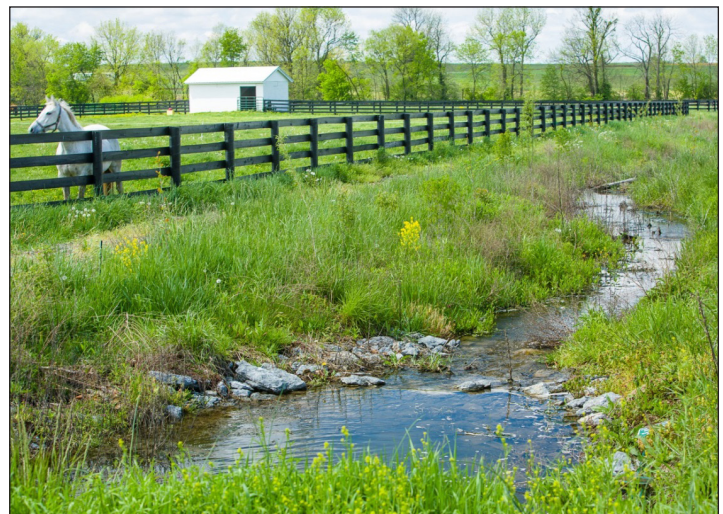


Photo: Matt Barton, Agricultural Communications Services

(b)

Figure 3. An intermittent stream before (a) and after (b) stream restoration.

What Technical Expertise is Needed?

Because restoring a stream is a complex endeavor requiring knowledge from a wide range of areas such as hydrology, hydraulics, geomorphology, ecology, botany, and construction management, it is important to get professional assistance. Trained engineers, hydrologists, biologists, and other such technical professionals are necessary to properly design and construct a stream restoration project.

Are Permits Needed?

Before construction can begin on a stream restoration project, it is important to obtain the necessary permits. Federal, state, and local agencies administer and distribute permits for stream restoration projects. At the federal level, consult with the U.S. Army Corps of Engineers. The Kentucky Division of Water administers the state-level permits in Kentucky. Local agencies should also be consulted regarding permit needs for stream restoration projects. The permitting process can take several months, so plan accordingly.

Who Funds Stream Restoration Projects?

Funding for stream restoration projects comes from a variety of sources from the federal to local level. Federal agencies such as the U.S. Department of Agriculture, U.S. Environmental Protection Agency, and the U.S. Army Corps of Engineers have funded stream restoration projects across the country. State and local governments also provide funding through grants, mitigation programs, and stormwater management programs. Non-governmental organizations such as local non-profits also fund stream restoration projects. Private landowners who wish to restore their streams may self-fund a stream restoration project.

Further Reading

HENV-206 *Understanding and Protecting Kentucky's Watersheds*

IP-73 *Living Along a Kentucky Stream*

ID-185 *Planting a Riparian Buffer*

HENV-202 *Planting Along Your Stream, Pond, or Lake*

ID-175 *Riparian Buffers: A Livestock Best Management Practice for Protecting Water Quality*

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