RIVER BASICS

How do rivers work?

Rivers of all sizes are constantly changing and evoloving to manage and balance the water and sediment delivered to them. They adjecust their size and shape in order to achieve stability.

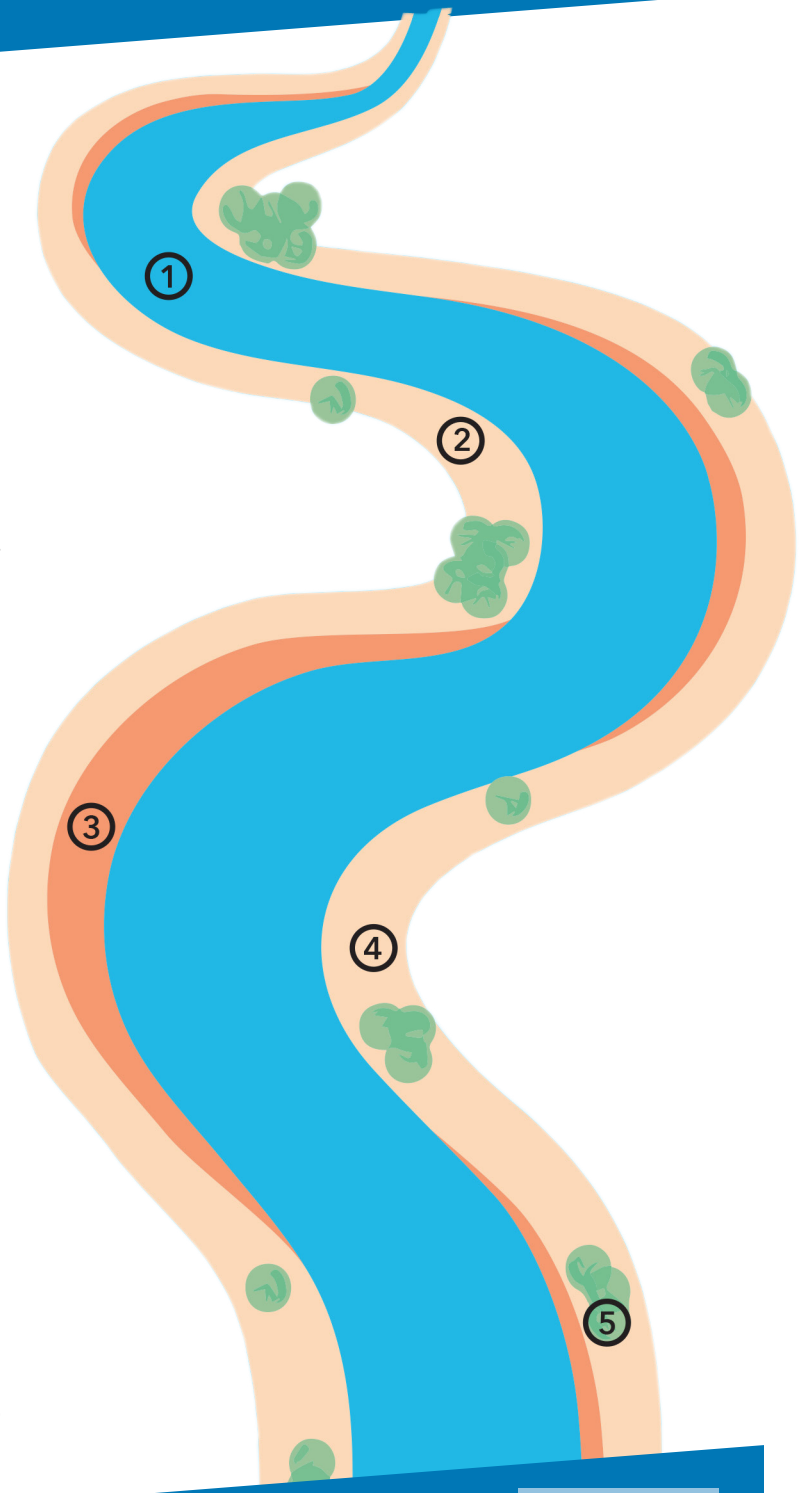
1. **Streamflow** is the flow of water in streams and rivers. Healthy streams develop a balance between streamflows and channel geometry so that channels are large enough to hold most flows. Streamflows are influenced by factors like precipitation, temperature, and land use changes. The fastest flows are generally the deepest portion of the channel ("thalweg").

2. **Floodplains** are the flat areas of land bordering rivers that store floodwater and sediment. Healthy floodplains reduce floodwater energy, recycle nutrients, provide habitat, and have fertile soils.

3. **Erosion** is the movement of soil and rock from one location to another. All streams erode, transport, and deposit sediment. Erosion is influenced by stream velocity and flow: the outer bend of a stream, where streamflow is faster, experiences more erosion than the inner bend of a stream, where sediment settles.

4. **Meanders** are the winding curves or bends in the river. Stream channels do not have fixed positions: over time they meander across the landscape, creating new bends and migrating to new locations in their floodplain. A stream's movement from side to side is called its pattern. The longer the distance between meanders, the flatter its slope and lower its water speed.

5. **Habitats** are the natural homes or environments of an animal or plant. Stable streams support diverse aquatic communities of fish, mussels, and other organisms. Natural vegetation on the banks helps enhance water quality and provides habitat for birds, amphibians, and reptiles.



Leading Iowans to restore, protect, and enjoy our rivers.

IOWA RIVERS REVIVAL
PROTECT, RESTORE, ENJOY

Why are rivers under pressure?

A watershed is the landscape from which water flows into a stream or river. Changes in a watershed may impact streams and result in unintended consequences that affect stream health and stability, including more erosion, pollution, water volume, and water velocities.

Pollution. Industry, agriculture, and urban wastewater all generate pollutants that can degrade water quality, including sediments, bacteria, nutrients, and other chemicals. Water quality declines as a result, affecting all users.

Dams and culverts. By constricting the passage of water and sediments, structures placed in channels limit a channel's ability to adjust naturally. These structures also diminish habitats and hinder fish passage.

Agriculture. Tile drains (underground drainage systems) leach nutrients from the soil and can provide a shortened pathway to the stream for other pollutants. The lack of perennial vegetation in agricultural areas also adds to higher runoff volumes.

Stream straightening. Stream straightening, or channelization, disconnects streams from their floodplains, there- by increasing flood flows and damage. It triggers downcutting upstream, resulting in bed degradation and massive bank erosion upstream.

Development. Pavement, roofs and urban storm drains prevent soils from absorbing water. As a result, water moves rapidly into streams, causing accelerated erosion and an increased chance of flooding.

Loss of vegetation. Urbanization, livestock overgrazing, continuous cropping, and lack of cover crops diminish perennial vegetation. This weakens streambanks and increases the potential for erosion.

What is river restoration?

River restoration is the process of returning rivers and streams to a more naturally stable and functional condition, enhancing our economic vitality and providing for diverse aquatic ecosystems.

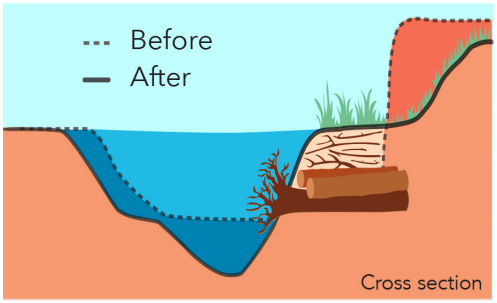
River restoration should be viewed as complementary to *watershed* work. Watershed improvement projects provide cleaner water to streams and lakes, but they generally do not address existing stream problems, such as habitat loss and unstable banks and beds. River restoration is not a "one size fits all" approach. The most successful projects draw on expertise from the fields of engineering, hydrology, landscape ecology, fisheries, and plant science. To be successful, projects must engage communities, policy-makers, and landowners.

Benefits include:

- Reduced nutrient runoff
- Reduced flooding and flood damage
- Reduced soil loss
- Less damage to bridges and roads
- Healthier ecosystems for plants, fish, and wildlife
- Improved economic development
- Improved recreational opportunities

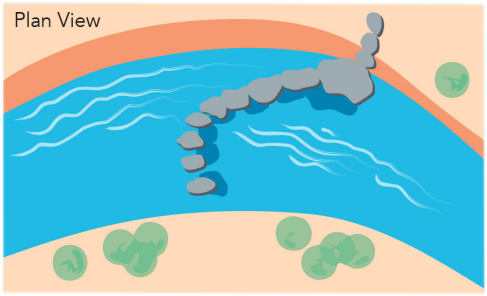
	Problem	Cause	Solution	
 *Photo courtesy of Iowa DNR*	Aging low-head dams may fail, and often are dangerous "killing machines."	Most of Iowa's dams are aging and deteriorating.	Modify or remove dams to ensure safe recreation, allow fish passage, stabilize streambeds, and improve river health.	 *Photo courtesy of Iowa DNR*
 *Photo courtesy of Mimi Wagner*	Rip-rap streambank protection fails. "Hard armoring" from top to bottom prevents long-term rooted vegetation from stabilizing the slope and providing long-term habitat.	Rip-rap placed on too steep of a bank to be stable, and higher than necessary to provide bank toe protection.	Use natural channel design practices to direct streamflows away from eroding banks; establish native trees, shrubs, grasses, and sedges, sloping back the eroding bank if necessary.	 *Photo courtesy of Rebecca Kauten*
 *Photo courtesy of Mary Skopec*	Channel is downcutting and streambanks are widening. This commonly occurs in urban areas where storm drain pipes are frequent.	High stormwater flows, due to impervious surfaces, travel to rivers through stormdrain pipes. Streams cannot move this much water without eroding. Once this happens, channel widening occurs.	Design a new channel that can handle increased energy using natural channel design; encourage urban landowners to infiltrate stormwater using bioretention and rain gardens.	 *Photo courtesy of DNR Fish Hatchery in Manchester*
 *Photo courtesy of Mimi Wagner*	Channel bottom is actively accumulating sediment and debris after large rain events, exerting more stress and damage to streambanks.	The slope and size of the river channel are unable to move the amount of sand, gravel, and sediment delivered to it. Thus, excess materials accumulate in the bottom.	Redesign the channel and riparian area to properly transport sediment delivered and allow high flows to move onto the floodplain. Use low impact bank stabilization practices to reduce erosion.	 *Photo courtesy of Mimi Wagner*

Examples of River Restoration



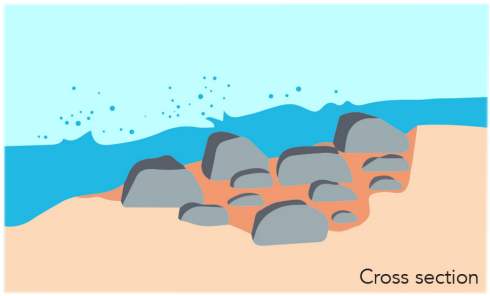
"Toe Wood-Sod Mat"

- Stabilizes the toe, or base, of steep and high streambanks
- A low flat bench is formed at the bottom of the streambank with materials such as logs, branches, roots and soil, known as a bankfull bench
- These materials are topped with sod mats of native vegetation at the bankfull elevation



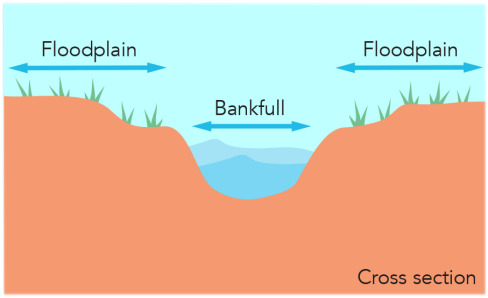
"J-Hook Vanes"

- Shifts the most erosive thalweg flows away from the outside bend bank, reducing bank erosion
- A series of boulders are designed and placed across two-thirds of the channel bottom and along one side of the bank
- Scours form a pool in the center of the channel bottom, providing fish and insects with favorable habitat



Natural Grade Stabilization

- Stops the active downcutting of the channel bottom
- Protects the upstream channel from further downcutting and widening, preventing bank erosion and habitat degradation
- Creates rapids for fish passage when done in combination with dam modification



Gradual Sloped Banks

- Allows more space for water
- Slows current and reduces scour energy of streams
- Reduces erosion of even deeper cutting

About Iowa Rivers Revival

Iowa Rivers Revival (IRR) is a non-profit leader in river education and advocacy and is committed to protecting some of our most precious natural resources — our rivers and streams. IRR is working to engage individuals, organizations, communities, and government leaders in river awareness, responsibility, and enjoyment in an effort to improve and enhance the condition of Iowa waterways — ensuring a quality, safe, and lasting resource for future generations.

Iowa Rivers Revival
P.O. Box 72
Des Moines, IA 50301

www.iowarivers.org
info@iowarivers.org
(515) 350-4387

RIVER RESTORATION

Why restore Iowa's rivers?

Iowa is the land between America's two greatest rivers, the Missouri and the Mississippi, with over 70,000 miles of interior rivers and streams. Yet, many sections of our rivers and streams have been degraded to the point where their natural functions are severely threatened. Many miles have been officially identified as impaired, with unstable, eroding banks and dwindling fish populations. Excessive amounts of sediment and nutrients cause algae blooms. The worst river segments are unhealthy, even dangerous, places for people, fish and wildlife.

Restoration on the Warner Farm along the banks of the Yellow River in Northeast Iowa. Photo courtesy of Iowa DNR.

River restoration is a process of restoring rivers and streams to healthier, naturally-functioning ecosystems.

Restored and healthy streams will:

• **Help Iowa meet nutrient pollution reduction goals**. Stable, healthy streams, connected to adjacent vegetated (riparian) areas, can filter and remove nitrate and phosphorus (nutrients) in the river through natural processes. Unstable streams make the problem worse by releasing phosphorus and nitrogen locked up in riverbanks.
• **Help landowners prevent loss of stream bank, land, and infrastructure.** Unstable stream banks contribute to flooding, cut away farm fields, and destroy river-crossing approaches.
• **Help the state and counties address damage to bridges and roads.** Excessive erosion undercuts bridge abutments and road surfaces and deposits silt on road beds.
• **Reduce flooding and flood damage.** Streams with stable, rounded banks, stable streambeds, two-stage channels, and established native vegetation hold more water and slow down water.
• **Cultivate a healthier ecosystem for fishing, hunting, and wildlife.** A healthy stream increases fish population and diversity and provides more habitat for aquatic life. A healthy greenbelt and river also provide essential habitat for a variety of native wildlife important to Iowans.
• **Increase and improve economic development.** Rivers and streams are an integral factor in boosting local economies — they generate new business and jobs and create recreational opportunities to attract tourists. Spending on river recreation alone totals about $500 million per year in Iowa and supports almost 5,000 jobs. Hunting and fishing add many millions more.

River Restoration is required by US Federal law through the Clean Water Act, to compensate for road construction damage to rivers and streams. Iowa needs a restoration plan to set priorities for the best use of these funds and provide guidance to road construction authorities.

Leading Iowans to restore, protect, and enjoy our rivers.

IOWA RIVERS REVIVAL
PROTECT, RESTORE, ENJOY

How does river restoration work?

River restoration is complex and begins with analyzing the root causes of river disturbances. It is not "one size fits all." The most successful projects draw on expertise from the fields of engineering, hydrology, landscape ecology, fisheries, and plant science. To be successful, projects must engage communities, policy-makers, and landowners.

River Restoration can include such practices as:

Stabilizing stream banks includes rebuilding and strengthening the stream bank using natural and native vegetation to help retain soil, reduce nitrate and phosphorus loss, and slow the velocity of water.

Improving habitat by reintroducing native vegetation to help slow stream flow, reduce erosion, and improve water quality, providing a healthy, diverse environment for people, fish, and wildlife.

Re-meandering streams that have been straightened to a more natural winding course across the floodplain. Restoring natural curves in the river reduces the power of the river, increases storage capacity, and slows the water to reduce flooding and sediment loss.

Reshaping stream banks to establish a gradual slope or widen the channel base to improve drainage, provide greater storage capacity for water after heavy rains, and enhance ecological functions such as nutrient filtration.

Modifying or removing old or unneeded dams to ensure safe recreation and enhanced fish passage.

Assessing the potential for river restoration and determining the preferred course of action.

How is river restoration different from watershed improvement?

A watershed is the landscape from which water flows into a stream or river. Watershed improvements are intended to provide cleaner water to streams and lakes and sometimes can also reduce the speed of water moving to streams. Watershed improvement projects are very important to reducing nutrients, sediment, and bacteria going to rivers, but they do not adequately address existing in-stream problems of habitat loss and unstable stream banks and beds. *River restoration should be viewed as complementary to watershed work.* Ideally, watershed practices should work together with river restoration to create balanced and healthy stream ecosystems.

According to Iowa's Nutrient Reduction Strategy (2013):

"Ongoing research at Iowa State University and other institutions indicates ***that in-channel scouring and stream bank erosion contribute higher levels of phosphorus to streams than previously recognized***. While the strategy emphasizes that continued in-field erosion reduction and soil sustainability are important to reduce sediment and phosphorus loading to streams, these measures alone are not likely to achieve water quality goals, especially for phosphorus loading, given in-channel bed and bank sediment contributions. Thus, understanding and addressing in-channel bed and bank sources of sediment and phosphorus should also be recognized."

Oxbow restoration on White Fox Creek, Hamilton County. Pre-restoration, the oxbow did not hold enough water year-round to sustain fish populations. Post-restoration, the oxbow holds water year-round and sustains over a thousand fish representing 18 species. Photos courtesy of The Nature Conservancy.

A River Restoration Program for Iowa should:

Rely on partnerships among public agencies, landowners, river users, and the public.
• Incorporate up-to-date science to establish river and stream restoration priorities and statewide design standards for implementing practices.
• Provide education and training to assist landowners, engineers, contractors, communities, and government agencies conducting river-related projects throughout Iowa.
• Set criteria and priorities for mitigation dollars (funds already being spent as part of federal regulatory requirements).
• Monitor the performance of projects and support research to improve restoration tools and improve effectiveness.

Who would benefit?

Small businesses, corporations, and communities working to attract new Iowans by marketing quality of life.
• Farmers and other landowners facing losses from flooding and stream bank erosion — and experiencing public pressure to reduce nutrient pollution of waterways.
• Downstream communities and businesses looking to enhance their economic vitality.
• Agencies charged with mitigation requirements needing guidance for cost-effective practices and projects.
• Providers — and users — of community water supplies.
• Businesses that need water for commercial, agricultural, and industrial processes.
• Paddlers, walkers and others who rely on rivers and riverside trails for healthy, active living.
• Soil conservationists and watershed planners struggling to find practical solutions.
• Anglers and hunters looking for better opportunities for fishing and hunting.

Dam modification project providing safe and accessible recreational use of the Cedar River in Charles City, Iowa. Photo courtesy of Charles City Press.

A vision of a statewide river restoration program

A River Restoration Program for Iowa should provide a framework for targeted restoration, preservation, enhancement, and beneficial use of Iowa rivers. A program can be based on existing models, such as Iowa's successful lake restoration program, and on best practices learned from other states.

Iowa's rivers face complicated challenges. A program run by professionals with input from communities and affected landowners is crucial to restoring river structure and function and improving water quality. The quality of our waterways affects the economic vitality and quality of life for all Iowans, now and into the future.

Stream restoration project on Dry Run Creek on the University of Northern Iowa campus, incorporating sloped banks, bank "hides" for fish habitat, and native prairie. The creek withstood the massive rains and floods of 2008, among other high flows. Photos courtesy of Rebecca Kauten.

About Iowa Rivers Revival

Iowa Rivers Revival (IRR) is a non-profit leader in river education and advocacy and is committed to protecting some of our most precious natural resources — our rivers and streams. IRR is working to engage individuals, organizations, communities, and government leaders in river awareness, responsibility, and enjoyment in an effort to improve and enhance the condition of Iowa waterways — ensuring a quality, safe, and lasting resource for future generations.

Iowa Rivers Revival
P.O. Box 72
Des Moines, IA 50301

www.iowarivers.org
info@iowarivers.org
(515) 350-4387