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Indiana

Two-Stage Ditch: How It Works



The two-stage ditch is a win-win for agriculture and conservation.

Photos

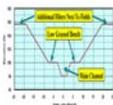


Two-stage Design

Graphic representation of the two-stage ditch design.

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Videos



Elevation & Width

Graph representing the size of a possible two-stage ditch, in feet.

[Click to Enlarge](#)

Water, when confined to a channel such as a stream or ditch, has the potential to cause great destruction. With too much water moving through an undersized area of land, there is no where for it to go but rush out its barriers.

Bank erosion, scouring, and flooding are good indicators that there is problem with how water is drained from the soil. Researchers have been working on a type of in-stream restoration called the two-stage ditch that may help relieve these problems.

THE TWO-STAGE DITCH DESIGN

Drainage has long been an important component in Indiana agriculture and property management. Land with flat, poorly drained soils require intensive draining for seedbed preparation and planting in order to minimize plant stress and subsequent yield reduction resulting from poor soil aeration due to waterlogging.

What we have done to gain proper drainage has dramatically influenced the landscape in the Midwest over the last 200 years. Draining of wetlands, tillage practices and deepening streams or ditches are just a few ways that we have changed the land, and with it, allowed water to become an unintentional threat.

Researchers have developed a drainage design by observing the natural processes of stable streams and rivers that could relieve the erosion, scouring and flooding that conventional ditches may cause. This design, known as the two-stage ditch, is a drainage channel that will benefit both agriculture and the environment.

The concept of the two-stage ditch is simple. The design incorporates a floodplain zone, called benches, into the ditch by removing the ditch banks roughly 2-3 feet above the bottom for a width of about 10 feet on each side. This allows the water to have more area to spread out on and decreases the velocity - or energy - of the water. The flow of that water is a function of the velocity and area of the water. And since flow can be considered as the amount of water moving through the ditch, the design has actually increased the amount of water that the ditch can process by constructing the benches, or floodplain area. This not only improves the water quality, but also improves the biological conditions of the ditches where this is located.

THE BENEFITS OF THE TWO-STAGE DITCH

The benefits of a two-stage ditch over the typical agricultural ditch include both improved drainage function and ecological function. The two-stage design improves ditch stability by reducing water flow and the need for maintenance, saving both labor and money. It also has the potential to create and maintain better habitat conditions here in Indiana and the waters into which our drains flow into such as the Gulf of Mexico.

Better habitats for both terrestrial and marine species is a great plus when it comes to the two-stage ditch design. This is done by minimizing the amount of sediment and nutrients (such as phosphorus and nitrogen) that are transported from ditch to stream to river to sea. The

transportation of sediment and nutrients is decreased considerably because the design allows the sorting of sediment, with finer silt depositing on the benches and courser material forming the bed. Two-stage ditches may also be useful in improving water quality by the possibility that the design may encourage nutrient assimilation.

WHAT THE NATURE CONSERVANCY IS DOING WITH TWO-STAGE DITCHES

Since August of 2003, the Indiana Chapter of the Nature Conservancy has been working on two-stage ditch designs in headwater areas of rivers in our aquatic portfolio sites. Headwater areas are located in the upstream most parts of the watershed where there are many small streams and man-made ditches that drain the landscape. These areas allow the greatest potential to improve the condition of the downstream, larger rivers.

In 2007, [The Joyce Foundation](#) provided \$5 million in grants to The Nature Conservancy and three other conservation organizations that would pay for projects in Indiana, Michigan and Ohio that would offer tangible and lasting improvements to both water quality and wildlife habitat in the Maumee River - one of the largest sources of pollution to Lake Erie.

The Conservancy will use these funds to fund projects around St. Joseph River, found in northeastern Indiana. Our chapter will enlist Hoosier farmers to test the two-stage design with the goal of 2-4 miles of these ditches in the Fish Creek watershed (a St. Joseph tributary) to reduce sediment and nutrients from leaving farm fields. We also plan on restoring 1,500 acres of wetlands and riparian corridors along St. Joe to filter water for nutrients and to reduce soil erosion. The construction of more two-stage ditches are set to begin this fall.

Prior to European settlement, Indiana was covered primarily by deciduous forests, wetlands and grasslands. Today the bulk of the state is dominated by row-crop agricultural lands. To make this land more productive for farming, streams have been ditched, fields tilled and wetlands drained such that water is quickly removed from the land. This has drastically altered the hydrology of our streams and rivers, creating “flashy” ecological systems. Bank erosion, scouring, and flooding are good indicators that there is problem with how the water is drained from the soil.

There is no simple solution to address altered hydrology. However, one promising innovation is the two-stage ditch. This design mimics a more natural stream channel when compared to the conventional channels found in most managed ditches. What makes this ditch unique is the low flow channel and corresponding bench that allows for bank overflows to occur within the confines of the ditch. The benches within a two-stage ditch function more like stream-side floodplains, slowing the flow of water and reducing bank scouring.

The Nature Conservancy believes that wide-scale implementation of the two-stage ditch can be part of a viable long-term solution to benefit local and state-wide water quality. With the funding we have received from the [Indiana Department of Environmental Management \(IDEM\)](#) Section 319 Program, the Chapter can promote the usage of this ground-breaking design in the Wabash River Watershed.

Education and outreach effort will be undertaken state-wide. The Conservancy will host workshops, presentations and field days targeting county surveyors, watershed managers and private landowners to increase general understanding of two-stage practices. These gatherings will provide information including design, construction and maintenance costs and proof of the ecological performance of the ditch. The Conservancy hopes that these outreach efforts will increase interest in the practice, translating to implementation in the future. Our hope is that the two-stage design will be an integrated solution that will positively impact water quality and aquatic habitat across the state.

FOR MORE INFORMATION

The Ohio Department of Natural Resources and The Ohio State University have also developed an educational tool called **STREAMS Modules**. Each module discusses various themes including basic stream knowledge, more advanced channel information as well as river evaluation, assessment and monitoring techniques.

The Conservancy would also like to acknowledge both Ohio State University and the University of Notre Dame for their monitoring efforts that is developing and has developed the science that guides the Two-stage Ditch Practice.

Conservancy's two-stage ditch design presentations created specifically for certain groups:

for Landowners

for Organizations

for Surveyors and Drainage Boards

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