Whitted Creek Stream Rehabilitation Project

Project Sponsor

The Papio-Missouri River Natural Resources District

The Papio-Missouri River Natural Resources District (NRD) is one of 23 NRDs across Nebraska with the mission to help manage and enhance our soil, water, wildlife, and forest resources for the benefit of all residents. The NRD is responsible for the drainage area of the Papillion Creek watershed and the Missouri River watershed in Nebraska, between Dakota City and the mouth of the Platte River.

It is said that we do not own the land; rather, we have it on loan from our grandchildren. This philosophy, "the wise use and conservation of our soil and water resources for future generations," remains the guiding principle of our NRDs. It takes sustained effort on the part of many groups to halt the erosion of our precious topsoil and preserve the quality of water in our streams and lakes.

Since 2001, representatives of 11 governmental bodies in the Omaha area have been working together to develop water quality and flood prevention policies that protect people, property, and the environment. This group, the Papillion Creek Watershed Partnership, includes the Cities of Bellevue, Bennington, Boys Town, Gretna, LaVista, Omaha, Papillion, and Ralston, as well as Douglas County, Sarpy County, and the Papio-Missouri River NRD. The Papillion Creek watershed encompasses 402 square miles, including parts of three counties and over one-third of Nebraska's population.

Site History

The Nebraska Territory was opened to settlement in the spring of 1854. As native prairie sod was broken for farming over the next decades, many streams in eastern Nebraska were dredged and straightened. Past farming practices resulted in excessive silt being transported to streams, smothering the habitat for bottom-dwelling insects and other aquatic organisms. Additionally, the practice of dredging and straightening channels resulted in channel degradation (deepening and widening) and stream bank and channel bed erosion during large storms.

These practices reduced lowland flooding and increased the agricultural productivity of the fertile soils in the floodplain at the time. Unfortunately, the long-term effect on the modified channels and adjacent tributaries has been heightened and steepened channel banks, as well as channel widening caused by stream bank failures. These past practices still impact the condition of the streams today. The changes to the channels' cross sections and meander patterns have led to a channel evolution process that is unstable, resulting in degraded ecosystems that are not sustainable.

In the early 1900s, the Whitted Creek channel was straightened and relocated to its current alignment. After a series of floods in the 1960s, flood control levees were constructed along the northern bank to protect property from flood damage. Channel bed incision (downcutting) began in Papillion Creek and progressed upstream into its tributary Whitted Creek. This incision created steep, erodible stream banks that cannot support stabilizing vegetation—the result was actively eroding channel banks along Whitted Creek.

Why Stream Rehabilitation?

Restoring stream channels to a more natural condition is the most sustainable mechanism to improve water quality, reduce erosion, and provide habitat for fish and other aquatic organisms. Streams are dynamic systems that are constantly changing in response to a wide range of factors. For example, land use changes in nearby areas--especially as they become more urbanized--can have profound effects. Runoff from these areas can carry sediment into the stream and can increase water velocities. Such changes lead to an imbalance that usually results in more erosion of the stream bed and/or bank, or deposition of sediment in the stream bed, all of which are undesirable. This project is intended to control the amount of sediment entering the stream, thus creating a more natural balance between water quality and sediment load. This "equilibrium state" is the most stable condition for the stream and produces the best habitat.

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The Whitted Creek channel and floodplain are constrained by flood control levees and natural topography. These constraints required a rehabilitation design that allowed the channel to remain along its current alignment, but limited the use of entirely natural channel design techniques, such as re-establishing historic channel meander patterns. The rehabilitation design implemented for Whitted Creek is a hybrid solution, focusing on stabilizing the channel bed and the stream banks to prevent additional erosion using stable, well vegetated bank slopes and a series of low-profile, rock grade control structures.

The following is a summary of the design features (explained further in boxes to the right), and their purposes and benefits.

Design Feature	Purpose/Benefit
Soil Bioengineering Techniques	- Use biodegradable geotextiles placed in the ground to prevent soil erosion for 3 to 5 years as native plants are established
Step-Pool Transitions	- Transition channel bed from newly established tributary stable grade down to incised mainstem channel bed - Dissipate the energy of high flows and mitigate bank erosion using features that appear natural
Channel Cross Section Adjustments	- Reduce stream bank slopes so they can support vegetation, reducing bank erosion - Convey channel-forming flows from smaller storms - Provide aquatic habitat
Grade Control Structures	- Establish hard points from natural materials to stabilize channel bed gradient - Have a low profile and appear natural once vegetation has established
Riparian Buffer Plantings	- Use deep-rooted native plants to provide long-term, low-maintenance bank stabilization that reduces maintenance costs - Provide habitat for wildlife

Project Goals

Reduce Stream Bank Erosion

Stream bank erosion is a significant problem in Sarpy County and many other urbanized areas. The loss of riparian vegetation and increases in flows have resulted in greater rates of bank erosion than would naturally occur. Stream bank erosion often occurs when historically dredged and straightened channels confine the erosive flows of large storm events. Stream banks, without stabilizing vegetation and adequate floodplain area, are susceptible to bank and bed erosion. Through channel reconstruction, soil bioengineering, and placement of rock structures, stream bank erosion will be greatly reduced.

Severe bank erosion along Whitted Creek.

Severe bank erosion along Whitted Creek.

Increase Aquatic Habitat for Fish and Insects

Aquatic habitats are the homes where aquatic creatures dwell. This includes the water they move in, the rocks, pools, logs, and organic debris they use to avoid danger, and the areas where they breed and rear their young. Rock features such as cross vanes and step pools were constructed to provide riffle and pool habitats. These structures will create fast and slow moving water conditions that are necessary for aquatic biota. Native vegetation planted along the stream banks provide shade, moderate stream temperatures, and provide refuge for fish and insects in the plant tissues and root masses.

Photos of Plains Killfish and Plains Topminnow

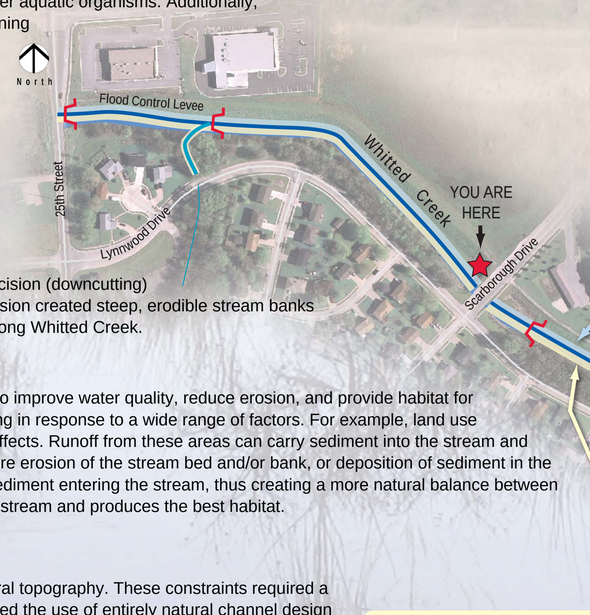
Additional Grant Funding Provided by:

Nebraska Department of Environmental Quality

Nebraska Environmental Trust

For more information:

www.papionrd.org
www.environmentaltrust.org
www.DEQ.state.ne.us
www.papiopartnership.org



Design Features

Soil Bioengineering Techniques

Soil bioengineering is used extensively throughout the Stream Rehabilitation Project. Soil bioengineering uses live plant materials and environmentally friendly engineered materials such as biodegradable fabric (made from coconut fibers) to stabilize eroding stream banks.

Biodegradable fabric used in stream restoration

Step-Pool Transition

Step-pools provide a natural way to transition the stream bed through a relatively large change in elevation. Step-pools in streams serve several purposes: dissipating the energy of high-velocity water, protecting the banks and bed from this high-energy erosive flow, and providing fish passage across the changes in bed elevation through several small "steps" instead of one big jump. The restored tributary contains a step-pool transition from Whitted Creek to Papillion Creek.

Channel Cross Section Adjustments

Different types of streams display different characteristics with regard to channel slope, sinuosity, and channel width and depth combinations and are influenced by the extent to which the channel is confined within its valley. For the Whitted Creek Stream Rehabilitation Project, adjustments to the channel cross section were used in the design. In some locations, the stream bed was elevated since it was so highly degraded.

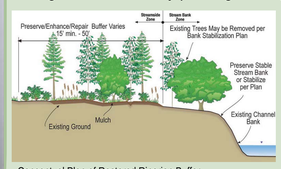
Unconfined stream channel characterized by high sinuosity and highly connected floodplain.

Confined stream channel characterized by rapids and steeper gradients.

Riparian Buffer Plantings

Riparian buffers are strips of vegetation along the banks of rivers and streams that filter polluted runoff and provide a transition zone between water and human land use. They are complex ecosystems that provide habitat and improve the stream communities they shelter. Greater than 11 acres of riparian buffer will be improved along Whitted Creek by planting over 5,000 native trees and shrubs and over 5,000 native aquatic plants along the stream.

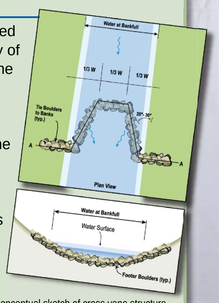
Mature riparian buffer on right bank, mowed levee on left bank.



Conceptual Plan of Restored Riparian Buffer.

Grade Control Structures (Cross Vanes)

Specially designed structures are used in this project to maintain the stability of the channel. One type of structure, the cross vane (seen at right) is used extensively. These structures are made of large rocks that are strategically placed in the stream. The structures divert stream flows away from the stream banks to the center of the channel, creating scour pools and oxygenating the water, elements that are critical for aquatic habitat.



Conceptual sketch of cross vane structure.

Photograph of a typical cross vane structure.

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