Vermillion River Watershed Handbook

A guide to help landowners make their property "Vermillion River Friendly"

Vermillion River Watershed Handbook:

A guide to help landowners
make their property
"Vermillion River Friendly"

Written and Designed
by
Diane Riggs

The Minnesota Department of Natural Resources
St. Paul, Minnesota • 2002

Acknowledgements

The *Vermillion River Watershed Handbook* was spawned by a need to help private landowners learn about their watershed and ways in which they can protect the Vermillion River. The *Handbook* could not have come together, however, without generous funders, dedicated reviewers, and a core production team. Below is a list of those who were instrumental in making the *Handbook* possible.

Production Team

- Kevin Bigalke, Lower Minnesota Watershed District (formerly Minnesota Department of Natural Resources)
- Michele Hanson, Minnesota Department of Natural Resources–Waters
- Jason Moeckel, Minnesota Department of Natural Resources–Fisheries
- Jay Riggs, Dakota County Soil and Water Conservation District

Reviewers

- Brad Becker, Dakota County Soil and Water Conservation District
- Mike Hipps, Trout Unlimited
- Laura Jester, Dakota County Soil and Water Conservation District
- Karen Schik, Friends of the Mississippi River
- Julie Westerlund, Minnesota Department of Natural Resources–Waters
- Dave Zappetillo, Minnesota Department of Natural Resources–Fisheries

Funders

- Dakota County Soil and Water Conservation District
- Friends of the Mississippi River (through a MetroEnvironment Partnership Grant from the Twin Cities Metropolitan Council)
- Minnesota Department of Natural Resources
- Trout Unlimited
- U.S. Forest Service

Contents

Preface

What's your first memory of a river? Fishing with your father? Wading into the cool rushing water on a hot summer's day? Crossing over the mighty Mississippi on the way to Grandma's house? It is hard to live in Minnesota without having at least some connection to rivers, streams, tributaries, or creeks. And if you live on or near the Vermillion River—the 38-mile stretch of water that begins in east-central Scott County, crosses through Dakota County, and empties into the Mississippi River past Hastings—you know that the River and the land on either side is not what it once was.

During the summer of 1998, the Minnesota Department of Natural Resources (MN DNR) and the Vermillion River Watershed Management Commission took a close look at the Vermillion River. An assessment team looked at bank erosion, checked the fish population, and tested for water quality. The team determined that the River was not healthy and that agricultural practices and urban development have been and still are the two most significant threats to the River's well-being. Through discussions with individuals who own property on or near the River, team members concluded that landowners would benefit from a handbook that explains how river systems work and identifies strategies landowners can employ to improve the River's health.

The goal of this handbook is to help landowners learn more about the Vermillion River and the role they can play in brightening the River's future. The *Vermillion River Watershed Handbook*:

- provides a brief look back into the River's history
- offers information about the interaction between rivers and upland areas
- identifies current threats to the River and surrounding areas
- suggests ways landowners on and near the River can protect their land and help the River
- highlights case studies of landowners who have worked to improve areas near the River

- lists agencies and organizations that can provide more information about land and water protection

This handbook is designed to be a resource for landowners, not a text to be read from cover to cover. Review the table of contents on pages iii–iv, or consult the index at the end to find portions of the text that apply most directly to you. If you have further questions, or need additional help in implementing land or river protection strategies, contact your local Soil and Water Conservation District (SWCD), MN DNR, or other "Vermillion River Friendly" partners listed on pages 73 to 83.

And thank you for helping to make your property Vermillion River Friendly.

Michele Hanson
Minnesota DNR

Jason Moeckel
Minnesota DNR

Jay Riggs
Dakota County SWCD

Minnesota Department of Natural Resources

For more information, contact:

Metro Watershed Initiative
1200 Warner Road
St. Paul, MN 55106
651-772-6152 (Twin Cities Metro area)

www.dnr.state.mn.us

Additional funding and support provided by

DAKOTA COUNTY SOIL & WATER CONSERVATION DISTRICT

Dakota County Extension
and Conservation Center
4100 220th Street West, Suite 102
Farmington, MN 55024
Phone: 651-480-7777 • Fax: 651-480-7775
Web: www.dakotaswcd.org

State of Minnesota, 2002
Department of Natural Resources, St. Paul, MN

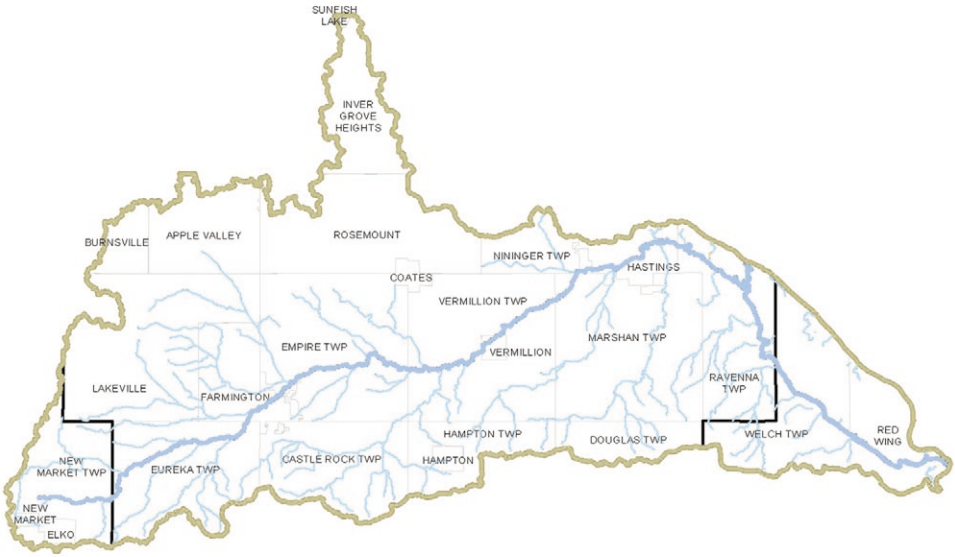
Vermillion River Watershed Handbook
Photo, Drawing, and Figure Credits

Many kind individuals, generous agencies, and nationally-respected photo services have made the *Vermillion River Watershed Handbook* come to life with illustrations, drawings, and photos. Below is a list of groups and people who supplied graphic elements for this *Handbook*.

- Kevin Bien: 61, 66b
- Dakota County: 8, 58b, 62t
- Dakota County Heritage Village: 1, 2
- Federal Interagency Stream Restoration Working Group: 5, 6 (modified), 13t, 63b
- Connie Fortin: 59
- Great American Rain Barrel: 47t
- Dave Holmen: 52m
- Low Impact Development Center: 46b, 47m, 70b, 71
- Minnesota Department of Natural Resources: 32, 36m, 39, 44
- Jay Michels: v, 12b
- Jennifer Morrow: 55b
- John Deere Visual Services: 65t
- Diane Riggs: cover photos, 3, 9, 11m, 12t, 14t, 16, 25, 31m, 33, 41b, 54, 72
- Jay Riggs: 31t, 46m, 47b, 48b, 52t, 56, 57, 58t
- Fred Rozumalski: 60 (modified)
- Twin Cities Metropolitan Council: 66t, 68b
- USDA Agricultural Research Service: 28b, 29
- USDA Natural Resources Conservation Service: 17, 18, 21, 24t, 27m, 45, 46t, 50, 51, 65b
- Unigroup USA: 48m
- University of Minnesota, Department of Landscape Architecture: 70t/m
- University of Wisconsin-Extension: 41t, 53
- Washington State Water Quality Consortium: 55t

All other images supplied courtesy of the Dakota County Soil and Water Conservation District.

Key: t=top of page; m=middle; b=bottom



To request additional copies of the
Vermillion River Watershed Handbook, contact:

Dakota County Soil and Water Conservation District
Dakota County Extension and Conservation Center
4100 220th Street West, Suite 102
Farmington, MN 55024

Phone: 651-480-7777 • Fax: 651-480-7775

Chapter 1

Introduction

Eventually, all things merge into one, and a river runs through it. The river was cut by the world's great flood and runs over from the basement of time. On some of the rocks are timeless raindrops—under the rocks are the words and some of the words are theirs.

~Norman Maclean, from *A River Runs through It*

History of the Vermillion River

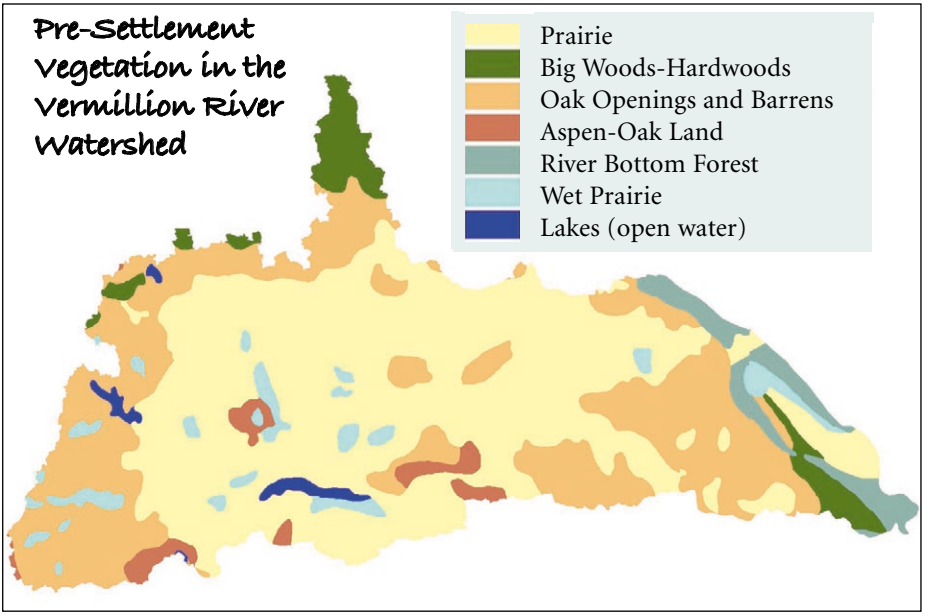
French and English explorers first ventured into what are now the counties of Dakota, Scott, and Goodhue in the late 17th and early 18th centuries. They found many Native American tribes in the region, and a beautiful and varied land—with vast stretches of prairie, woods thick with oak trees and other timber, rolling hills, and a vibrant network of clean-flowing rivers and streams.

Nineteenth-century settlers who made their homes along the Vermillion River and within surrounding areas appreciated the region's fertile soils and the rivers' bounty of speckled brook trout.

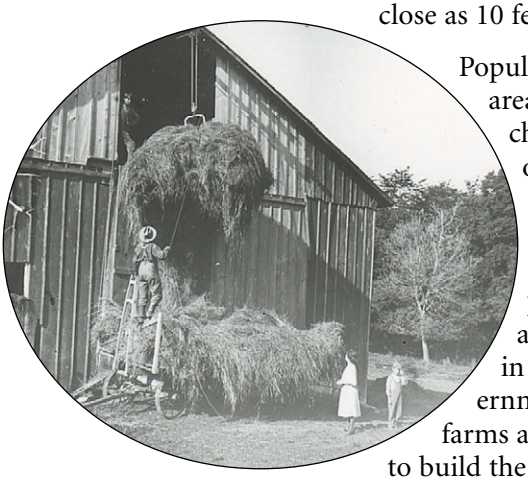
Ted and Jessie Scofield enjoy a quiet afternoon fishing on the Vermillion River near the turn of the 19th century.

In the wintertime, existence was more challenging—especially when traveling. One hapless Lakeville resident entered the town's record book in 1885 (as the first settler to die) when he froze his feet and subsequently died while attempting to cross the "Seven Mile Prairie." By late in the 19th century, much of the prairie land in towns like Vermillion, Farmington, and Lakeville, had been turned under by teams of horses that broke up the soil for agricultural use.

Nineteenth- and early 20th-century farmers grew wheat, corn, oats, barley, and potatoes in substantial tracts of the upland areas on both sides of the Vermillion River. For them, the River afforded a good source of

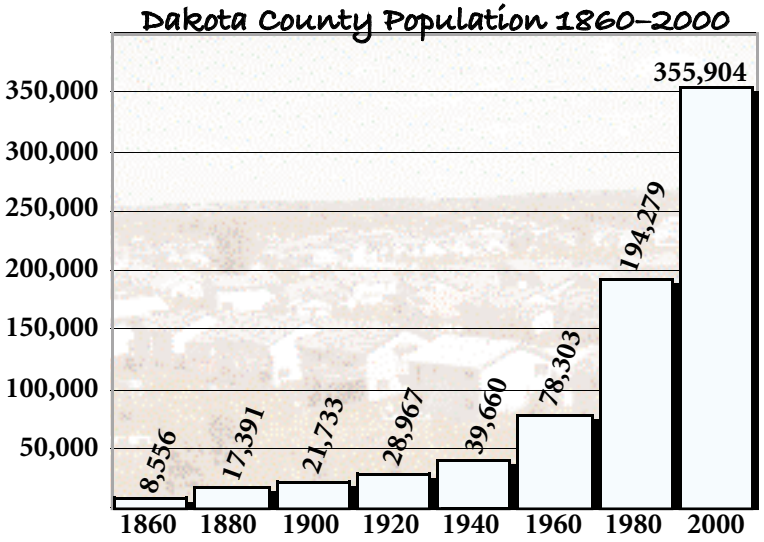


water for irrigation. Farmers who also raised livestock used the River's clean, cold water to keep cattle cool during hot summer days. Families who dug wells for drinking water enjoyed abundant, clean water; in Eureka, records indicate that some residents found drinkable water as close as 10 feet below the surface.



Population figures also show how the area around the Vermillion River changed. In 1900, more than half of Dakota County's population lived in rural, mainly agricultural, areas. By 1920, the figure had dropped to less than 40 percent. World War II also affected farming communities; in the early 1940s, the U.S. government acquired more than 100 farms and 11,000 acres in Rosemount to build the Gopher Ordnance powder plant—a munitions plant built at the end of World War II that never went into production. The land was subsequently transferred to the University of Minnesota and is now the Rosemount Research Station.

Communities near the Vermillion River lost even more farmland after the war when a steady stream of Twin Cities residents moved south. Farms gave way to residential and commercial development, and cities grew rapidly. New bridges across the Mississippi and Minnesota Rivers that connected Dakota County with Hennepin and Ramsey counties contributed to the surge of suburbanites. In 1960, Dakota County's population was 78,303; by 1998, the population was 339,256. By 2020, the Twin Cities Metropolitan Council projects, Dakota County's population will exceed 456,000.



During the past 150 years, areas near the Vermillion River have changed from untamed open prairie, oak savanna, and forests, to farmland and towns. Farmland still dominates much of the area, but ever-widening urban landscapes strung together by mazes of streets, highways, and bridges are an increasingly significant part of the picture too. And as land use near the Vermillion River has changed, so too has the River.

The Vermillion River and Its Watershed

Thus far, this *Handbook* has examined the Vermillion River and surrounding areas within a historical context. The rest of the *Handbook* focuses on the River and its watershed—a well-defined area around the River that directly affects the River's well-being.

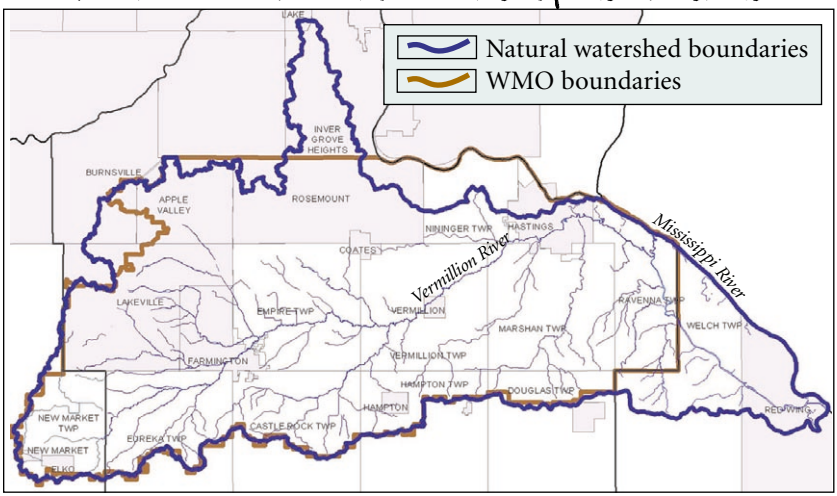
Watersheds Defined

A watershed is the total land area that contributes flow to a particular body of water. The natural boundaries of the Vermillion River

watershed, outlined in blue in the map below, encompass about 372 square miles—335 of which are in Dakota County.

The Vermillion River watershed is also home to 25 communities in three counties, including Lakeville, Rosemount, Farmington, Apple Valley, Inver Grove Heights, and Hastings, as well as smaller cities and townships spread throughout thousands of acres of farmland. The boundary established by the River's Watershed Management Organization (WMO)—outlined in brown on the map below—roughly follows the topographical features of the watershed, but leaves out part of Inver Grove Heights for ease of management, and lack of streams. The WMO boundary also excludes part of Goodhue County because it falls outside the metropolitan area.

Natural and WMO Boundaries of the Watershed



The River itself begins in Scott County's New Market Township. Its main branch flows northeast through Dakota County for about 38 miles and then drops 90 feet at the falls in Hastings. East of Hastings, the River splits. One branch goes north into the Mississippi; the other branch (known as the Vermillion River Bottoms) flows south through Ravenna Township before meeting up with the Mississippi River near Redwing in Goodhue County. The Vermillion is the only river in Minnesota that flows both north and south.

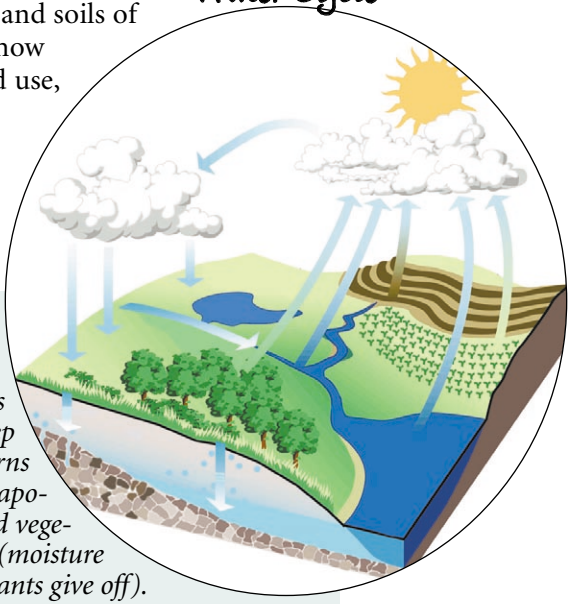
Connections between Rivers and Their Watersheds

Land use within a watershed affects many aspects of the river. When more water flows from the watershed into a river, the river channel grows wider and deeper. Polluted runoff pollutes the river.

Below are five key river components that can change with changing land use:

1. Hydrology: the flow of water in a river, especially how much, how fast it flows, and how it changes over time. The shape, size, topography, and soils of a particular land area affect how water flows into a river. Land use, vegetative cover, and climate also dictate how much rain will soak into the ground or run off. Together, these factors drive the water cycle.

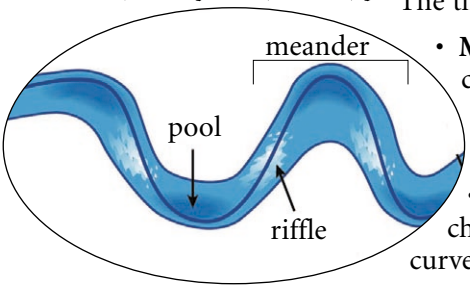
Water Cycle



In a typical water cycle, water falls to earth as precipitation, and then runs across the earth, soaks into the ground's top layer, or percolates deep underground. Water then returns to the atmosphere through evaporation (from streams, soil, and vegetation) and transpiration (moisture that growing plants give off).

2. Morphology: the shape, size, and structure of water channels. The size of the watershed, soil types, and general contours of the area also determine the channel's shape and structure. High runoff volumes can create wider river channels. Rivers with a flatter slope, especially when lined with finer soils, tend to curve or meander more.

Channel Structure



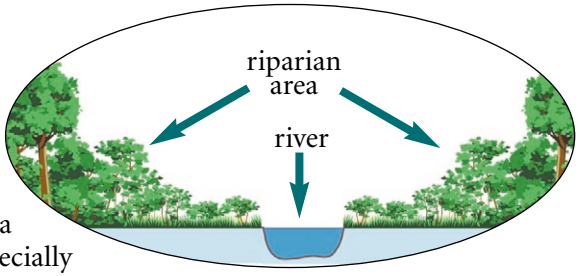
The three main parts of a channel are:

- **Meanders:** places in the river that curve and bend
- **Riffles:** shallow, more turbulent stretches of river between meanders
- **Pools:** the deepest parts of the channel typically found on the outside curve of a meander

3. Water Chemistry: how chemicals in the water interact with each other and with living organisms in the river. In undeveloped areas, a river's water chemistry is largely determined by

watershed soils and the soils' nutrient and organic content. With the influx of people, livestock, houses, farm fields, and cars, pollution entering the river can change natural chemical processes and how the water affects living organisms—generally for the worse.

4. Aquatic habitat: structural and chemical features that make a river livable for various plants and animals. To live and breed, fish and aquatic insects and plants require certain conditions in their home environment. As anglers know, many fish prefer to hide out in deep holes or around underwater structures. They also need certain conditions for breeding, like clean gravel and a good supply of oxygen-rich water. River features such as meanders, riffles, pools, woody underwater debris, and specialized aquatic plants provide living and breeding space for insects upon which fish can dine. If the insects have no habitat, the fish may not have enough food to survive. River life is very interdependent.



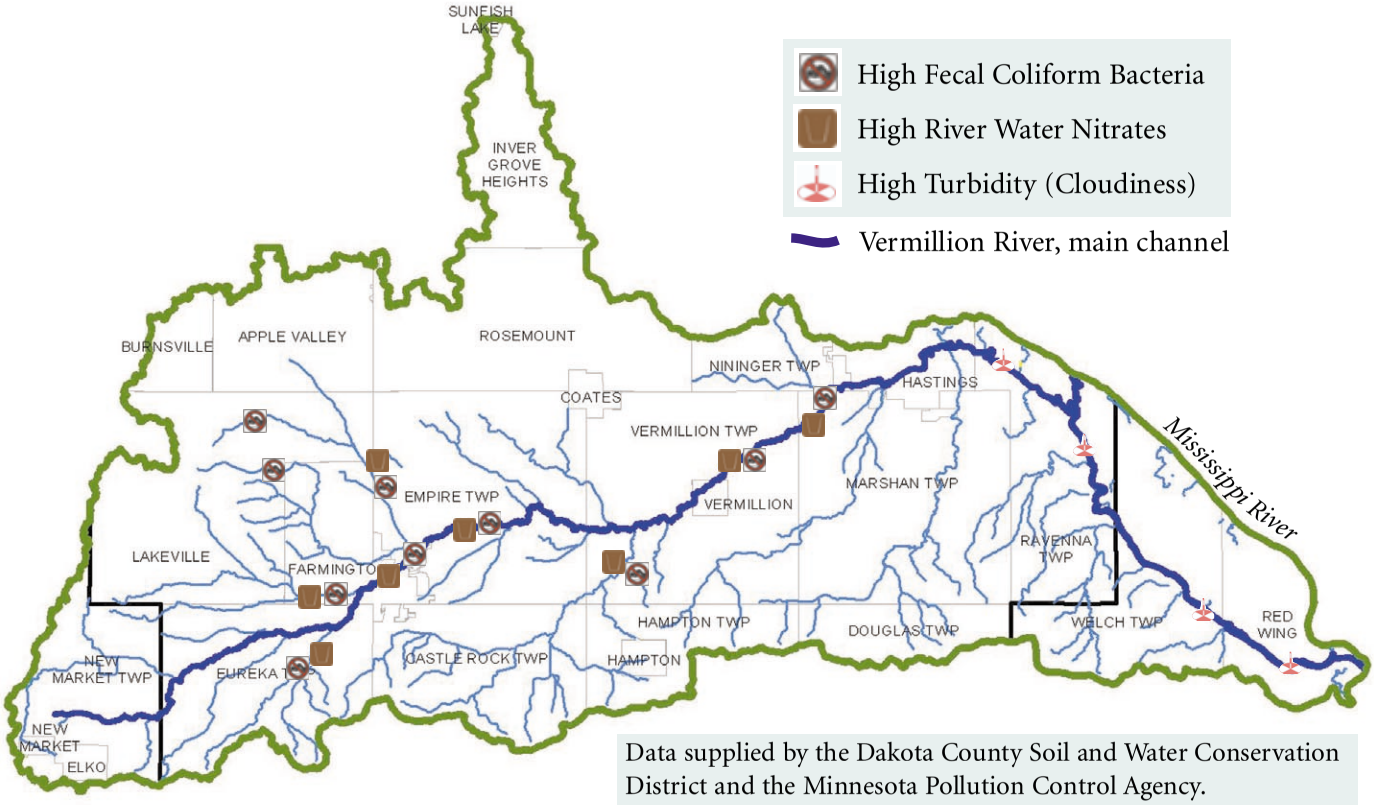
5. Riparian zone: land that runs alongside a river, including the floodplain area—land that is normally dry but sometimes floods. The area adjacent to the river is especially important. Riparian areas normally shift in response to rivers' natural inclination to meander, and water-tolerant, deep-rooted vegetation growing within the riparian zone can also prevent bank erosion and filter harmful substances from polluted runoff.

In a healthy river system, the river, its watershed, and aquatic life exist in a cycle of balance. Each simultaneously supports the others and relies upon the others for its well-being.

The Vermillion River: A Health Report

Stream survey notes from 1959 indicate that the Vermillion River watershed was "intensively farmed" and that streambank shade was "practically nil" because livestock grazed up to the River's edge. (*Assessment*, Volume II, Appendix C) A 1969 Minnesota Pollution Control Agency (MPCA) water quality study discovered another problem: discharges from wastewater treatment plants and other industries were polluting the River. As the *Dakota County Tribune* reported in February of 1970, MPCA's findings indicated that "possibly the main use of the river …[was]…as a receiving watercourse for disposal of sewage effluents."

Water Quality Issues along the Vermillion River



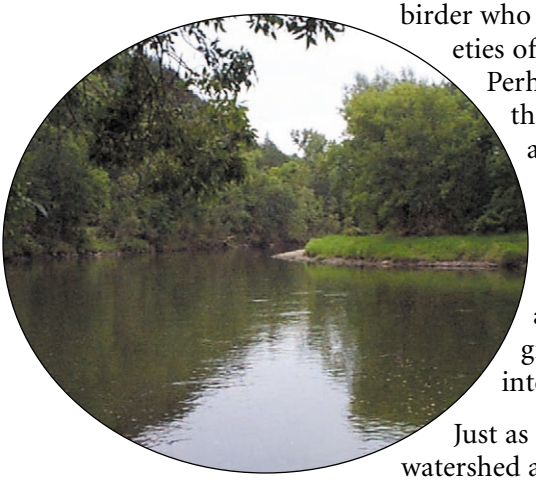
Data supplied by the Dakota County Soil and Water Conservation District and the Minnesota Pollution Control Agency.

The most recent Vermillion River study results were published in 1999. Completed jointly by the Vermillion River Watershed Management Commission and the Minnesota Department of Natural Resources, the *Vermillion River Assessment* concludes that the Vermillion is still below its potential for health and use. The *Assessment* reports that many streambanks and channel segments are unstable, and poor water quality along some tributaries and parts of the main branch are threatening desirable forms of aquatic life. As shown on the map on page 7, the MPCA has also found that many areas along the River do not meet water quality standards and are not thought to be safely "swimmable" due to certain pollutants.

Water discharged from sewage treatment plants has, however, improved significantly, and trout still live in certain sections of the River. Nonetheless, urban and agricultural runoff is figuring strongly in problems related to excess flow, bank erosion, and impaired water quality.

Living with the River—For Better or Worse

Even if you don't live next to the Vermillion River, you still live with the River if you own property within its watershed. The River affects your life. Maybe you've lived through a damaging flood. Maybe you're a birder who would like to see more varieties of birds near your home. Perhaps you like to fish, and wish the River had more abundant and larger game fish. If you are a parent with young children, you might be concerned about the health risks of eating fish from the River and pollutants in underground flows that could seep into your well water.



Just as the River and land within its watershed affect one another, so too do people and the River. If every property owner within the watershed works to improve the River, the River will return the favor. If managed properly, the River and its watershed will sustain more diverse life (plants, butterflies, fish, birds, etc.), be less subject to flash flooding, raise fewer health concerns, and become an even better place to live, work, and play.

Chapter 2
How Changes in Land Use Affect the River and Its Watershed

The river moves from land to water to land, in and out of organisms, reminding us what native peoples have never forgotten: that you cannot separate the land from the water, or the people from the land.

~Lynn Noel, from *Voyages: Canada's Heritage Rivers*

Rivers and their watersheds share an intimate relationship. When one changes, so does the other. Such is the case with the Vermillion River and its watershed.

As discussed in Chapter 1, the Vermillion River watershed has dramatically changed in the past 150 years. Early settlers first transformed much of the prairie, oak savanna, and timberland near the River into farms and small towns. After World War II, the Twin Cities metropolitan area began expanding south into the watershed where several urban centers continue to grow. This chapter discusses ways in which agricultural practices and urban development have remade the watershed, and how these changing land uses affect the River.

Nonpoint Source Pollution

To understand how land use in the Vermillion River watershed affects the River, one must know something about how pollution reaches the River through point and nonpoint sources. Point source pollution, like effluent from a wastewater treatment facility, enters the water at clearly identifiable places and is often easy to see and measure. Nonpoint source pollution arrives more indirectly and diffusely through the air or over land and is much more difficult to quantify.

Nonpoint source pollution includes soil, road salt, animal waste, engine oil, and other substances that flow to rivers in runoff generated by snowmelt and rainstorms. Within the Vermillion River watershed, nonpoint source pollution is the greatest threat to water quality. It is also the hardest type of pollution to control because it originates from many small sources.

Nonpoint source pollution:

- destroys aquatic habitat
- damages fish and other aquatic species
- impairs water quality, both in ground water and in the River
- reduces recreational opportunities—high fecal coliform levels restrict swimming, birders see fewer bird species, fish populations decline
- creates health threats due to ground water contamination and fish that are not safe to eat
- reduces agricultural productivity

Below is a discussion of how changing land use practices in the past have created problems we need to address today.

The Effects of Agriculture

Early settlers in Dakota, Scott, and Goodhue County used horses and teams of oxen to uproot trees, turn over the prairie soil, and create farm fields. They also built homes and towns, and established roadways to transport goods, people, and supplies. Livestock from farms along the Vermillion grazed near the water, drank from the River, and waded in its cool waters during the summer.

As twentieth-century farmers struggled through the Depression, droughts, and two World Wars to make their land more productive, land and tributaries within the Vermillion River watershed changed even more dramatically. Federal farm policy encouraged and provided financial and technical assistance to help farmers drain water from swamps, marshes, and other wet areas to create more cropland. During years of economic hardship, increased land production was key to farmers' survival.

With government support, farmers drained wet areas through ditching and tiling. Straightening—changing meandering River and tributary curves into straight channels—was another common practice to pro-

mote rapid drainage from cropland. If you look at a map you will see several small stretches of the River and its tributaries that are unnaturally straight.

Spring runoff flows through an agricultural ditch.

Historically, some federal farm policies and federal farm assistance programs have rewarded farmers based on the number of bushels they produce. To keep farming profitable, farmers have worked hard to increase per acre crop yield by draining land and using fertilizers and pesticides. Regrettably, straightened channels are more prone to erosion, and chemicals designed to increase crop production become pollutants when wind and runoff transport them to the River.

How have these changes affected the River?

- **Ongoing soil erosion.** Since settlers first cultivated the land, soil erosion has been a fact of life. Rain is the primary eroding factor, but wind, snowmelt, and irrigation can also erode soil.
- **Increased runoff/flooding.** In the Vermillion River watershed, many wetlands that once stored and slowed moving water are now gone, and runoff is diverted directly to the River. During heavy storms, ditches and tiles transport water so fast that the River and its tributaries cannot easily contain the sudden surge.

In addition, surface runoff is greater in areas where there is no vegetative cover (as when fields are being tilled in the spring), and where riparian vegetation consists of grazed and compacted pasture grass.

- **Stream bank erosion.** Increased runoff, and the loss of native vegetation due to crop cultivation and grazing, makes the banks of the Vermillion River highly susceptible to erosion. Grazing areas alongside the River are especially vulnerable because livestock can damage the banks and graze away vegetation that holds soil in place.
- **Impaired water quality.** Farms often produce a wide range of pollutants. Overgrazed pastures, erosion-prone cropland, barnyards, and feedlots produce a wide range of pollutants. If not properly managed, these pollutants—sediment, nutrients (including fertilizer),

pesticides, organic matter (including fecal bacteria and ammonia from livestock), etc.—can find their way into the River and seep into ground water supplies.

- **Physically altered channels.** Farmers, local governments, and engineers in the first half of the 20th century thought that straight river channels would draw water away from their fields more quickly. For that reason, natural curves on many of the Vermillion's channels and tributaries were straightened. Unfortunately, straight channels are not stable or self-maintaining, so fast-flowing water through them leads to flooding, bank erosion, and other problems.
- **Loss of species diversity.** The loss of channel features (like riffles, pools, and meanders), and increase in sediment and other pollutants, destroys important fish habitat, as well as habitat for invertebrates upon which fish feed. Wildlife diversity is directly tied to the diversity of habitat and vegetation. In streamside areas, native plants lost to livestock pastures and cropland can no longer serve as habitat for birds, insects, and small mammals. Where habitat has been destroyed or damaged, aggressively invasive plants like buckthorn and reed canary grass—both of which have little habitat value—may take over.

Invasive reed canary grass thrives near the Vermillion River.

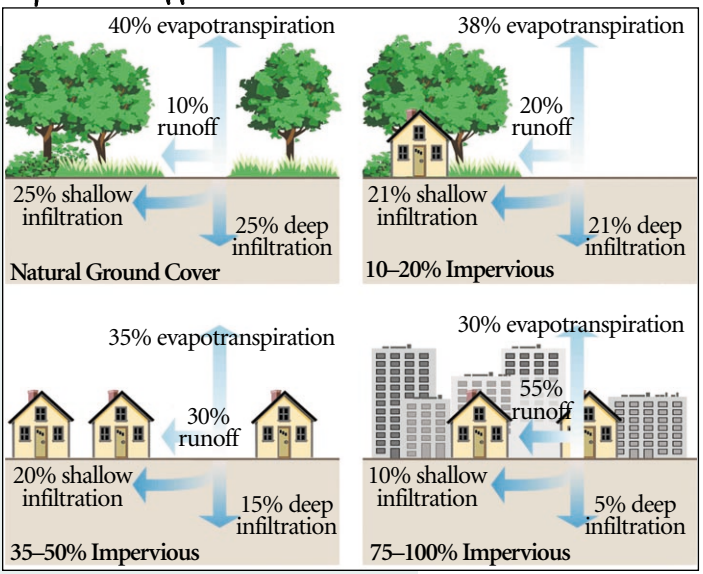
The Effects of Urbanization

To build houses, streets, and other urban structures, developers also change the land. They clear trees and brush, grade land for road surfaces and building sites, bury pipes to carry fresh water to and wastewater from each building, and often erase all traces of the original landscape. Once a development is complete, home and business owners may plant trees and flowers, but the natural landscape, native vegetation, and insects and animals that lived with it, may never return.

Developers not only scrape away topsoil, remove native plants, and uproot trees, they also seal the ground's surface. Every roof, sidewalk, parking lot, and street becomes a hard, impenetrable surface that keeps water from filtering into the earth. In cities today, these impervious

surfaces are largely responsible for conveying water-borne pollutants and excessive runoff directly into lakes and rivers. Nonporous surfaces also keep ground water resources from receiving needed flow.

How Development Affects Water Flow in Urban Areas



Impervious cover in a watershed (roofs, streets, etc. that keep the ground from absorbing water) results in increased runoff that can harm streams. As little as 10 percent of impervious cover in a watershed can hurt the quality of stream water.

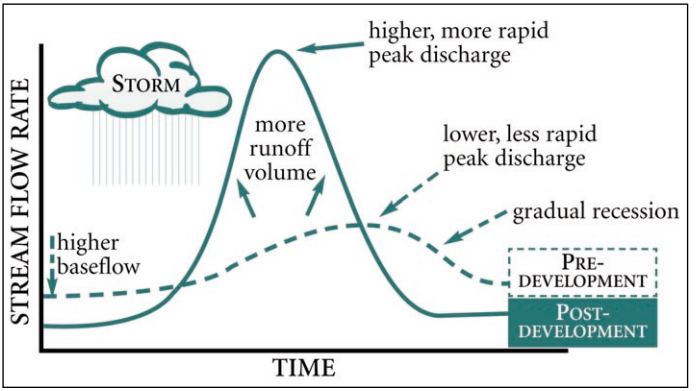
In the drive to expand urban areas, local governments within the Vermillion River watershed have also paved and populated land that is prone to occasional flooding. These floodplain areas, when left undeveloped, serve a very important function; they store and filter runoff before it reaches surface water and provide habitat for plants, animals, and birds. When developed, floodplains can do neither. How do these changes affect the Vermillion River?

- **Higher sediment deposits.** In construction areas, rain and wind can transport exposed soil into the River (through tributaries, from storm sewers, etc.) at rates 10 to 100 times greater than from agricultural fields. Over time, accumulating sediment can cover streambed surfaces used for fish spawning areas and destroy habitat for other aquatic plants and animals.

- **Flooding.** During heavy storms, water that cannot soak into the ground finds its way into the River through direct

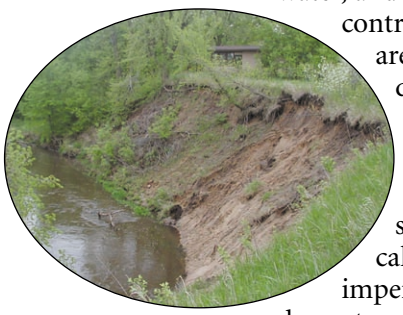
surface runoff and storm sewers. Because more water now flows directly to the River from urban areas, the River rises more quickly to a higher level than it did under pre-development conditions. In urban areas with stormwater treatment ponds, the ponds sometimes control the increased rate of flow, but can also cause the River to stay high over a longer period of time (particularly during periods of frequent storms) and increase the duration of downstream flooding.

Stream Flow Rates: Pre- vs. Post-Development



The loss of wetlands, forests, and floodplain areas (many of which were filled in during surges of development) also contributes to flooding. Wetlands absorb and filter water, and reduce the amount of and speed with which water can run into streams. During rainstorms, forest vegetation catches water before it reaches the ground and absorbs water that seeps into the ground. Without wetlands, wooded areas, and buffers in undeveloped floodplains, higher amounts of water and soil runoff flow to the River.

- **Stream bank erosion.** Higher water levels, more quickly flowing water, and longer lasting high flows after storms contribute to bank erosion, particularly in areas where the bank is not protected by deep-rooted, native vegetation that can hold soil in place.



- **Channel widening or deepening.** Stream bank erosion is often the first sign that a river is changing. Rivers typically adjust to increased flows created by impervious surfaces by deepening or widening downstream from the point of increased runoff.

- **Physically altered channels.** In urban areas, floods represent not only a personal crisis for those who sustain damage to their property, but a financial burden for the city or township as well. For that reason, communities are sometimes eager to implement a quick solution to prevent additional flooding.
- **Reduced base flow.** Because hard urban surfaces repel rather than absorb water, less water filters into the ground to recharge ground water supplies. In many areas along the Vermillion River, ground water contributes flow to the River independently of storm events (a phenomenon known as base flow). During hot, dry summer weather, fish and other creatures that live in the Vermillion rely on abundant, clean ground water to keep the stream cool and flowing.
- **Heightened water temperature.** Where streambank vegetation is sparse, more sun reaches the Vermillion River and warms the water. For sensitive species like trout, the lack of shade during summer can prove especially dangerous. Summer storm runoff from parking lots, streets, rooftops, stormwater detention ponds, and other hot surfaces also raises the River's water temperature.
- **Impaired water quality.** Increased sediment deposits, heightened water temperatures, and pollutants that reach the River over land or through base flow, all degrade water quality. Some pollutants are obvious and easily identifiable—like a plume of sediment in the River—but others are much harder to identify and trace. Pollutants from car exhaust and leaking fluids, lawn fertilizers, and dirt build up over time and then wash off all at once during storms. Excess nutrients spur high levels of algae growth which in turn blocks sunlight for and steals habitat from other aquatic plants.

The iridescent stream of gas flowing through this parking lot is on its way to polluting a lake or river.

  Rain and wind wash pollutants into storm sewer systems that in turn empty the stormwater (and chemicals within the water) directly into the Vermillion River. Water quality is better in areas where stormwater flows to treatment ponds, but stormwater ponds do not keep all pollutants from reaching the River.
- **Loss of species diversity.** Changes to land directly alongside the River and to the River itself make many areas of the Vermillion poorly suited for a diversity of birds, fish, plants, and other aquatic

life. To survive, such creatures need food, a means of reproducing, and a stable home. We have talked already about the loss of riparian vegetation, which in turn changes conditions for birds and other animals. *The Vermillion River Assessment* has also concluded that fish are driven away from areas of the River where the water is too warm and where sediment covers the natural river bottom.

Watershed Management Philosophy

As we are continually learning, changes to the Vermillion River and its watershed—straightened channels, lost wetlands, cleared forests, urban developments, etc.—have resulted in negative consequences, particularly for those who live downstream from the altered areas. For that reason, current ideas about managing the River and its watershed reflect the truth that we are much better off when we work according to the rules of natural processes. We must address the source of problems in the River and not just try to control the River itself.

To ensure that we do less harm, and help the River to become healthy again, everyone who lives, works, and plays within the Vermillion River watershed must understand how rivers naturally work. Once we fully appreciate how our actions affect the River, we are more likely to find good ways to protect and promote the River's and watershed's well-being. The cure will take time, but it is not hard and everyone can make a difference.

Chapter 3

How to Make Your Farmland Vermillion River Friendly

The rivers are our brothers. They quench our thirst. They carry our canoes and feed our children. You must give to the rivers the kindness you would give to any brother.

~Chief Seattle

During the growing season, much of the Vermillion River watershed is home to waving fields of corn and soybeans, grazing livestock, and busy family farms. At the start of the 20th century, agriculture was the dominant industry and accounted for most of the land use within the watershed. With the expansion of urban centers and the rise of consolidated corporate farms in the second half of the 1900s, the amount of farmland in production has declined, but farming remains a dominant land use in the watershed. Within the Vermillion River watershed today, close to 40 percent of the land is still dedicated to agriculture.

Even in the best of times, farming is hard work. For the family farmer, sick and vacation time is rarely part of the benefits package. Livestock always need to be fed or milked. Crops must be maintained carefully to ensure a good harvest. Weather needs to cooperate. Farmers need to maximize the value and efficiency of every action; they must do more with less.

Farmers in the Vermillion River watershed have a vested interest in keeping their land and the River healthy and productive—whether to ensure that they have clean drinking water from the farm well or nutrient-rich soil that consistently produces a profitable crop. Fortunately, while taking steps to reduce the amount of pollutants that reach the River, farmers can receive significant benefits of their own.

Strategies

Strategies listed here for making farmland "Vermillion River Friendly" pertain to land throughout the watershed. Chapter 4 has more suggestions for streamside farm property. The next few pages outline the following techniques for improving erosion control, reducing and filtering runoff, and promoting a healthy watershed:

- riparian buffers
- conservation tillage
- cover crops
- grass waterways
- contour farming/stripcropping
- structural runoff control
- wetland management
- rotational grazing
- feedlot management
- nutrient management
- pesticide management

Not every strategy will work on every farm. Before deciding on any course of action, contact the Natural Resources Conservation Service (NRCS) or your local Soil and Water Conservation District (SWCD) office (*see River Friendly Partners, pages 73–83*). Professionals at these organizations can help you learn more about strategies described here.

Riparian Buffers

Streamside buffers are strips of vegetated land alongside streams or rivers. When appropriately sized and planted, buffers can effectively trap and filter runoff before it reaches the stream or river. Buffers are equally important along ditches that carry water from farmers' fields.

Read more about the benefits of buffers on pages 34–35.

Conservation Tillage

Conservation tillage is a system of preparing the soil for planting in a way that reduces soil and water loss relative to conventional tilling methods. In particular, the term refers to forms of tillage—including minimum tillage, strip-till, ridge-till, and no-till—which leave a protective surface layer of residue or mulch on the field.

To maximize the benefits of conservation tillage:

- Adjust field equipment to leave behind more residue.

- Over erosion-prone areas, till more slowly at a more shallow depth to leave more residue.
- Check residue cover throughout the season so that you can make adjustments to leave more residue if need be.
- Distribute crop residue evenly over the field during harvest.
- When possible, avoid fall tillage. If you must till to relieve soil compaction, till when the soil is dry. Wet soil will compact.

Benefits of Conservation Tillage:

✓Residue keeps soil from blowing or washing away. In favorable conditions, conservation tillage can reduce erosion by as much as 90 percent.

✓Residue helps to promote increased water infiltration, slows evaporation, and can reduce the need for irrigation.

✓Reduced runoff and increased infiltration keep sediment and other pollutants from reaching the River.

✓Crop residue contains valuable nutrients that can make the soil more fertile.

✓Crop yields may increase because topsoil and nutrients are not washed away.

✓Conservation tillage practices can save time and money because they involve less labor, less fuel, and fewer pieces of equipment.

Conservation Tillage Considerations:

✓Weeds like marestail (horseweed), giant foxtail, and milkweed are sometimes more prevalent in minimally tilled fields (though velvetleaf may be less of a problem).

✓In the spring, soil in minimally tilled fields may take a little longer to warm up enough for planting.

Cover Crops

Best when used in conjunction with no-till or other conservation tillage methods, cover crops are typically grasses (ryegrass, fescue, or bromegrass), or legumes (including clover) planted each year after harvest throughout fields—like sweet corn—that have little residue.

Benefits of Cover Crops:

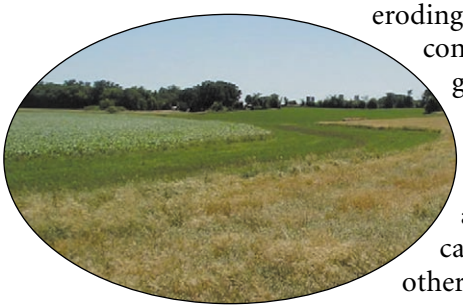
- ✓Cover crops prevent erosion during winter months and during the wet months of early spring. After the crop is tilled in the spring, its residue may continue to provide erosion control.
- ✓Legume cover crops are capable of nitrogen fixation; the cover crop can draw nitrogen into the soil where it will benefit the next crop planted there.
- ✓Cover crops can provide seasonal forage opportunities for wildlife.

Cover Crop Considerations:

- ✓Corn planted into a grass cover crop tends to have a lower yield than corn planted without a cover crop. Legumes, or a legume/oat mixture may work better.
- ✓Quickly growing cover crops can dry out the soil and may create the need for spring irrigation before planting.
- ✓In wet planting conditions, cover crops can keep soil moist and cool—thus delaying the sprouting of new crops.

Grass Waterways

If you have noticed that excess water in the field runs across the same eroding path year after year, it may be time to convert that path to a grass waterway. A grass waterway is a shallow channel (either natural or graded) thickly planted with grasses such as redtop or fescue that carries runoff water away from cropland. Grass waterways can also be used in conjunction with other runoff control measures.



Benefits of Grass Waterways:

- ✓Properly structured and planted grass waterways control soil erosion and promote water infiltration.
- ✓Grass waterways can direct cleaner stormwater runoff to a designated outlet.
- ✓Grass waterways can also help to filter concentrated runoff from terraces, diversions, or adjacent property.

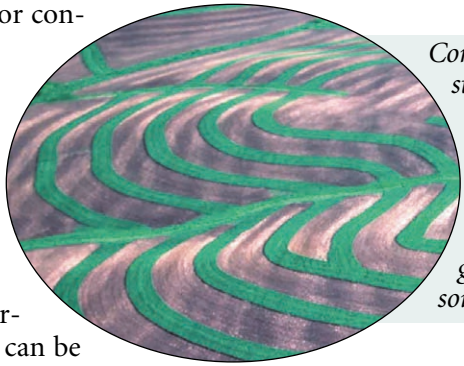
Grass Waterway Considerations:

✓The best time to plant a new grass waterway is in late summer.

✓Waterways require ongoing maintenance and cannot be used as roads or for grazing. Farmers must also be careful to keep pesticides and water-soluble chemicals out of the waterway, since such substances will travel to the River with water flowing through the waterway.

Contour Farming/Stripcropping

Described as both a science and an art, contour farming refers to working cropland across the slope and following the shape or contour of the land. Compared to working the land up and down the slope, this practice can significantly reduce erosion on gently sloping fields. On long, steep slopes, terraces and diversions can be used in conjunction with contouring to maximize erosion control.



Contour farming, stripcropping, and grass waterways—all shown on this Iowa farm field—greatly reduce soil loss.

Contour stripcropping is a mix of contouring and crop rotation. The practice involves alternating strips of tightly planted meadow or small grains with row crops on the contour. Row crop strips should be about the same width as strips of closely grown crops and hayland. To maximize benefits of this practice, no more than half the field should be planted in row crops.

NRCS Strip Width Guidelines

% Slope	Strip Width
1–2 %	150 ft
3–5 %	135 ft
6–8 %	120 ft
9–15 %	105 ft
16–20 %	90 ft
≥21 %	60 ft

Benefits of Contour Farming:

✓ Contour stripcropping can reduce soil erosion by as much as 75 percent (as compared to planting up and down a slope).

✓ For some farmers, contouring can save on fuel and equipment costs. Farming across the slope often takes less fuel and less of a toll on farm machinery than farming against the slope.

✓Field borders on contoured fields make good cover for wildlife. In stripcropped fields, the edges between crops are also attractive to wildlife.

✓Contour stripcropping creates a visually attractive landscape and advertises good conservation practices to other farmers.

Contour Farming/Stripcropping Considerations:

✓Tilling, planting, and harvesting along the contour can be difficult if the land has many dips, ridges, and elevation changes.

✓Contouring is less effective at controlling runoff on longer slopes, unless paired with terracing or a similar technique that can break the slope into shorter segments.

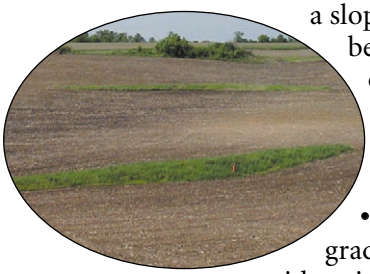
Structural Runoff Control

To control erosion, one must first manage land so rain can soak into the ground more effectively and take less soil and fewer pollutants with it when it runs over the surface. The second step is to control how water runs through the field, especially in areas that slope downhill. To control field runoff, farmers can work to prevent soil compaction, and make structural changes in the land to direct water to a safe outlet. Options include:

- **Grade Control Structures.** For land with steep slopes, grade control structures can prevent excess flow from forming gullies. Such structures often consist of earthen berms (like the one pictured here) that have one of three common types of controlled outlets: weirs, chutes, or pipes. Often built of corrugated metal with a concrete apron, weirs allow water to drop over the metal like a waterfall onto the apron. The apron absorbs the falling water's impact and guides it to an outlet. Chutes (built with concrete blocks, poured concrete, or rocks) are more appropriate for significant grade changes. Chute structures simply allow water to flow down the chute to the lower level. Pipes also work well for transporting water through or under an earthen embankment to a much lower level.

This grade control structure uses a berm and a controlled overflow pipe to slow the flow of water across a corn field.

- **Terraces.** The longer the slope, the more momentum water has to bore trails into the soil and increase erosion. Terraces are embankments, channels, or a combination of the two built along a slope to shorten the distance water will travel before the terrace guides it to a designated outlet. Outlets may be grass waterways on the bottom section of a slope, or underground outlets fed by a surface inlet pipe at the low area in each terrace.



- **Diversions.** Like terraces, diversions are graded channels constructed across the slope with a ridge running the length of its lower side. They are not, however, threaded together into a system like terraces, and often serve one specific function. Diversions can divert water and runoff from farm buildings and feedlots, collect or direct water to a pond, and break up concentrations of water on long, gentle slopes, and areas too flat or irregular for terracing.

- **Water and Sediment Control Basins.** If terraces are not a viable option, water and sediment control basins may work. Simply put, a water and sediment control basin is an earthen dam that holds runoff water and sediment during storms, and then slowly releases water (while capturing sediment).

Benefits of Structural Controls:

✓Every runoff control measure listed above will help to prevent flooding, reduce erosion, and keep field sediment from reaching the Vermillion River.

✓Grade control structures, if they are designed to store water, can provide a source of water and habitat for wildlife.

✓Farming may be easier when the terrace or top and side of the basin embankment is appropriately wide and sloped.

Structural Runoff Control Considerations:

✓Structural runoff controls must be established carefully to ensure efficiency, and modifications to prepare a field for installation can make the project take longer and cost more.

✓Excessive runoff and erosion can shorten the life of grade control structures.

Wetland Management

Wetlands are transitional areas where the water table is at or near the surface, or where land is usually covered with water up to a few feet deep. Passed in 1991, Minnesota's Wetland Conservation Act (WCA) requires landowners to avoid destroying wetlands, and replace (re-create elsewhere) wetlands that are filled in or eliminated. Farmers who are exempt from the WCA look to the NRCS for guidance on wetland issues. As much as possible, the NRCS advises, farmers should work to protect, sustain, and enhance wetland areas on their property.

Benefits of Wetland Management:

- ✓Wetlands help to control flooding and recharge ground water supplies.
- ✓Wetlands can trap and filter pollutants in field runoff and floodwater.
- ✓Because they cycle nutrients and play a key role in the natural ecosystem, wetlands can sustain a high volume and diversity of aquatic and animal life.

Great Egrets thrive in Minnesota wetland areas.

Wetland Management Considerations:

- ✓The process of constructing wetlands can be costly (*see pages 67–68 to learn about programs that can offset the costs of protecting natural areas*).
- ✓To protect or restore wetlands, farmers may have to take a small area of land out of production.

Rotational Grazing

Rotational grazing, also known as planned grazing, involves subdividing pasture land into smaller paddocks, and allowing livestock to graze in different areas on a schedule that maximizes plant growth and fulfills the animals' nutritional needs. As the livestock rotate, paddocks undergo a short period of grazing (one to four days), followed by a longer rest period (about a month).

When setting up a rotational grazing system:

- Consider factors such as available water, topography, and animal traffic when designing a paddock layout, and minimize the use of a single livestock traffic lane that can foster cow path erosion.
- Determine how much grazing area your livestock need.
- Schedule rotations so that the same paddocks will not be grazed at the same time each year.
- Plan rest periods during the growing season that allow each paddock to fully recover and regrow. All livestock must be removed from paddocks during the rest period.

Benefits of Rotational Grazing:

✓ Short grazing periods promote more even grazing, less trampling, and larger root masses—factors that maximize forage quality at harvest.

✓ Because rotational grazing keeps animals from overgrazing any area, it also prevents soil erosion (and improves water quality).

✓ The structure of enclosed grazing areas keeps animals well fed and prevents them from eating away river bank vegetation and compacting the soil.

✓ Rotational grazing systems can accommodate more animals per acre than standard systems, so farmers can devote more land to other uses.

Rotational Grazing Considerations:

✓ Farmers must carefully determine the number of paddocks needed, the size of each, and the rotation schedule.

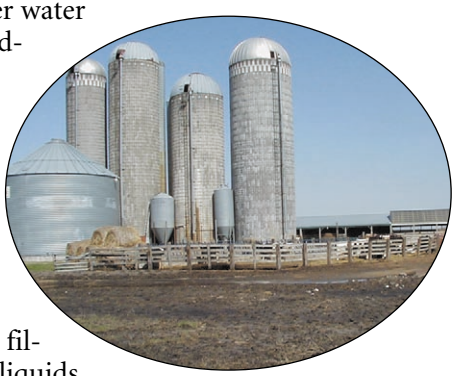
✓ Systematic rotation is more labor intensive than allowing livestock to freely roam and graze.

Feedlot Management

The first goal of a good feedlot management program must be to keep manure and other waste substances out of ground water, streams, rivers, and other water bodies. At the same time, it is in farmers' best interest to obtain the greatest benefit possible from nutrients found in animal waste (*see Nutrient Management on page 27*).

To help prevent feedlot runoff:

- **Divert runoff water.** Put gutters and downspouts on livestock buildings to direct clean rainwater away from the feedlot and keep it from washing manure solids from the lot. Use concrete or earthen terraces and channels to divert other water around the outside of feedlots, buildings, or farmsteads.



- **Collect and store feedlot runoff.** Through structures such as terraces, channels, pipes, or culverts, direct livestock runoff to a settling tank or basin. The tank or basin typically keeps the solids and passes most of the liquids onto a holding pond, lagoon, or vegetative filter strip. Solids from the basin and liquids from the holding pond can then be applied to the field as needed.
- **Install a vegetative filter.** When used in conjunction with settling basins and temporary liquid storage systems, vegetative filter strips can be a good economical alternative for smaller operations. The best kind of filter is a wide, relatively flat area surrounded on the upslope sides by a berm or dike.

Benefits of Feedlot Management:

✓By diverting rainfall from the feedlot, farmers can reduce the load on holding ponds, and increase the efficiency of settling basins or other solid-liquid separation equipment.

✓ Vegetative filter strips, when properly installed and maintained, can remove as much as 60 to 80 percent of wastewater nutrients.

✓ Manure that is properly collected and stored can be used to fertilize fields and reduce or eliminate the need to buy other fertilizer.

Feedlot Management Considerations:

✓If your feedlot slopes off in more than one direction, you will need to develop a more complex system to collect runoff from multiple outlet points.

✓Vegetative filter strips are harder to design and maintain than holding ponds, and runoff quality cannot be guaranteed.

Nutrient Management

In high concentrations, nutrients (including fertilizers such as nitrogen and phosphorus) damage both ground water and surface water. Nutrient management refers to practices that limit the amount and type of fertilizer used on farm fields, while promoting optimal crop yields.

- **Set realistic yield projections.** The first step in managing nutrient use is to set realistic yield projections. Consider each field's soil type, past years' yields, yields on neighboring farms, and average yields in your county. The projection should be no more than 10 percent higher than your average yield during the past five years.

- **Test your soil.** In late summer or early fall, test your soil to determine how much nutrient is already available. When calculating the amount of fertilizer needed each year, also take into account nitrogen supplied by the previous year's legume crops and other organic materials (including crop residue, and manure).
- **Get the most from your farm's manure.** To get the benefit of fertilizer from manure without endangering water resources:
  - assess the nutrient content of your farm's livestock waste,
  - compare each crop's relative needs for nitrogen, phosphorus, and potassium against the soil's nutrient content and the amount of those nutrients in the manure you will apply, and
  - base the manure application on the amount of phosphorus your crops need. Because manure is relatively high in phosphorus and low in nitrogen (based on what most plants need), applications based on nitrogen will give plants too much phosphorus.

Avoid over-using ammonia as a nitrogen fertilizer. It is toxic for fish, and has reached dangerously high levels in southern Dakota County surface waters. Avoid spreading manure near waterways, over snow, or on frozen fields in the wintertime as well. In the spring, nutrients from the manure will flow with melting snow into the Vermillion River and other surface and ground water resources.

Benefits of Nutrient Management:

- ✓Many farmers who take time to calculate the amount of nutrients their fields need find that they need less fertilizer. Consequently, they save money.
- ✓Thoughtful storage and use of manure can also drive down fertilizer costs.
- ✓When farmers apply less fertilizer and apply it in the spring when growing plants can readily use the nutrients, much less nutrient will leach into ground water or run off into the River.

Nutrient Management Considerations:

- ✓Too much manure can slow crop growth and hurt yields.
- ✓When manure is applied through sprinkler irrigation or broadcast methods, it should incorporated into the soil within 24 hours of application. Unincorporated manure can lose up to 35 percent of its nitrogen within a few days of application.

Pesticide Management/Integrated Pest Management

Insect and weed infestations can make the already difficult job of farming even harder. In the past, farmers relied on broad applications of herbicides and pesticides (a practice that damaged water resources). Among Vermillion River Friendly farmers today, the goal of pesticide management is to provide effective insect and weed control while safeguarding surface and ground water.

Midwest farmers are very familiar with the corn borer—a common pest in local corn fields.

Integrated pest management is an ecologically sensitive and inclusive system of controlling unwanted weeds, insects, and other pests. Pests

are tolerated or eliminated through biological means (naturally occurring controls like weather, predators, and parasites), cultural methods (farming practices that strengthen crops and make the environment less welcoming and livable for pests), and, as a last resort, carefully applied and limited use of pesticides. At its core, integrated pest management aims to control pests enough to keep crops economically viable, while minimizing adverse effects on humans and natural resources.

Below are some management suggestions.

- Use cover crops, crop residue, and planting techniques (including crop rotation and stripcropping) that will help your crops and fields combat weeds and insects.
- Conserve or enhance pest predators, parasites, pathogens, antagonists, and competitors that can help to keep unwanted pests at bay.
- Scout for insects and weeds early and often to determine if spot treatments (versus field-wide coverage) will provide adequate protection.

Lady bugs are natural predators that eat other harmful insects.

- When you notice that a certain percentage of your crop seems to be infested, compare the expected loss in income due to reduced crop yields with the cost of applying pesticides. If the chemical application would cost more than the yield lost, don't waste time and money trying to treat the problem.
- Apply herbicides and insecticides at the lowest suggested rate. To get the most benefit from the least chemical, treat weeds before they become well established, and use insecticides designed to target the problem bug without harming beneficial ones.
- Carefully dispose of leftover pesticides and pesticide containers, and take advantage of the Minnesota Department of Agriculture's waste pesticide collection program. Call 651-297-1062 or 800-657-3986, or visit the Department's web site at www.mda.state.mn.us.

Benefits of Pesticide Management:

✓Repeated pesticide use makes pests resistant to commonly used chemicals. Over the long run, an assortment of natural controls can manage pests much more effectively than chemicals.

✓By using insecticides sparingly, farmers can promote the health of earthworms and beneficial insects (including lady beetles and dragonflies) that prey on insects that harm crops.

✓Farmers who reduce pesticide use will save money, as well as the time usually spent mixing pesticides, applying the chemicals, and cleaning up.

✓Careful application and disposal of pesticides will help to keep more of these toxic substances away from the Vermillion River and out of the ground water supply.

Pesticide Management Considerations:

✓ To effectively employ integrated pest management techniques, farmers must know a lot about pests and pest cycles, plan carefully, scout often, and take time to compare costs of control options against benefits gained.

✓ Weeds that are not treated at a very young age will be much harder to control later and require more pesticide use.

Case Study

Conservation Farming Practices Reap Benefits

For Kevin Chamberlain, conservation farming is a family tradition. A fifth generation farmer, Kevin owns 265 acres of rolling hills west of Hastings in Nininger Township that have been in his family for 150 years. Kevin's father first implemented conservation farming practices 50 years ago to resolve and guard against soil erosion problems. Since taking over the farm 25 years ago, Kevin has continued to reap the benefits of the same practices.

Both a crop and dairy operation, the Chamberlain farm supports a herd of 100 milk cows and 100 replacement animals, and cultivates row crops as well as hay or grain. Kevin engages in the following conservation practices:

- **Contour stripcropping**—Contouring reduces soil erosion on hills.
- **Conservation tillage**—Kevin also controls erosion by using a chisel plow and field cultivators to leave residue on the field and tilling only in the spring.

- **Crop rotation**—Kevin rotates crops on a four year cycle. Cycling fields between row crops (that deplete soil nutrients) and grasses (that add nutrients) promotes a healthier soil structure.
- **Soil testing**—Every year Kevin tests his soil to determine his crops' nutrient needs.
- **Nutrient management**—Based on soil tests, Kevin can apply manure to the areas of his land that need it the most.
- **Feedlot management**—Kevin diverts water before it can enter the feedlot, and disperses feedlot runoff into adjacent fields.

Kevin says that conservation farming mostly requires a bit more of a mental effort rather than extra labor; careful planning and follow-through is key to success. He firmly believes, however, in working to conserve resources, and is enjoying the many benefits of conservation farming.

The benefits: reduced water runoff, reduced soil erosion, reduced wind erosion, and simple beauty. His farm, Kevin attests, is "a lot nicer looking than one big square corn field, especially from the air." But best of all, Kevin says, conservation practices have also improved his crop yields.

Case Study

Farmer Retires Land to Help the Vermillion River

Walter Klaus owns farmland in Dakota County's Empire Township. For more than a century, his family has grazed cattle and planted crops right up to the edge of the Vermillion River. A 1998 channel assessment near the Klaus property indicated that vegetation along the shore was very sparse and the bank was showing serious signs of erosion.

To help prevent further erosion, Walter took 80 acres of his land out of farm production and enrolled them into the continuous Conservation Reserve Program's buffer option.

Volunteers—including 240 students from a local school, their teachers, and other natural resource management professionals—then planted 2,500 willow and dogwood live stakes and 1,766 hardwood trees along the Vermillion River corridor.

Right next to the River, volunteers planted willow and dogwood trees. These trees work well for bank stabilization because they grow quickly, have a deep root mass, and provide good shading once established. In the upland area, volunteers planted a variety of hardwood trees—among them cottonwood, silver maple, bur oak, green ash, American elm, black walnut, basswood, ironwood, American hackberry, and black willow.

Luckily for Walter, the Natural Resources Conservation Service (NRCS)—through the Conservation Reserve Program—covered half of the cost for vegetation. Trout Unlimited generously covered the remaining plant costs. In addition, Walter will receive annual payments (equal to the township land rent value) to compensate him for the land he took out of production.

The project worked well for the River and for everyone else involved. Walter receives money to leave his land out of production, students learned first hand about the importance of riparian buffers, and the restored riparian area on the Klaus farm will reduce streambank erosion and allow for increased floodwater storage during heavy storms.

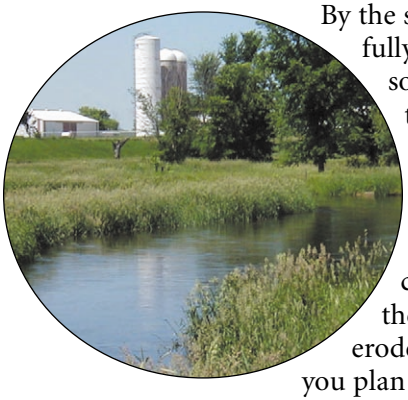
Chapter 4

How to Make Your Streamside Property Vermillion River Friendly

Boundaries don't protect rivers, people do.

~Brad Arrowsmith, landowner along the Niobrara National Scenic River, Nebraska

Of the 372 square miles in the Vermillion River watershed, almost half is within 300 feet of a water resource (the River, its tributaries, streams, and wetlands). Close to 20 percent of this riparian land lies within developed areas. Farmers or residential property owners in unincorporated villages and townships own the rest. In developed areas, even residents who live more than 300 feet from the River, directly contribute water flow through city storm sewers. Care of land directly connected to the River is key to the River's well-being.



By the same token, property owners who carefully maintain the streambank will gain some of the benefits that may have drawn them to life on the River in the first place. Healthy streamside areas can support a diversity of wildlife—from deer, mink, and foxes, to hawks, great blue herons, and scarlet tanagers. Good care will also help to ensure that part of the streamside or farm field does not erode away and float downstream. Whether you plan to live along the Vermillion River for generations or think you might want to sell your property in the next few years, you have an undeniable interest in making the River and the land alongside it as attractive and healthy as possible.

Strategies

Strategies listed here for making your streamside property "Vermillion River Friendly" broadly apply to landowners whose property lies within 300 feet of the River, its tributaries, smaller creeks, and intermittent streams (streams that only flow during the wet season or after storms).

Chapter 5 includes additional suggestions about what you can do around your house to protect the River and its watershed. The next few pages briefly outline the following techniques:

- streamside buffers
- streambank stabilization
- stream habitat restoration
- animal waste management
- septic system management
- streambank fencing

Pages 73–83 includes contact information for organizations that can help you to learn more about and implement strategies described here.

Streamside Buffers

Streamside buffers are strips of land next to streams or rivers that are planted with select grasses, trees, shrubs, and other native plants. Depending on the site (and characteristics such as soil type, topography, and wildlife management goals), a mix of trees and shrubs might work well. In other areas, grasses and flowers may provide the desired benefits of a buffer strip.

Streamside landscape buffers are best when they are:

- wide enough to accommodate the expected overland flow of water from rainstorms and snowmelt. In general, the wider the buffer, the better it will filter pollutants and control excessive flow—especially in areas that are often wet or prone to being covered by high water.
- continuous and contain a wide variety of vegetation that offers diverse bird and animal habitat features.
- planted with native vegetation. Shrubs, trees, and grasses that are native to the Vermillion River watershed (*see list on page 35*) are well suited for riparian areas, and add to the bank's aesthetic character.

Benefits of Streamside Buffers:

✓ Depending on width and placement, buffers can substantially improve water quality by catching, filtering, and absorbing 50 to 100 percent of sediment and debris from surface runoff.

✓ Buffers can help to recharge ground water supplies and prevent flooding by absorbing runoff and reducing the flow of water that dumps directly into the river.

✓ Because native plants have deeper roots than non-native plants, buffers planted with native grasses and shrubs can hold onto soil and more effectively prevent streambank erosion.

- ✓Forested buffers can improve river water quality and provide shade, as well as food and shelter, for insects and fish. Cooler water holds more oxygen and can better sustain fish populations.
- ✓Continuous stretches of buffer create travel corridors for birds and animals that are attracted to the trees, shrubs, and grasses planted there.
- ✓Forested stretches of buffer serve as a windbreak and provide a measure of privacy.

Native Streamside Trees, Shrubs, Grasses, & Flowers

Trees

Common Name	Scientific Name
Black willow	*Salix nigra*
Cottonwood	*Populus deltoides*
Green ash	*Faxinus pennsylvanica*
River birch	*Betula nigra*
Silver maple	*Acer saccharinum*
Swamp white oak	*Quercus bicolor*

Shrubs

Common elderberry	*Sambucus canadensis*
Nannyberry	*Viburnum lentago*
Red-osier dogwood	*Cornus sericea*
Silky dogwood	*Cornus omomum*
Willow shrubs	*Salix spp.*

Grasses

Blue-joint grass	*Calamagrostis canadensis*
Canada wild rye	*Elymus canadensis*
Dark green bulrush	*Scirpus atrovirens*
Prairie cordgrass	*Spartina pectinata*

Flowers

Joe-pye weed	*Eupatorium maculatum*
Marsh milkweed	*Asclepia incarnata*
New England aster	*Aster novae-angliae*
Sneezeweed	*Helenium autumnale*

Streambank Stabilization

Visible along much of the Vermillion River, streambank erosion eats away at cropland and private property, and sends damaging sediment downstream. The goal of stabilizing streambanks is not to completely stop erosion—erosion and movement, after all, is part of the natural cycle of streams—but to slow the rate of erosion and protect both the River and riparian areas that are threatened by streambank instability.

Normal rates of erosion are measured in inches per year; accelerated erosion is often measured in feet per year. The difference between stable and unstable streambanks can translate into 4,000 cubic feet of sediment per mile of river versus 40,000 cubic feet of sediment per mile.

Methods listed here emphasize effective, economical, and environmentally friendly use of plants and other materials to control erosion. These techniques are alternately referred to as naturalization or bioengineering. Many floodplain shrubs (mostly willow and dogwood) will grow from cuttings when planted during dormant periods. Cuttings have been used for hundreds of years and are a very low-cost and effective means of quickly growing plants to hold soil in place. For maximum benefit, many of the following techniques should be used in combination.

- **Bank re-sloping.** As a preliminary step, re-sloping the bank to a gradual incline (versus the vertical cliff-like ledges left by bank erosion) and planting upland areas may be necessary to prevent erosion.
- **Root wads.** Root wads (the cut off trunk of a good-sized tree with its root system intact) can be placed into the base of a streambank to help prevent bank scouring (erosion created by rapidly flowing water over the streambed and up the bank). Typically used with plantings, root wads provide erosion control while the plantings take hold and then gradually and naturally decompose.

An excavator installs a root wad on South Creek in Lakeville.

- **Soil tiers and brush layering.** In areas where bank re-sloping is not a viable option, soil tiers can serve the same function. Tiers can be made from layers of soil covered with a durable erosion blanket. Dormant cuttings can be placed between the layers to promote rapid revegetation.

- **Brush or coir fiber rolls.** When staked or anchored into a streambank below the water's surface, brush or coir fiber rolls help to

direct the flow of water away from the bank. Formed from bundles of brush—typically willows—or dense rolls of coconut husk fiber, the biodegradable rolls shield the bank from erosion, collect sediment, and form a shelf upon which aquatic plants can grow.

- **Fascines.** Live fascines (from a Latin word meaning "bundle") are connected sections of live but dormant woody cuttings such as dogwood or willow that can be anchored into a trench in the streambank with live or dead stakes. When the growing season starts, fascines sprout and create a thick brush cover. When used in combination with other vegetative stabilization techniques, fascines offer a substantial degree of erosion control even before they sprout.
- **Live stakes and posts.** Along smaller streams and rivers like the Vermillion, live stakes and posts are an economical, effective means of reducing bank erosion. Stakes and posts are live, but dormant, willow or dogwood branches inserted into the ground. Stakes are about one inch in diameter and two feet long, and posts are up to four inches in diameter and longer than two feet. When placed into tightly packed soils, stakes and posts must be installed with the help of an auger.

For this staking project, one person drills holes with an auger while the other pounds in the stakes.

- **Tree revetments.** In effect a retaining wall of trees, revetments consist of densely branched softwood trees—like cedar, fir, or spruce—overlapped at the bottom of the streambank. Trees are kept in place by cables that run around or through the tree trunks and clamp into duckbill anchors driven into the bank.
- **Flow deflectors.** Flow deflectors (called bendway weirs or boulder vanes) redirect the energy of the River's flow away from the streambank and toward the center of the channel. Because water then flows more slowly next to the bank, soil is less likely to wash away, and vegetation on the bank has a good chance to take hold.

- **Rip-rap.** Rip-rap consists of fieldstone and limestone placed at the foot and on the slope of a streambank. Once used widely and sometimes exclusively along streambanks, rip-rap should only be used in conjunction with live plantings and other methods like those listed above. When used alone, rip-rap offers little wildlife habitat and can also speed the flow of water. More rapid flow can in turn cause bank erosion and flooding problems down stream.

Benefits of Streambank Stabilization:

✓When used properly, all of the methods listed above are less expensive, easier and faster to install, and more beneficial to the River and its watershed than excessive rip-rap now installed along some sections of the Vermillion River.

✓Most techniques offer immediate or nearly immediate erosion control by protecting the bank from the erosive forces of moving water and waves, holding the bank's soil in place, and (with the exception of rip-rap) collecting sediment.

✓Once live willow posts, brush mattresses, and fascines take root and grow, they provide a very attractive and natural cover of brush and trees—a much prettier sight than bank erosion.

✓Except for stone rip-rap, all the methods listed above provide some form of habitat for both aquatic and upland plant and animal life. For example, tree revetments and root wads direct the river's current to scour the river bed (instead of the bank) and help to create deeper pools and shelters for fish. On the bank, brush offers cover and food for small animals, and trees provide nesting and resting sites for birds.

Stream Habitat Restoration

A river's health can be measured by the health of the life it sustains. Efforts to restore habitat and improve living conditions for plants, fish, bugs, and other organisms in the Vermillion River will in turn help to make the River healthier and more functional. Stream habitat includes naturally occurring channel features like pools, riffles, meanders, aquatic vegetation, and bottom substrate (the river bed surface).

Suggestions listed below can be implemented with help from restoration experts at the Minnesota Department of Natural Resources (DNR) or your local Soil and Water Conservation District (SWCD).

To improve river habitat:

- **Enhance riffles.** Riffles—the shallower, straighter, and more turbulent stretches of a river between meanders (or curves)—usually occur after pools (*see diagram on page 5*). But in sections of the river that have been restructured or channelized, the natural pool/riffle pattern may be diminished or nonexistent.
- **Enhance or recreate channel meanders.** In areas where streams have been straightened, meanders can be brought back with help from heavy equipment (to excavate and regrade the river bed) and careful planning. Meander designers must work to ensure that the new structure is stable, and guard against creating additional erosion problems elsewhere. Another option is to enhance meander patterns by installing flow deflectors that accentuate a low-flow channel segment within the larger channel. Deflectors can be formed with rocks or coir rolls.

The South Creek re-meandering project in Lakeville involved several phases.

- **Modify or eliminate channel dams and obstructions.** In the course of its history, the Vermillion River and its tributaries have accommodated many small dams and other obstructions (like field road crossings) that no longer serve a function. Obstructions hinder aquatic biodiversity by limiting the migratory path for fish, and may worsen flooding problems. If possible, they should be removed or modified.

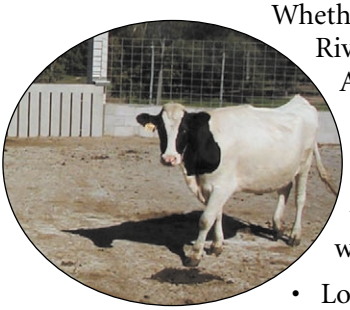
Benefits of Stream Habitat Restoration:

✓Improvements that promote fish migration, spawning, and shelter will enhance the Vermillion River's biodiversity and recreational value.

✓Alterations that recreate natural features of rivers (meanders, pools, and riffles) can help to make the River healthier and more attractive, and help to reduce downstream flooding.

✓The introduction and maintenance of fish-friendly environments will help the fish population to better sustain itself.

Animal Waste Management



Whether you live or farm close to the Vermillion River, waste management is a serious concern. According to some reports, a 100-cow dairy herd can produce as much waste as 2,400 people. If waste is not properly handled, it can contaminate ground water and the River with nitrate and bacteria. To keep livestock waste from making its way into the River:

- Locate feedlots far away and down hill from wells, sink holes, and surface water, especially if you temporarily store livestock waste on the lot.
- Collect and properly dispose of runoff from the lot, and remove new waste deposits every few days. (*See feedlot and nutrient management tips on pages 25–28.*)
- Locate longer-term waste storage facilities away from surface water, and make sure waste is not seeping into the soil through the floor.
- Compost manure.
- Follow sound manure application practices. Never apply manure to slopes by rivers, streams, or wetlands, or within 100 feet of wells, springs, or sinkholes. Never apply manure to snow-covered fields in the winter; it will not help crops and its pollutants will find their way into surface water with spring snowmelt and showers. Apply manure in the spring when new plants can immediately absorb the nutrients.

Benefits of Animal Waste Management:

✓Proper waste management keeps pollutants from entering drinking water supplies and water that supports river life.

✓Composted manure, because it is easy to transport, reduces the incentive to apply manure more heavily to fields near the feedlot. Heavily applied manure can transmit dangerous levels of phosphorus and nitrogen to the soil, and increase the risk for contaminated ground water and surface runoff.

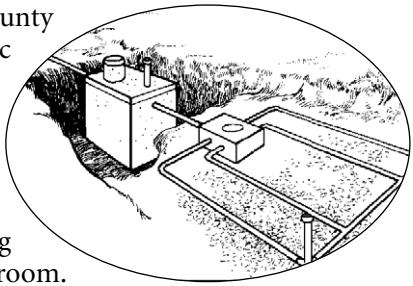
✓Sound livestock waste disposal practices can prevent unsafe conditions that could cost farmers time and money in clean up efforts.

Septic System Management

Within the Vermillion River watershed, human waste—from defective septic systems that discharge untreated sewage to surface waters—also

threatens water quality. To avoid polluting surface and ground water that may flow into the Vermillion River, homeowners must carefully maintain their septic systems. Below are some suggestions.

- Locate drainage fields as far from the River as possible.
- Where possible, direct storm runoff away from drainage fields.
- Monitor the system according to County regulations. In Dakota County, septic system owners must have their systems pumped out or have a Maintenance Inspection at least once every three years. Homeowners must also undergo a Compliance Inspection before selling the property or adding an extra bedroom.



- Avoid planting trees or shrubs near drainage field pipes. Roots can obstruct drain lines, and create problems.
- Avoid driving over or parking on the drainage field. The weight of a car or truck can compact the soil and cause premature system failure.
- Compost vegetable and other food scraps with lawn refuse instead of using a garbage disposal.
- Conserve water. Use water efficient appliances and flow restrictors (like 1.6 gallon toilets and less than 2.5 gallon per minute shower heads), and spread tasks that use a lot of water (laundry, dish washing, etc.) over the course of a week to avoid overloading the system.
- Avoid or severely limit the use of household chemicals—like bleach and drain cleaner—that can destroy the bacteria that breaks down solid wastes.
- Use toilet paper made for septic systems.

- Avoid flushing or pouring into a sink materials that can clog the drainage field. Examples include cooking grease, oils, coffee grounds, cigarettes, facial tissue, hair, bandages, sanitary napkins, tampons, and paper towels.
- Check labels so you can avoid detergents and water conditioners that contain phosphates. Use liquid laundry and dishwashing detergents that contain no fillers. Over time, fillers can clog drainage fields.
- If possible, save space in your yard for a replacement drainage field that could be installed if the original drainage field fails.

Benefits of Septic System Management:

- ✓Proper septic system management helps keep pollutants from entering ground and surface waters.
- ✓Careful septic system maintenance will keep systems from failing and keep homeowners from spending money to clean-up and replace systems prematurely.

Streambank Fencing

Permanent streambank fencing placed at least 30 to 50 feet from the water's edge is the best way to guarantee that livestock will not gain access to the River or its tributaries. Grazing is a tool for managing vegetation, and limited access to riparian vegetation can be beneficial if livestock are carefully monitored. If uncontrolled, livestock can harm the River in many ways—by grazing away vegetative streambank cover, by breaking up or compacting streambank soil, by stirring up sediment in the River, and by directly polluting the River with nutrients and bacteria.

If livestock must cross the River, the fencing plan should include narrow crossings that restrict livestock to a short stretch of water. To minimize erosion, the bank on either side of the crossing should be stabilized with natural material. State statutes also restrict the use of fences across navigable streams to a single strand of wire that can be lifted out of the way when passing underneath. Contact the Minnesota DNR to learn more about regulations and permits concerning Vermillion River crossings.

Benefits of Streambank Fencing:

- ✓Keeping livestock away from the River and its banks is good for the animals. Livestock that are exposed to waterborne bacteria are at greater risk for mastitis and other disabling ailments. Livestock that travel across uneven or crumbling streambank surfaces are also at greater risk for leg injuries.
- ✓Fencing projects in other states have significantly reduced soil erosion and sediment loading in streams.
- ✓By preserving streambank vegetation, fencing promotes an attractive landscape, protects plants that shade the stream, and conserves valuable habitat for small animals, insects, and birds.

Case Study

Bioengineering Used to Stabilize Vermillion Streambank

Many reaches of the Vermillion River are experiencing serious bank erosion. In the late 1990s, one of the most unstable banks was located in the City of Vermillion, in the middle of the watershed. From 1997 to 1998, along a 220-foot stretch, the bank receded more than six feet and began threatening a nearby garage.

In 1997, the Dakota County Soil and Water Conservation District (SWCD), in cooperation with the Minnesota Department of Natural Resources (MN DNR), City of Vermillion, Vermillion River Watershed Management Organization, and Norbert Girgen (a property owner along the eroding section of the River), applied for and received a Board of Water and Soil Resources (BWSR) Special Projects grant to:

- stabilize the eroding bank
- protect the adjacent property
- reduce the sediment load to the River and improve downstream water quality
- create more productive fish habitat
- demonstrate how bioengineering techniques work on the Vermillion River

Project coordinators selected multiple bioengineering techniques for the demonstration project—including boulder vanes (flow deflectors), a boulder toe, nine root wads, willow posts, fascines, and live stakes. In the spring of 1998, personnel from the Dakota SWCD, MN DNR, Natural Resources Conservation Service (NRCS), and BWSR, as well as a skilled private contractor, completed the project in just three days.

Today the bank looks very different than it did in 1997. Bank vegetation is very dense, the flow deflectors are working, and bank erosion is almost nonexistent. The site is also a favorite fishing spot for City of Vermillion residents. Best of all, knowledge gained during the construction and monitoring of this successful project has been very useful for other stabilization projects on the River.

Case Study

South Creek Re-Meandering Serves Multiple Interests

South Creek, a tributary to the Vermillion River in Lakeville, is a designated trout stream. It has earned that classification, in part, because its waters are very cold—a factor crucial to trout survival. In the early 1900s, South Creek was ditched and straightened to promote drainage from farm fields. The stream alterations subsequently caused the channel to become unstable, and the bank to rapidly erode. Ironically, expanding urban traffic demands in the late 1990s inspired a project to move part of South Creek, and re-incorporate the natural meanders lost through straightening.

In 2000, the City of Lakeville initiated a road expansion project at Cedar Avenue, and began planning to extend Highway 70 through Lakeville. If plans were to go forward, a portion of South Creek would have to be realigned. For the Minnesota DNR and the Dakota County SWCD, the road expansion project presented an opportunity to improve conditions for trout, so with Dakota County, the City of Lakeville, and project designers, they devised a channel realignment that would meet everyone's needs.

With Dakota County Highway Department funding (plus money from DNR Fisheries, the Dakota County SWCD, and Trout Unlimited), work on South Creek began. In about three weeks, heavy equipment dug out and re-meandered 2,500 feet of stream. Volunteers from area schools and crews from the Minnesota Conservation Corps then spent a week planting thousands of trees—including willow and dogwood shrubs—to protect the streambanks and provide shade. To enhance aquatic habitat and stabilize the stream channel, workers also installed boulders and rootwads, planted native grasses from seed, and covered the banks with an erosion control blanket.

Today, South Creek's cool, trout-friendly waters flow through natural-looking meanders, and streamside vegetation creates a lush, green border along either side of the stream. The Cedar Avenue expansion is completed too—proof that River-friendly projects can serve multiple interests.

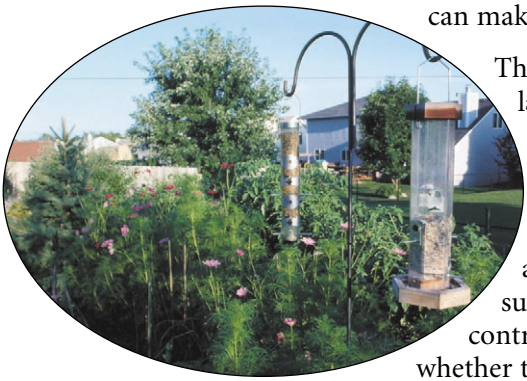
Chapter 5

How to Make Your Backyard Vermillion River Friendly

Can we afford clean water? Can we afford rivers and lakes and streams and oceans which continue to make possible life on this planet? Can we afford life itself? Those questions were never asked as we destroyed the waters of our nation, and they deserve no answers as we finally move to restore and renew them. These questions answer themselves.

~ Senator Ed Muskie of Maine,
arguing for passage of the Clean Water Act in 1972

One strong premise of any conservation effort—whether an effort to preserve a town's history, reduce dependence on electricity, or promote clean ground water and healthy rivers—is that individual actions are critically important. It's not that one person can do everything, but that a group of individuals can make a significant difference.



Though you are just one landowner among many in the Vermillion River watershed and perhaps live miles from the River, your individual efforts to protect the River affect its well-being. Every surface within the watershed contributes flow to the River, whether through stormwater runoff, overland flow, or ground water that enters into the River through base flow. Steps you take to control runoff on your property not only affect your family's quality of life, but also the quality of life for other property owners in the watershed, and the River's health.

Strategies

Strategies listed in this chapter are intended for individual landowners, but can also be used by businesses, corporations, and city governments. The next few pages contain information about limiting surface runoff

from your property, keeping runoff cleaner, attracting a healthy diversity of wildlife, and improving the Vermillion River's health:

- home runoff management
- natural landscaping
- lawn maintenance
- waste management
- vehicle maintenance

A list of organizations that can help you learn more about and implement strategies described here starts on page 73.

Home Runoff Management

Much of the rainwater that falls in urban areas runs off rooftops and driveways to streets; to storm sewers; and finally, to the River. As it travels, water can pick up a variety of pollutants. From a watershed perspective, the goal of runoff management is to keep excess water and pollutants from reaching the storm sewer that leads to the River. Discussed below are ways to control runoff from your house and surrounding surfaces.

Control runoff from your roof. While roof runoff may seem cleaner than runoff from parking lots and streets, it still transports airborne pollutants from vehicle exhausts, industrial discharge, and windblown soil. Excessive roof runoff is not healthy for the River, especially if it drains to driveways or roads. In addition, roofing materials such as galvanized steel, copper flashing, and metal-based paint can contribute toxic pollutants to the River.

To keep roof runoff from reaching the river:

- Move or extend downspouts so that water from the roof flows to a vegetated area that can absorb the water.
- Create a rainwater garden. Rainwater gardens are depressions dug into the ground that are partially filled with sand, soil, and organic mulch; and planted with native shrubs, grasses, and trees (*see list of appropriate plants on page 50*).

Rainwater gardens are attractive and absorb excess runoff.

- Consider grading into your lawn a shallow retention area for roof or other runoff. Like rainwater gardens, retention areas are grass-covered depressions designed to hold rainwater until it can be absorbed into the ground.
- Station a rain barrel at the end of one or more shortened downspouts. Water collected in the rain barrel can be accessed through a spigot, and used to water plants in the yard.
- Feeling ambitious? Install a green roof. Also known as rooftop meadows, green roofs are composed of specially constructed roof coverings upon which grass or similar vegetation can grow. Green roofs—possible on both flat and gently sloped surfaces—can reduce rooftop runoff by as much as 70 percent, and save homeowners money on heating and cooling costs.

Reduce the amount and improve the quality of driveway runoff. Runoff from driveways, like runoff from parking lots and streets, can be especially damaging to the River because rain and snowmelt wash pollutants (fluids from vehicles, sand, salt, fertilizers, etc.) from impervious concrete or blacktop surfaces directly into storm sewer systems or down other paths that lead to the River. Consider implementing suggestions below to improve the quality and lessen the quantity of driveway runoff:

- If your existing driveway needs to be replaced, or you need to add an extra parking spot, install a surface that is porous and will let water seep through. Some options—
  - wide cement or gravel tire tracks with a strip of vegetation in the middle and on either side of the tracks
  - stones in a flexible mold
  - porous paver blocks installed on top of a sand base
  - a driveway drywell—slotted grating on the driveway downslope through which rainwater falls into a box of sand and crushed rock that filters pollutants before the water soaks into the ground

Made from stones packed tightly into a flexible mold, this extra parking spot allows rain to soak into the ground below.

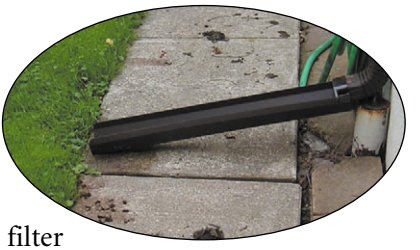
- a channel or gentle berm that diverts water running down the driveway into a rainwater garden

- If your car leaks oil, or you accidentally spill oil, gas, radiator fluid, etc. on your driveway, sprinkle the spill with absorbent cat litter and sweep the dirty litter into the garbage. All leaks should then be fixed.
- When you fertilize your lawn, sweep any fertilizer residue from the driveway back into the grass.
- During the winter, keep your driveway free from snow by shoveling, snow blowing, or sweeping the snow onto your lawn. Avoid using salt and sand that will travel with mid-winter and spring snowmelts to the River.

Control runoff from sidewalks and patios. Though most of us cannot control how public sidewalks are paved, we all have choices about walkways, paths, and patios on our property as well as the type of vegetation that borders those surfaces.

- When building or replacing outdoor patios, use porous paver blocks instead of a cement slab.
- Gently slope patios toward a border vegetated with deep rooted native plants—an area where excess water can soak into the ground.
- Paths through your yard or around the side of your house can also be built from paver blocks, flagstone, gravel, bricks, or other porous materials.
- Direct runoff from patios and walkways toward a rainwater garden or turf depression (*see descriptions of these structures on pages 46–47*).

Benefits of Home Runoff Management:



✓By using downspouts that direct water away from the house to a vegetated area, water will be less likely to seep into your basement during snowmelt and heavy rainstorms.

✓Rainwater gardens are an attractive landscaping feature that can filter pollutants and keep excess water from flowing into the storm sewer system or tributaries that lead to the River.

✓Alternative paving options (paver blocks, bricks, gravel, etc.) for pathways and patios complement landscaping and look more attractive than poured concrete.

✓During spring flooding and heavy summer storms, reduced runoff from individual property will help to keep River levels lower and prevent streambank erosion.

✓Throughout the year, runoff that stays in your yard instead of traveling to the River can help to keep your yard greener and the River cleaner.

Natural Landscaping

Landscaping can make your yard look more picturesque. It can also attract birds and butterflies, provide summer shade, or reduce the amount of water that runs off your property. Natural landscaping—the practice of planting yards with a strategic mix of native flowers, shrubs, and trees—can serve all these functions.

Below are a few suggestions for natural landscaping.

Plan your project carefully.

- Before you dig holes for trees or ponds, call Gopher State One Call (800-252-1166 statewide, or 651-454-0002 in the Twin Cities metro area) so someone can come out to tell you where power and gas lines are buried in your yard.

- Examine the area you hope to plant to determine its soil type (sand, silt, loam, or clay), assess its pH level (relative acidity), and estimate how much water might pool there during rainstorms. University of Minnesota's Soil Testing Lab can help. Call 612-325-3101 or visit http://soiltest.coafes.umn.edu.
- Keep track of how many hours of sun different parts of your yard receive during spring and summer days. Many prairie plants require between six and 10 hours of sun each day.
- Discuss benefits of the project with your family, and encourage them to join in—solicit help when planning, selecting plants, preparing the soil, digging holes for planting, etc. That will help to give everyone a sense of ownership and pride in the finished product.
- Plan your job in phases so that you can have the satisfaction of finishing one phase before starting another. Start with larger

features such as paths or ponds, then work your way down from planting trees, to planting shrubs, flowers, and smaller plants.

- Think ahead to how tall and dense shrubs and trees will become, and plant them away from overhead wires, and so they will not block the view of your doors or windows.
- Because chemical pesticides and fertilizers can harm some native plants, delay planting in areas that were recently treated.

Use plants, shrubs, and trees that are native to this area. As part of incorporating native plants into the landscape, you may also need to remove non-native invasive plants (buckthorn and purple loosestrife, for example) that will out compete native species. Below is an abbreviated list of native trees, shrubs, and other plants that are adapted to this area and may work well in your backyard landscape.

Native Backyard Trees, Shrubs, Grasses, & Flowers

Evergreens
Red Pine (*Pinus resinosa*)
White Spruce (*Picea glauca*)

Large Trees
Bur Oak (*Quercus macrocarpa*)
Hackberry (*Celtis occidenalis*)

Shrubs and Small Trees
Bush Honeysuckle (*Diervilla lonicera*)
Gray Dogwood (*Cornus racemosa*)
Highbush Cranberry (*Viburnum trilobum*)
Juneberry (*Amelanchier laevis*)
New Jersey Tea (*Ceanothus americanus*)
Wild Plum (*Prunus americana*)

Grass-like Plants
Big Bluestem (*Andropogon gerardi*)
Indiangrass (*Sorghastrum nutans*)
Junegrass (*Koeleria macranth*)
Little Bluestem (*Schizachyrium scoparium*)
Northern Dropseed (*Sporobolus heterolepis*)
Prairie Cordgrass (*Spartina pectinata*)
Sideoats Grama (*Bouteloua curtipendula*)
Switchgrass (*Panicum virgatum*)

Perennial Flowers
Black-eyed Susan (*Rudbeckia hirta*)
Blueflag Iris (*Iris versicolor*)
Butterfly Flower (*Asclepias tuberosa*)
Cardinal Flower (*Lobelia cardinalis*)
Great Blue Lobelia (*Lobelia siphilitica*)
Maidenhair Fern (*Adiantum pedatum*)
New England Aster (*Aster novae-angliae*)
Purple Coneflower (*Echinacea angustifolia*)
Rough Blazingstar (*Liatris aspera*)
Showy Penstemon (*Penstemon grandiflorus*)
Silky Aster (*Aster sericeus*)
Swamp Milkweed (*Asclepias incarnata*)
Prairie Smoke (*Geum triflorum*)
Wild Geranium (*Geranium maculatum*)

Consult the Minnesota Department of Natural Resources and other Vermillion River Friendly Partners listed on pages 73–83 to learn more about and select plants and trees that would work best in your yard.

Reduce lawn area. Many lawns, especially those where the soil has been compacted by heavy machinery during housing construction, are essentially impervious and provide little drainage. To help your property absorb more runoff, plant native shrubs, flowers, and trees in low-traffic areas where grass is not needed.

Benefits of Natural Landscaping:

- ✓Once established, native prairies and other natural landscaping features are very attractive and can provide welcome habitat for birds, butterflies, and other wildlife.
- ✓Native plants, because they are well-suited to Minnesota's climate and soil conditions, require less maintenance than non-native plants, and no pesticides or fertilizer. Spot weeding (and an occasional mowing if controlled burns are not allowed) is the only care needed.
- ✓By reducing lawn area, you can cut down on the amount of time you spend mowing, fertilizing, and controlling for dandelions, crab grass, etc.
- ✓Shrubs and small trees, when placed to shade an air conditioner, can help it to run more efficiently.
- ✓Larger trees can provide shade for your house too.
- ✓Native plants have deeper roots than turf grass, and can better absorb and filter runoff water.
- ✓By planting areas that need no pesticides or fertilizer, you will send less of those pollutants into the storm sewer and tributaries that drain to the River and make your yard safer for children and pets.

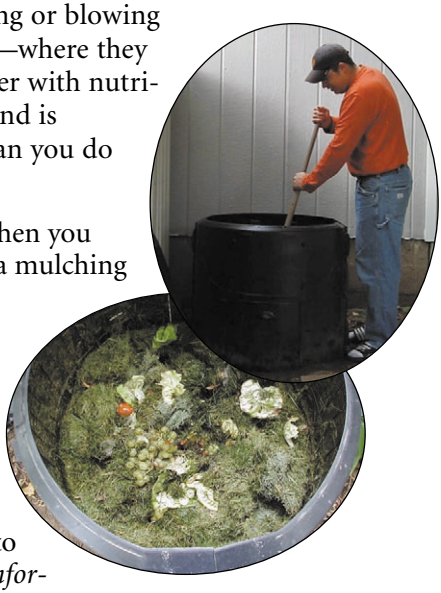
Lawn Maintenance

Even though—or perhaps because—Minnesota's growing season is shorter than in other parts of the country, property owners in the Vermillion River watershed devote many spring and summer hours to yard work. As early as April, we begin the war on dandelions, Creeping Charlie, and other common weeds. By summer we are working to keep our lawn looking green and mowed, and continuing to fend off invading crab grass and yet more dandelions. Heading toward winter, we prepare the lawn for the next spring with a final round of fertilizers and weed killers.

Lawn maintenance seems like an activity that only affects you and your lawn, but again, the way in which you and your neighbors care for your lawns directly affects the quality of the Vermillion River. Listed below are some Vermillion River friendly lawn care practices.

Grass clippings and leaves that are swept or blown into the street travel directly to (and pollute) the River.

Properly dispose of or find a way to reuse lawn waste. Under Minnesota state law, property owners cannot throw away yard and tree waste (grass clippings, leaves, trees, stumps, wood chips, garden debris, etc.) with their household garbage. Raking or blowing leaves or grass clippings into the street—where they clog storm sewers and overload the River with nutrients and sediment—is also a bad idea and is against some cities' ordinances. What can you do instead?



- Leave grass clipping on your lawn when you mow. This practice works best with a mulching lawnmower.
- Put grass clippings and other yard waste into an outdoor compost bin. With little effort, yard debris will decompose into fertilizer for your yard and gardens.
- If you generate too much lawn debris to compost or mulch, take it to a composting site. (*See composting information on pages 74–75.*)

Minimize water use and runoff while maximizing benefits. Minnesota homeowners rarely face watering bans and it seems like we have an unlimited supply of lakes, rivers, and other surface waters. Clean ground water, however, is a limited resource, and water conservation practices are important for both our health and the River's health.

Conserve water and reduce runoff when maintaining your lawn.

- Replace some of your thirsty lawn with attractive native plants that require less water and care. (*See page 50 for a list of native plants.*)

- Spread mulch around the base of flowers, shrubs, vegetables, and trees. Mulch keeps plants from losing water to evaporation and promotes plant growth.
- Aerate the lawn to improve its health and promote water infiltration.
- Sweep grass clippings, leaves, and other debris from your driveway and sidewalks instead of cleaning surfaces with a hose or blower.
- Opt to not sprinkle when conditions are windy or extremely hot. Water will evaporate before reaching plant roots on hot days and will blow off course in high winds.
- Sprinkle only living plants. Sidewalks and streets don't need water.
- Water shrubs and gardens with a slow trickle at the base of the plants. Slow soaking encourages root growth, prevents water loss, and reduces mildew.
- Choose the right sprinkler for the job. Those that spray a fine mist lose water to evaporation before it gets to the plants. If you only have a small area to water, use a small sprinkler or one that is adjustable.
- Water your lawn and garden plants early in the morning or during evening hours, so plants will lose less moisture to evaporation.

Use pesticides and fertilizers sparingly and find alternatives.

The U.S. Environmental Protection Agency estimates that homeowners and lawn care services apply nearly 70 million pounds of active pesticide ingredients (herbicides and insecticides) to urban lawns every year. Fertilizers are perhaps even more popular. A fairly recent study of Minnesota homeowners' lawn care habits indicated that as many as 7 in 10 homeowners surveyed use pesticides, and more than 8 in 10 use fertilizers. To reduce chances that pesticides and fertilizer from your yard will find their way to the River:

The three numbers on fertilizer labels signal the ratio of nitrogen, phosphorus, and potassium in the product. Lawns within the Vermillion River watershed usually need NO extra phosphorus—nor do local lakes and rivers.

- Plant native shrubs and flowers in your garden that are naturally hardy and deep-rooted enough to out compete weeds.

- Before applying any fertilizer, test your soil to determine how much fertilizer (if any) your lawn and gardens need. Soil testing kits are available through the University of Minnesota Extension Service and through the University's Soil Testing Lab (*see pages 75–76*).
- Use compost instead of commercial fertilizer.
- If you must use commercial fertilizer, use zero phosphorus fertilizers, apply only as much as your yard needs, and only fertilize in the fall.
- Instead of applying herbicides over the entire yard, target just those spots that are weed infested.
- Never use old pesticides and carefully dispose of pesticides that are more than 10 years old.
- Never apply pesticides or fertilizer if rain is forecasted within the next day or two.

Benefits of Lawn Maintenance:

✓Grass clippings left on your lawn provide growing grass with nutrients and extra moisture. Decomposing grass clippings offer the same benefits as one application of fertilizer each year.

✓Informed and reduced use of pesticides and fertilizers can save time and money.

✓ Native plants and trees require less maintenance than hybrids and exotics, can attract desirable wildlife, and are equipped to fight off weed invasions without help from weed killers.

✓ Homemade compost costs less than commercial fertilizer, and is conveniently located right where you need it—at your home.

✓ Indoor and outdoor water conservation prevents excess water from overloading septic and sewage treatment facilities, and reduces the amount of water transporting surface pollutants to storm sewer systems that empty into the Vermillion River.

✓Limited use of pesticides and fertilizers lessens the chance that lawn maintenance practices will unintentionally harm small children and pets.

Waste Management

Waste is an everyday fact of life—from the morning coffee grounds in your coffee maker, to food scraps from dinner. You do, however, have many choices about how you dispose of waste, and many opportunities to keep your family's waste from negatively impacting the River. See suggestions below.

Used in a Washington State water protection campaign, this image represents how uncollected pet waste directly threatens rivers' and lakes' water quality.

Properly dispose of pet waste throughout the year. While many of us are accustomed to picking up our pets' waste at public parks, we must also pick it up on our own property—especially in the winter. During spring snowmelt and during summer storms, waste that is left on the ground travels with runoff directly to the River and contributes to elevated bacteria and nutrient levels. To keep pet waste from polluting the River consider these options:

- Flush solid waste down the toilet, so your septic system or the sewage treatment plant can treat it.
- Seal the waste in a plastic bag and throw it into your garbage.

Compost food waste. Every year, the average family in the Vermillion River watershed throws away as much as 300 pounds of organic materials, more than 80 percent of which is food waste. Instead of sending food waste to the landfill, try creating some garden-friendly compost from it instead. Fruits, vegetables, grains, bread, unbleached paper napkins, coffee grounds, and eggshells are good candidates for composting. Add food waste to your lawn compost bin OR set up a small, indoor compost bin using special food-eating red worms. Through a process known as vermicomposting (vermi for vermilion—the reddish color of the worms), worms help food to quickly decompose by digesting the organic material and creating a rich, odor-free compost.

Properly handle hazardous household wastes. Hazardous household wastes are products (labeled CAUTION, WARNING, DANGER, POISON, etc.) that pose risks to human health or the environment if improperly stored, used, or thrown away. Examples include paint, paint thinner, drain cleaners, aerosol sprays, and rodent poisons. Below are guidelines:

- Buy the least hazardous product that will get the job done, in amounts that you can use up easily.
- Keep hazardous products in their original containers, and follow instructions for proper ventilation while using, amounts to apply, and safe ways to throw out unused product.

- Store hazardous products in a dry place away from heat or flames and out of children's reach.
- Use alternative products that pose fewer risks to your family's health and water quality. For example: mix a half cup of vinegar with a quart of warm water to clean inside windows; use baking soda to clean stainless steel; or clean your toilet with baking soda and castile soap.
- Bring unwanted household hazardous waste to hazardous waste drop off sites (*see pages 74–75*), or to neighborhood clean up days.

Minimize household water use. Water that we use for showers, washing clothes and dishes, flushing toilets, etc. (as much as 80 gallons per person according to some estimates) goes to either a private septic system or a sewage treatment plant. Sooner or later, that water enters surface water or ground water. To conserve water:

This toilet displaces just 1.6 gallons of water per flush.

- Use a showerhead that sprays out less than 2.5 gallons of water per minute.
- Fix toilet leaks and replace old toilets (that may use up to five gallons of water per flush) with newer 1.0 to 1.6 gallon versions.

- Install efficient replacement faucets with shutoff levers that allow you to reduce the flow of water without changing its temperature. A flow rate of .75 to 1.5 gallon per minute is plenty for bathrooms, and kitchen faucets need only flow at 2.0 to 2.5 gallons per minute.
- When its time to replace your old washing machine, purchase one that runs on a horizontal axis instead of the standard vertical axis. Available in front- and top-loading models, efficient horizontal-axis washers use less water and energy, require less detergent, and clean clothes better.
- Wash only full loads of dishes or clothes (or adjust your washer to the appropriate water level for the size of your load).
- Store a jug of drinking water in the refrigerator so you don't need to run the tap until it's cold every time you want a drink.

Protect your septic system's health. See pages 40–42 for a list of ways you can keep your septic system healthy and prevent ground and surface water pollution. Pages 74–75 list contacts for learning more about septic system regulations in your county.

Benefits of Waste Management:

✓Good household waste control practices help to keep pollutants from reaching the River.

✓Proper handling of hazardous waste and disposal of pet waste protects children and pets from health-threatening chemicals and bacteria.

Vehicle waste oil can be recycled at service stations.

✓Home-composted food waste provides a great low-cost fertilizer for gardens, trees, and shrubs, and reduces the need for less environmentally friendly fertilizers.

✓Composted food waste saves dwindling landfill space.

✓Reduced water use can lower water bills, as well as costs associated with the water heater.

✓In new construction with septic systems, a more efficient plumbing system may allow the homeowner to install a smaller, less expensive leach field.

✓In existing construction with septic systems, reduced water use can prevent over-flowing cesspools and septic tanks—problems that pollute ground and surface water and can lead to expensive fixes.

Vehicle Maintenance

The advent and increasing use of passenger cars and trucks through the 1900s played a significant role in the changing landscape of the Vermillion River watershed. Roads cut through prairies, bridges spanned rivers, and as access to the area south of the Twin Cities improved, residential developments sprouted and grew. Today, vehicles and the pollution they generate continue to affect the watershed. Actions listed below can help you to make your vehicle more Vermillion River friendly.

Fix all leaks. If your vehicle leaves fluid spots on the pavement when it sits for a couple hours, check it for a leak. Common leaks involve oil, gas, transmission fluid, and coolant. All are toxic to aquatic life.

Dispose of vehicle waste responsibly. Normal vehicle maintenance generates a dangerous set of wastes including used oil, dead batteries, and worn tires. If you take your vehicle to service stations for maintenance, they will dispose of old oil, batteries, and other worn out parts. If you are your own mechanic at least part of the time:

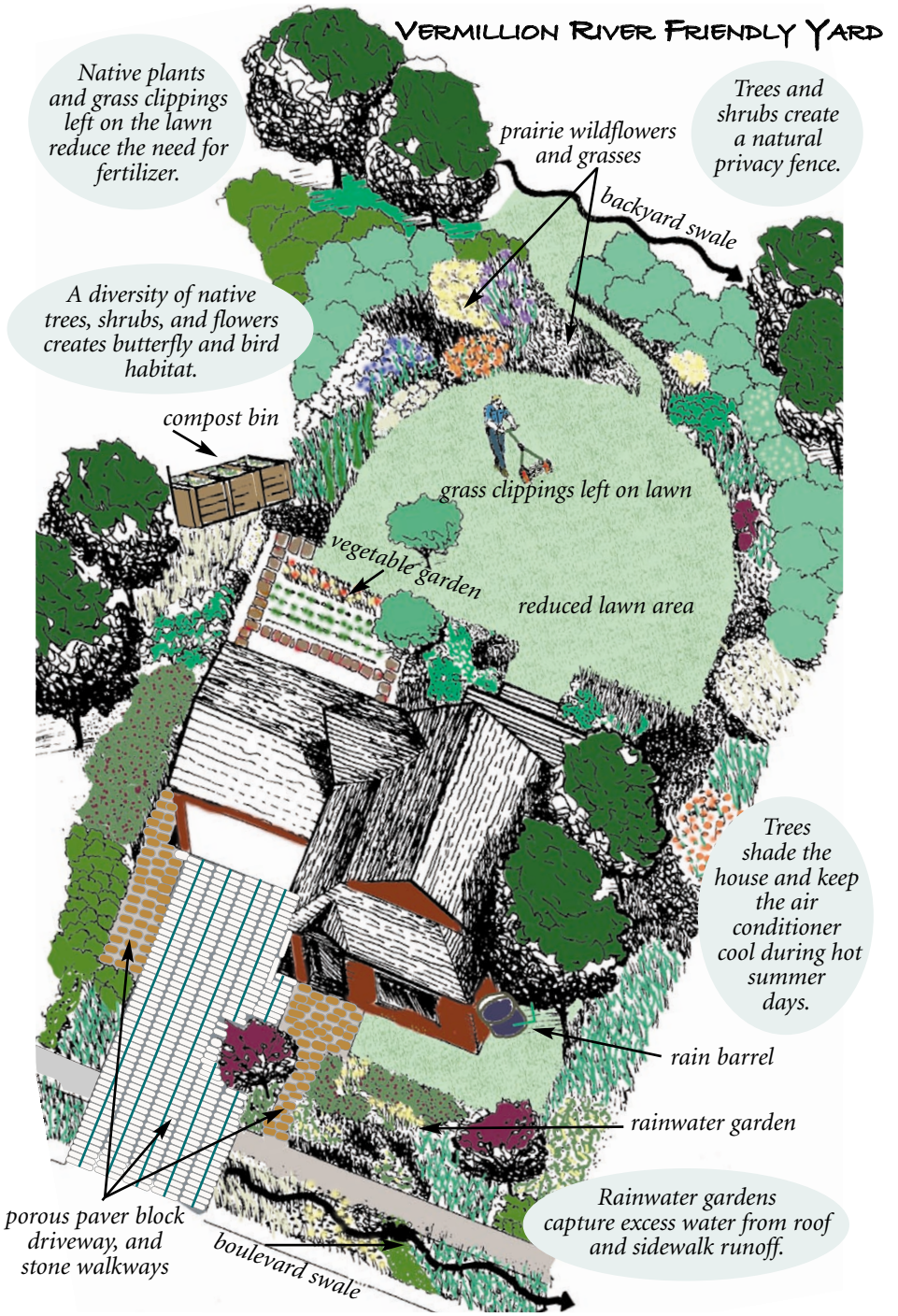
- Carefully collect waste fluids and, if possible, work on vehicles parked away from the street and driveway.
- Take used oil to a local vehicle repair shop or to a household hazardous waste disposal site. Never let oil flow down a storm sewer. Waste oil is a serious water pollutant.
- Bring used batteries, tires, oil filters, antifreeze, degreasers, and gasoline to household hazardous waste disposal sites (*see pages 74–75*).
- For larger vehicle parts (engines, for example), call vehicle service centers or scrap yards to see if they would be able to use the part.

Avoid sending soapy water down storm sewers when washing your vehicle. Here are some options:

- Wash your vehicle on the lawn or another surface that will absorb water instead of sending it to the storm sewer.
- Use a small amount of phosphate-free soap when washing. Check labels for phosphate-free options.
- Conserve water by turning off the hose while you are soaping the vehicle, and rinsing from the top down.
- When you are done washing your vehicle, dump the dirty, soapy water into a sink in your house. That way the soap and dirt will go to a wastewater treatment plant instead of directly to the River.
- Wash your car at a self-serve or automated car wash. By state law, car washes must drain water used for washing vehicles to wastewater treatment facilities and not storm sewers.

Benefits of Vehicle Maintenance:

- Well-maintained cars run better, emit fewer pollutants, and get better gas mileage.
- By washing your car (or bicycles, outdoor furniture, etc.) on the grass, you can water the lawn while you clean.
- By fixing oil and other vehicle fluid leaks, you will keep toxic pollutants from washing off streets, driveways, and parking lots, and into the River during storm events.

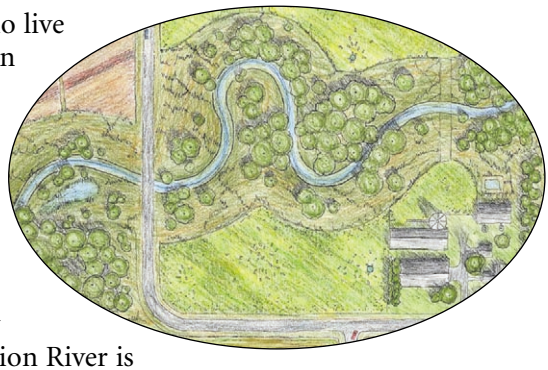

Vermillion River Friendly Yard
Native plants and grass clippings left on the lawn reduce the need for fertilizer.
prairie wildflowers and grasses
Trees and shrubs create a natural privacy fence.
backyard swale
A diversity of native trees, shrubs, and flowers creates butterfly and bird habitat.
compost bin
grass clippings left on lawn
vegetable garden
reduced lawn area
Trees shade the house and keep the air conditioner cool during hot summer days.
rain barrel
rainwater garden
porous paver block driveway, and stone walkways
boulevard swale
Rainwater gardens capture excess water from roof and sidewalk runoff.

Chapter 6

The Big Picture: How to Make the Watershed Vermillion River Friendly

Any river is really the summation of the whole valley. To think of it as nothing but water is to ignore the greater part.

~ Hal Borland in *This Hill, This Valley*



Most of this handbook focuses on what individuals who live within the Vermillion River watershed can do to make the River (and thus the watershed) cleaner and healthier. This chapter takes a step back to thread individual efforts into a larger context. Individual commitment to clean water is vitally important, but if the Vermillion River is going to be the cool and clean-flowing river it once was, communities and local governments must also make the River's well-being a priority.

Strategies for overall watershed improvement in many ways mirror strategies for individual property owners. Key strategies include:

- maximizing natural areas,
- encouraging the revitalization of greenway corridors and streamside buffers, and
- promoting conservation-minded development that minimizes impervious surfaces and reduces the negative effects of urbanization.

Preserve and Restore Natural Areas

Naturally vegetated areas in the Vermillion River watershed include wetlands, forests, oak savannas, and prairies like those that once dominated the landscape in southern Minnesota. Less than three percent of these natural areas remain in the Vermillion River watershed. While we clearly cannot return the watershed to its original (pre-development)

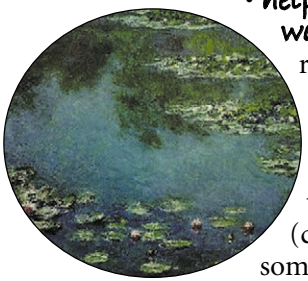
condition (*see pre-development map on page 2*), work to maintain and recover these rapidly disappearing and invaluable natural elements will yield important water quality and watershed benefits.

Wetlands

Regrettably rare in developed areas, wetlands are transitional habitats where the water table is at or near the surface (as between bodies of water and upland areas), or where land is habitually covered with water up to a few feet deep. Not surprisingly, wetlands—marshes, bogs, swamps, and floodplain forests—are typically populated with plants (from cattails and water lilies to various grasses, shrubs, and trees) that can tolerate intermittent flooding and near constant wetness. Wetlands account for 46 square miles of the Vermillion River watershed.

In the past decade or so, Minnesota legislators have passed laws to protect these important ecosystems—the most significant of which is the Wetland Conservation Act (WCA) of 1991. Administered by local governments, the WCA requires landowners and developers to avoid altering and destroying wetlands, and replace (re-create elsewhere) wetlands that are destroyed or filled in.

Functions: Not only do wetlands provide ideal growing conditions for water lilies like those in Monet's famous impressionist paintings, they:



- **help to control flooding and recharge ground water.** Wetlands act as a storage basin for excess runoff and floodwater, and then allow excess water to filter slowly into the ground.
- **trap and filter pollutants in runoff and floodwater.** Wetlands have the unique ability to trap nutrients like nitrogen and phosphorus (commonly found in agricultural runoff), return some of the nitrogen back into the air as a harmless gas, and store the remaining nutrients in sediment where emerging wetland plants can benefit from them later on.
- **cycle nutrients and play a key role in the natural ecosystem.** In addition to absorbing and re-using nutrients like nitrogen and phosphorus, wetlands also capture large amounts of sun that plants can use for photosynthesis. As a result, wetlands produce a

high volume of plant life that other organisms and animals can feed upon, and that decompose and cycle back into mineral nutrients and organic compounds that enable the wetland to self-perpetuate.

- **provide habitat for fish, birds, muskrats, ducks, and other waterfowl.** Biologists estimate that more than 150 kinds of birds and 200 different types of fish depend on wetlands for survival. In Minnesota, deer, bears, and raccoons also feed on plants and animals found in wetlands.

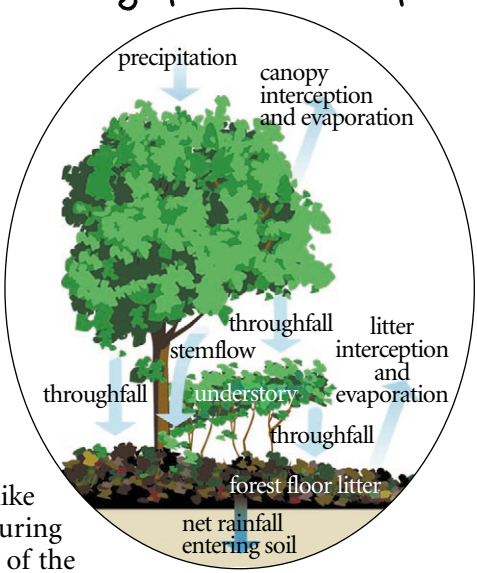
Forests and Woodlands

In Minnesota, forests or wooded areas are composed of deciduous trees (those—like maple and oak trees—that lose their leaves every fall), evergreens (trees with needles or other leaf structures—like cedar, fir, and pine trees—that keep their foliage throughout the year), or a mix of both. Most of Minnesota's 16.7 million acres of forest land is located north of the Twin Cities, but southern Minnesota is also home to wooded areas. Ongoing reforesting efforts are also helping to bolster tree populations on state and private land.

Functions: Though most communities in the Vermillion River watershed are not surrounded by forests, conscientious use of trees by private individuals and on public land can benefit the River and its watershed. Wooded areas:

- **keep the air cleaner.** Trees trap and remove from the air dust particles and dangerous chemicals like carbon, nitrogen, and sulfur compounds. At the same time, trees release oxygen that animals need to survive.
- **prevent soil erosion and runoff.** Tree canopies act much like an umbrella for the earth below during rainstorms. Leaves intercept some of the

Pathways for Forest Rainfall



rain, and what falls through or drips off is in turn caught by plant debris on the forest floor before seeping into the soil. Thickly forested regions experience almost no soil erosion or runoff.

- **offer flood storage.** Hardwood trees in river bottomlands, floodplains, and low lying areas can help to absorb and store excess water. Extensive and deep root systems enable trees to store excess water and slowly release moisture into the soil and air.
- **provide habitat for birds, mammals, and other wild animals.** Wooded areas offer animals nesting space, shelter, and food. Larger or closely connected woodlands provide habitat for the greatest number of birds and animals.

Oak Savanna

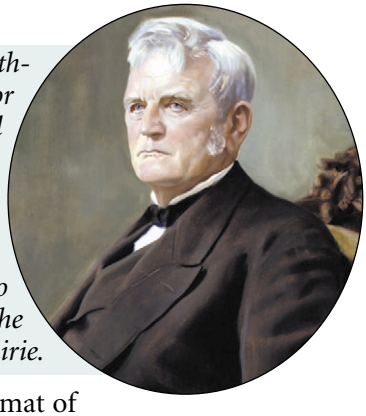
Once a dominant feature of the Vermillion River watershed (*see pre-development map on page 2*), oak savanna is a rich transitional landscape that in the early 1800s cut a wide swath between Minnesota's northeastern forests and southwestern prairie. Because savanna occurs between forests and prairies, it contains features of both. Kept healthy by light grazing and occasional fires, savannas have a light covering of open grown trees (typically oak—thus the term oak savanna), filled in with prairie and forest grasses and shrubs, as well as other plants suited to a mix of light shade and sun.

Functions: The wide diversity of grasses, trees, and shrubs found in oak savannas collectively form a unique ecosystem and sustain an equally diverse mix of butterflies, birds, and other flying, crawling, and furred creatures. Savannas also benefit water quality in the same ways that forests and prairies do (*see above and below*).

Prairies

It is no coincidence that so many town and city names in Minnesota include the word "prairie." Prairies—vast stretches of hardy native grasses and flowers, as well as trees and shrubs, that survive with limited rainfall through hot summers and cold winters—once defined southern and western Minnesota. Typically classified (based

on rainfall amounts) as tallgrass, mixedgrass, or shortgrass, prairies naturally maintain themselves when helped by periodic fires, grazing, and temperature extremes.



John Deere, 19th-century inventor of the steel mold board plow, enabled Vermillion River watershed farmers to till much of the native prairie.

Functions: Prairie land was an integral part of the Vermillion River watershed before settlers began replacing it with farm fields and communities. Restored and recreated prairies can still provide:

- **highly effective erosion control.** When healthy, prairies are composed of a dense mat of tall plants with deep roots—characteristics that made early plowing of the land especially challenging. Prairie plants hold soil tightly in place through wind and rainstorms.
- **a shield against excess runoff.** Prairies are adept at absorbing and storing excess water in deep-rooted plants, and slowly filtering into the soil or evapotranspirating into the air moisture the plant does not need.
- **filtering benefits.** Because prairies can readily absorb excess water and slow runoff, they are also able to filter pollutants before they reach surface and underground water supplies.
- **habitat for mammals, birds, and insects.** In times past, the prairie was home to bison, red-backed voles, greater prairie chickens, upland sandpipers, and ottoe skipper butterflies. Many of those creatures disappeared with the prairies of old, but new prairies can still attract colorful butterflies, clear-throated song birds, and a variety of mammals.

Encourage the Revitalization of Greenway Corridors and Streamside Buffers

It seems that one inevitable effect of human settlement is the loss and fragmentation of natural areas. The Vermillion River watershed was once an uninterrupted expanse of prairie, wetlands, and wooded areas. As communities have taken shape, all of these natural areas have

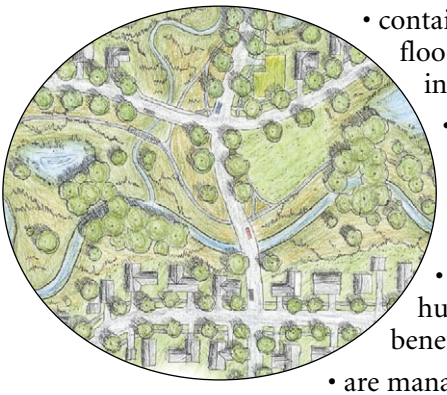
been either destroyed or, at the very least, disconnected from one another. Consequently, the diversity of plant and animal species that thrived when the various natural habitats lay side by side has been lost. Important water resource benefits have also been lost.

The Functions of Greenways and Riparian Buffers

Greenways, also known as greenway corridors, are extended stretches of connected natural areas (wooded areas, open fields, wetlands, etc.) that provide significant habitat benefits for a diversity of wildlife, and can protect the balance of life and movement between rivers and adjacent areas. Riparian buffers (a strip of vegetated land that runs alongside a stream or river or around the edge of lakes and wetlands) are crucial components of active greenway corridors. Because greenways are a composite of natural areas, they benefit rivers like all natural areas do. Greenways that include riparian buffers:

- moderate the flow of water between the river and surrounding land
- filter out nutrients and other harmful chemicals
- control water temperature
- stabilize streambanks
- supply food and shelter for fish and other aquatic species

The best greenway corridors for people, wildlife, and water resources:



- contain diverse natural features—including flood plains, streamside forests, wetlands, intermittent tributaries, gullies, etc.
- are wide enough to effectively filter pollutants and absorb runoff from surrounding areas
- connect networks of other corridors
- provide recreational benefits for humans without compromising the benefits of greenways to other creatures
- are managed to benefit native species of plants, shrubs, trees, and wildlife

Protection Options for Greenways and Natural Areas

Because greenways are linked stretches of natural areas that can extend into and through public and private land, landowners' willingness to preserve natural areas is key to sustaining greenways (and their benefits). There are many ways, like those listed below, that landowners can protect green space on their property. Each option should be considered carefully and evaluated in light of the landowners' circumstance.

1. Voluntary registry programs. Various conservation organizations allow landowners to "register" their land. By registering, landowners enter into an informal and non-binding agreement to preserve natural areas in exchange for advice about good management practices. Contact Friends of the Mississippi River (*see page 79*) to learn more about the Mississippi-Vermillion Heritage Land Registry.

2. Land retirement. Land retirement programs offer landowners financial incentives to take farmland out of production. The most popular is the Conservation Reserve Program run by the Natural Resources Conservation Service (NRCS).

3. Property tax relief programs. Property tax relief programs lower, delay, or eliminate assessed property taxes on land. A proposed forest land tax relief program would help landowners who have a forest stewardship plan registered with the state.

4. Restoration cost-share. As the name suggests, restoration cost-share programs encourage landowners to restore and protect natural areas by funding some costs of restoration and preservation projects.

DAKOTA COUNTY
SOIL & WATER
CONSERVATION DISTRICT

In Dakota County, the Soil and Water Conservation District's Community Conservation Cost-Share Grant Program offers 50 percent matching grants (up to $5,000 each) to property owners or residents who work to preserve or restore natural areas in the County.

5. Conservation easements. A conservation easement is the voluntary (and typically permanent) transfer of land and land use rights from a landowner to a qualifying organization.

6. Land sale to conservation buyer. If your land has rare or significant natural elements or borders a protected natural area, state park, or wildlife refuge, there is a chance that the agency responsible for managing the protected area, or one that is especially concerned with nature conservation, will be interested in acquiring your land.

7. Land donation. Through land donation, a property owner can transfer title to a conservation organization that will manage it according to the terms of the transfer.

8. Land exchange. Often initiated by conservation organizations, land exchanges allow property owners to trade title on a piece of their land in exchange for title on another piece of land.

Learn more about ways to protect land for greenways in *Land Protection Options*, a publication available from the Minnesota Department of Natural Resources.

Promote Conservation-Minded Development

Every year in the United States, more than 1.5 million acres of open space is converted into residential housing, shopping centers, roads, and other structures that signal urban growth. Development within the Vermillion River watershed (*as indicated by the Dakota County population graphic on page 3 and the aerial picture of Apple Valley on the left*) has progressed at a similarly aggressive pace.

For rivers, one primary problem with urban development is the increase in areas where water cannot sink in. Because water cannot soak into parking lots and buildings, more unfiltered storm runoff travels to storm sewers that dump into a nearby river or other surface water. In addition, conventional stormwater management has dictated that storm runoff should be quickly conveyed directly to a stormwater pond or the nearest receiving water. Even if treated in stormwater ponds, high volumes of runoff from urban areas can worsen water quality and cause flooding problems.

To protect essential water resources, developers and property owners must:

- minimize the adverse effects of new development and re-development; and
- manage existing development more effectively.

Minimize Adverse Effects of New Development

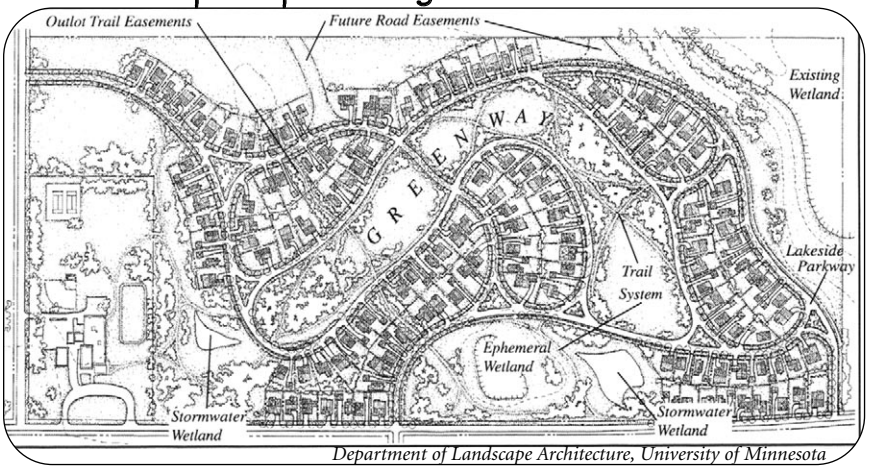
In older neighborhoods, storm sewers convey runoff directly to lakes, rivers, and wetlands. Developments in the past 10 years or so have been designed to quickly convey runoff to a centrally placed collection area—often a wet or dry stormwater pond. Typically, these ponds simply hold water from rainstorms and slowly release it over time. While ponds can help to manage the rate of overall runoff and improve runoff water quality, they usually do nothing to reduce runoff volume, and often fail to provide additional natural benefits.

Urban stormwater detention ponds store excess runoff.

The best way to keep untreated runoff from reaching rivers and streams is to reduce and manage runoff right where it occurs. That is a key premise behind conservation-minded development. To accomplish this end, developers should:

- **protect natural areas.** At the most basic level, developers should make every effort to avoid filling in wetlands on, clearing all vegetation from, and re-grading new development sites.
- **design sites that work to preserve open spaces.** Open space design (also known as clustering—*see diagram on page 70*) establishes a greater density of homes or commercial buildings on one portion of a site, in exchange for open space elsewhere on the site. When open space is structured like or as part of an existing greenway corridor, such developments will go a long way toward minimizing adverse water quality effects.
- **follow low-impact development standards.** The goal of low-impact development is to design sites and lots that store, absorb, evapotranspirate, and detain stormwater and other runoff the way land used to do. In essence, low-impact development maximizes areas that naturally store, absorb, and detain water, and works to substantially reduce site runoff as compared to traditional developments.

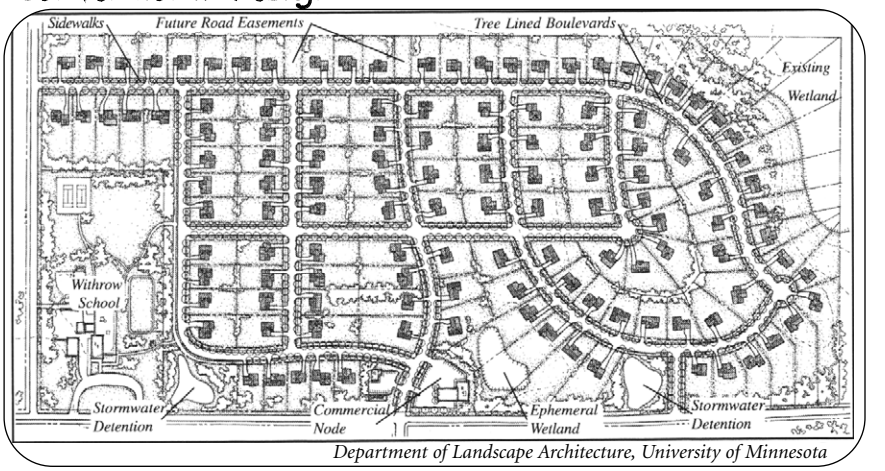
Cluster or Open Space Design



Department of Landscape Architecture, University of Minnesota

The designs above and below illustrate radically different approaches to managing space with the same number of houses. The open space design includes habitat for wildlife, natural runoff controls, and attractive surroundings. The design below retains no natural qualities.

Conventional Design



Department of Landscape Architecture, University of Minnesota

Developers can achieve low-impact development outcomes through practices like:

- designing the development to mimic natural hydrology
- reducing impervious areas by making lightly used streets in new developments both narrower and shorter

- incorporating vegetation into the middle of residential cul-de-sacs
- using vegetated open channels to convey runoff away from sidewalks and other impervious surfaces
- promoting shorter driveways through reduced front setbacks or by shared driveways that lead to two or more houses
- (where practical) installing sidewalk on just one side of the street
- creating parking areas only as large as use warrants, and incorporating vegetated traffic islands and landscaped filter strips to manage lot runoff

- identifying and selecting practices—rainwater gardens, rain barrels, drywells, etc.—to manage runoff from individual lots (*see pages 46–53*)

Not every idea works for every site. Zoning, parking, street, and subdivision codes—as well as each site's unique characteristics—may keep developers from following low-impact development standards. When used, however, conservation-minded development strategies produce real benefits, both for new developments and re-developed sites.

New conservation-minded developments:

- protect local streams, rivers, and other water bodies by reducing total runoff volumes and mimicking the natural (pre-development) interplay between land and surface waters

- protect sensitive natural areas that offer wildlife habitat and water quality benefits
- promote ground water recharging
- reduce soil erosion during construction
- keep construction costs lower
- increase local property values and tax revenues
- filter stormwater pollutants on each lot
- create neighborhood designs that provide a sense of community and have safer streets
- provide more open space for recreation
- feature landscapes that are naturally attractive

Effectively Manage Existing Developments

In established communities, individual property owners are best able to manage runoff from their property. Chapters 3, 4, and 5 suggest ways in which Vermillion River watershed residents can individually reduce runoff, promote water infiltration, reduce erosion, and protect the Vermillion River.

To promote individual action on a larger scale, educate friends and neighbors about River-friendly practices. Work with local governments or your Soil and Water Conservation District to retrofit innovative stormwater management practices and amend ordinances to allow for conservation developments in your community. Bring up the subject at neighborhood association meetings, theme a summer block party around making the neighborhood River friendly, or find out if a neighborhood newspaper would be willing to include a seasonal flyer about River-friendly practices four times a year. Just as people have played (and continue to play) a pivotal role in harming the Vermillion River, so too must we take responsibility for securing its future health.

In Summary...

The Vermillion River watershed is where we live. Let's make sure that our actions are geared toward preserving and improving our natural home and its river. Strategies for managing the Vermillion River watershed should:

- manage stream channels and upland areas as an integrated whole
- include management strategies that serve multiple needs (of plants, animals, people, agriculture, and industry)
- consider the sustainability of management strategies (so that management can be sustained with a minimum of expense, effort, and environmental harm)
- recommend cost-effective techniques that can be easily implemented
- encourage everyone within the watershed to make their property "Vermillion River friendly"

Thanks for doing your part to make certain the Vermillion River is healthy and full of life!

Glossary

Aquatic – growing, living in, frequenting, or pertaining to water.

Base flow – portion of a stream's flow derived from natural storage or ground water, and not from surface runoff.

Bendway weir – a rock structure placed in a stream perpendicular to an eroded streambank to divert the flow of water away from the bank.

Berm – an earthen mound, commonly planted with vegetation, used to divert or hold back water.

Biodiversity – the variety of life and life processes; different plants and animals, their differing ecosystems, and the evolutionary processes that keep them functioning.

Bioengineering – the practice of using living plant material to control erosion.

Boulder vane – a rock structure placed in a stream angled upstream to an eroded streambank to divert the flow of water away from the bank.

Buffer – thickly vegetated strip maintained along the edge of a stream or lake to mitigate the impacts of actions on adjacent lands. Buffers filter pollutants in water and provide wildlife habitat.

Channel – a waterway that periodically or continuously contains moving water, has a definite bed, or has banks that confine water at low to moderate levels.

Coir fiber rolls – a tube-shaped roll made from natural coconut husk fiber that is used for erosion control.

Compost – a nutrient-rich fertilizer made from decomposed organic material such as leaves, grass clippings, and fruit and vegetable waste.

Compost bin – a container designed to hold and aerate organic materials while they decompose into compost.

Conservation easement – a legal agreement through which a landowner retains title to a given property while voluntarily restricting certain uses of the property to protect and conserve natural areas.

Conservation tillage – the practice of minimizing the disturbance of the soil and leaving crop residue on the fields to enhance soil health.

Contour farming – the practice of farming on the contour of the land to slow water flowing down the slope.

Contour stripcropping – contour farming with areas of permanent vegetation between areas of tilled cropland.

Cover crops – temporary crops planted to prevent erosion.

Deciduous – pertaining to trees that annually lose their leaves.

Ditching – the practice of straightening existing streams or creating new channels to more quickly convey water.

Diversions – structures designed to direct the flow of water in a manner that reduces erosion.

Drainage field – the part of a septic system that consists of a distribution box, perforated distribution lines and a soil area that can infiltrate wastewater.

Drywell – a structure placed below ground that allows water to rapidly seep into the ground.

Ecosystem – a complex of living organisms (plants, animals, etc.) interacting with their non-living environment as a complete, self-sufficient unit.

Erosion – the process by which (through water, ice, wind, or other factors) streambanks and adjacent land slopes weather or wear away.

Evapotranspiration – loss of water from land to the atmosphere through evaporation from the soil and transpiration from plants.

Evergreens – trees and shrubs that retain their leaves all year.

Fascine – a bundle of willow or other brush cuttings used to help prevent soil erosion.

Fecal coliform – a bacteria found in the digestive track of mammals.

Feedlot – an area where livestock are fed or watered.

Feedlot management – the practice of managing a feedlot to prevent water quality problems.

Filtering – the process of removing pollutants from water that flows through vegetation.

Floodplain – land adjacent to a water course that is flooded or covered with water following a heavy storm event or a spring snowmelt.

Flow deflectors – devices used in streams to redirect the flow of water to protect an eroding bank.

Grade control structures – structures that drop water safely from one level to another to prevent it from causing erosion.

Grass waterways – vegetated channels in farm fields that convey excess water and minimize erosion.

Greenway corridor – a linear, vegetated natural area that connects other large natural areas.

Ground water – water that lies beneath the earth's surface and originates from springs deep within the earth and rain or snowmelt seeping down into the earth.

Ground water recharge – the process by which surface water is transferred into the ground.

Habitat – a place within an ecosystem occupied by an organism, population, or community that contains living and nonliving elements with specific characteristics including basic life requirements of food, water, and shelter.

Hydrology – study of the cycling of water between precipitation and return to the sea. Also the study of surface and ground water.

Impervious surfaces – surfaces through which water cannot filter.

Infiltration – the seepage of water into the ground.

Integrated pest management – an ecologically sensitive system of controlling unwanted weeds, insects, and other pests that aims to keep crops economically viable while protecting natural resources.

Invasive plants – plants not historically found in a certain location that can crowd out native species.

Land retirement – a program by which farmers are compensated for taking marginal cropland out of production.

Land trust – an organization that uses various legal tools to help individuals and communities satisfy land protection goals.

Low-impact development – an innovative approach to the design of developments that attempts to recreate natural, pre-development water flows in post-development scenarios.

Mastitis – in cows, a bacterial infection that causes sore teats and renders the cow's milk unsuitable for human consumption.

Meander – a curved portion of a winding stream channel, consisting of two loops, one turning clockwise and the other counter-clockwise.

Morphology – physical attributes of a water body (curves, pools, etc.) and the methods for measuring those attributes.

Native plants – plants that are suited to and have historically grown in a particular area.

Naturalization – using natural materials to stabilize eroding streambanks and shorelines.

Natural landscaping – planting and establishing trees, plants, and shrubs that are native to an area in a manner that maximizes benefits to water resources as well as aquatic and land-based wildlife.

Nitrate – the oxidized and soluble form of organic nitrogen. High nitrate levels can be toxic to both aquatic life and humans.

Nitrogen – a naturally occurring nutrient used by plants. Excess nitrogen causes algae blooms.

Nonpoint source pollution – pollutants that enter water bodies in a diffuse pattern— through land runoff, precipitation, atmospheric deposition, or percolation—rather than from a specific, single source.

Nutrient management – a tool to increase the efficiency of the nutrient sources crops use while reducing environmental risk and, ultimately, increasing profit.

Pesticide management – a tool to increase the efficiency of pesticides used to increase production while reducing environmental risk.

pH level – level of acidity.

Phosphates – a form of phosphorus found in some household cleaning products.

Phosphorus – a naturally occurring nutrient that, in large amounts, can upset the ecological balance of a lake or river.

Plume – the deposit of a large mass of soil in a water body.

Point source pollution – pollutants flowing into a water body from a well-defined source such as a pipe or ditch.

Pool – a small depression with standing water as found in a marsh or on a floodplain. Also, an area in a stream between meanders that is normally deeper and wider than the areas above and below it.

Potassium – an element essential for plant growth that is recycled by aquatic vegetation.

Prairie – an area dominated by grasses and wildflowers that relies on fire to inhibit tree growth and restore nutrients into the soil.

Rain barrel – a cylindrical device used to collect water that drains off rooftops.

Rainwater garden – a shallow depression planted with attractive vegetation that holds water and allows it to seep into the ground.

Registry program – a program whereby landowners with high quality natural areas voluntarily place their names on a list that recognizes the natural significance of their property.

Restoration cost-share – a program to help repair the composition, structure, and function of a natural system.

Revetments – a facing or structure made of hard material like boulders or logs along a streambank or shoreline.

Riffles - aquatic habitat in a stream that is normally shallower than aquatic habitats immediately above and below it.

Riparian area – the area of land around the edge of a river or other water body.

Rip-rap – hard materials, like rock or boulders used to protect a bank or another feature of a stream, lake, reservoir, or other water body.

Root wads – root mass from a tree intentionally placed along a streambank to protect it from erosion and provide cover for fish.

Rotational grazing – the practice of regularly shifting where livestock graze to minimize disturbance to the area.

Runoff – natural surface drainage of water away from an area that results in discharge to a stream or other waterbody.

Scour – localized erosion of streambed substrate caused by quickly flowing water.

Sediment – fragmented material from weathered rocks and organic material that is suspended in, transported by, and eventually deposited by water or air.

Sediment control basins – holding areas that slow the flow of water, collect sediment, and release water in a controlled manner.

Sink holes – areas where surface soils collapse into subsurface voids.

Soil type – a description of the soil based on the percentages of sand, silt, clay, and organic content.

Stream bank stabilization – the process of increasing a streambank's resistance to erosion by using protective vegetation, woody material, or rock.

Substrate – mineral and organic material forming the bottom of a waterway or water body; the base upon which organisms grow.

Swale – an open drainage channel designed to convey and/or absorb water from a storm event.

Terraces – relatively level or gently inclined land surfaces that are elevated above an active stream channel in a step-like arrangement of a slope or lake bed.

Tiling – placing pipes or drainage tiles below the ground to drain water from the land.

Tilling – the practice of turning over the soil to incorporate nutrients, reduce compaction, and inhibit weed growth.

Transpiration – the loss of moisture by evaporation from the surface of a plant.

Tributaries –streams that flow into larger streams or channels.

Vegetative filter – ***See Buffer***

Waste management – the practice of generating less waste and disposing of the waste in an environmentally sensitive manner.

Wetlands – land areas that are wet at least for part of the year, are poorly drained , and are characterized by plants that grow well in water or saturated soils.

Watershed – an area of land from which all water drains to a common location. Watersheds are generally named for the river or lake to which the land drains, such as the Vermillion River watershed.

Watershed Management Organization – an organization mandated by state law to manage water resources within its jurisdiction.

Index

T

U

V

W

Y