Citizen's guide to watershed conservation in western Montana

Neysa King

The University of Montana

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A Citizen's Guide to Watershed Conservation
in Western Montana

by

Neysa King

B.A. The University of California, Santa Barbara 1995

presented in partial fulfillment of the requirements

for the degree of

Master of Science

The University of Montana

1999

Approved by:

Dr. Watson, chairperson

Dean, Graduate School

12-29-99

Date
Abstract

Since the passage of the Clean Water Act in 1972, federal efforts to restore the integrity of our nation's waters have been joined by private landowners, local citizens and conservation groups. There is a growing understanding of the critical role that citizens in a watershed play in protecting that ecosystem. By understanding the processes and parts that create healthy watersheds and the critical services they provide, communities are more likely to take meaningful action to protect the economic and ecological benefits of healthy watersheds. In many cases, local communities across Montana are restoring and protecting watershed ecosystems by actively participating in land and water conservation in their area. This guide is intended to help community groups rise to this challenge.

Today, there are over 1500 watershed groups (also called watershed councils and watershed initiatives) practicing watershed conservation in the United States. Watershed conservation is a natural resource planning strategy that prioritizes the health and condition of natural watershed ecosystems, while managing human impacts on these systems. This type of strategy is based on an ecological understanding of watershed characteristics and connections. The basic principles of watershed conservation ecology are presented along with the relevant legal tools to support watershed conservation efforts. In watershed planning, watershed groups should assess the condition of a watershed, select conservation goals and objectives, and design an implementation strategy to achieve these goals. Two case studies are presented to illustrate how watershed groups have undertaken this challenge in western Montana. There are a series of attachments that include: a template for a watershed conservation plan; a description of the primary environmental agencies and organizations participating in watershed conservation; additional watershed references; and a glossary of common watershed terms.

Watershed conservation will continue to be a blending of science and art that will evolve and grow into the 21st Century. As our understanding of watershed ecology increases, and our experience with citizen-based watershed conservation efforts ripens and matures, the long-term benefits of these activities will revitalize natural communities in decline today.
Acknowledgements

I would like to thank a number of people for the time and energy they generously gave to assist in the completion of this guide. I’d like to thank my committee: Drs. Vicki Watson, James Burchfield and Len Broberg. Many of the ideas on watershed conservation used in this guide evolved from classes and discussions with Dr. Watson. Drs. Burchfield and Broberg provided many useful suggestions and comments on the paper.

Thanks to the Mineral County Conservation District, the Cabinet Resource Group, and the Rock Creek Watershed Council for all of your enthusiasm and trust. Thank you, Laurel Graham, for your help and support in entering the world of watershed conservation. Thanks Anna, for your many words of encouragement. Thanks to my family, for all of your love and support in my many endeavors. And thank you, Mike, for everything. This would not have seen the light of day were it not for all you’ve given. Mom, this one’s for you!
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**Acronyms Used in This Guide:**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>BMP</td>
<td>Best Management Practice</td>
</tr>
<tr>
<td>BLM</td>
<td>Bureau of Land Management</td>
</tr>
<tr>
<td>CD</td>
<td>Conservation District; Soil and Water Conservation District</td>
</tr>
<tr>
<td>COE</td>
<td>The Army Corps of Engineers</td>
</tr>
<tr>
<td>CWA</td>
<td>The Clean Water Act</td>
</tr>
<tr>
<td>DEQ</td>
<td>Montana Department of Environmental Quality</td>
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<tr>
<td>DNRC</td>
<td>Montana Department of Natural Resource Conservation</td>
</tr>
<tr>
<td>ECWC</td>
<td>Elk Creek Watershed Council</td>
</tr>
<tr>
<td>EPA</td>
<td>The United States Environmental Protection Agency</td>
</tr>
<tr>
<td>ESA</td>
<td>The Endangered Species Act</td>
</tr>
<tr>
<td>FOIA</td>
<td>Freedom of Information Act</td>
</tr>
<tr>
<td>FWP</td>
<td>Montana Department of Fish, Wildlife &amp; Parks</td>
</tr>
<tr>
<td>GMCD</td>
<td>Green Mountain Conservation District</td>
</tr>
<tr>
<td>HUC</td>
<td>Hydrologic Unit Code (a watershed reference number designated by the USGS)</td>
</tr>
<tr>
<td>LWD</td>
<td>large woody debris</td>
</tr>
<tr>
<td>MT</td>
<td>Montana</td>
</tr>
<tr>
<td>NEPA</td>
<td>The National Environmental Policy Act</td>
</tr>
<tr>
<td>NRCS</td>
<td>Natural Resources Conservation Service (formerly Soil Conservation Service)</td>
</tr>
<tr>
<td>SCS</td>
<td>Soil Conservation Service (currently the NRCS)</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load (a type of water quality management plan)</td>
</tr>
<tr>
<td>US</td>
<td>The United States</td>
</tr>
<tr>
<td>USDA</td>
<td>The United States Department of Agriculture</td>
</tr>
<tr>
<td>USEPA</td>
<td>The United States Environmental Protection Agency</td>
</tr>
<tr>
<td>USFS</td>
<td>The United States Forest Service</td>
</tr>
<tr>
<td>USFWS</td>
<td>The United States Fish &amp; Wildlife Service</td>
</tr>
<tr>
<td>USGS</td>
<td>The United States Geological Society</td>
</tr>
<tr>
<td>WC</td>
<td>Watershed council</td>
</tr>
</tbody>
</table>

**303(d) List** The list of impaired waterbodies (those not meeting their designated uses) that is compiled and maintained by the DEQ

**305(b) Report** The updated 303(d) list the DEQ submits to the EPA every two years
Forward

During May, 1999, I moved from Missoula to a house just south of Moise on the Flathead Reservation. I was taken by the charm and solitude of the surroundings, the house being perched on the 100-year floodplain of the Flathead River, a mere 40 feet from the water surface. I envisioned the move as a retreat of sorts, a place where I could focus and complete my task of writing a guide to watershed conservation. My head was swarming with ideas regarding the most efficient way to make information on watershed and stream conservation available to individuals who could apply this knowledge to restore and manage their own land. I quickly realized that my path was going to make itself most obvious to me for within the first week of living at the new house, I was struck ill with stomach problems. It seemed that our well water was contaminated with all sorts of bacteria, and that our proximity to the river was a likely source of contamination. I knew the issues surrounding the placement of human dwellings near water bodies and within flood plains, but I fell under the spell when given the opportunity to live next to the beauty and splendor of the river. I too am therefore guilty of wanting to surround myself with the enchanting elements found in nature; however, I received a message that must be heard if we are to protect our watersheds for future generations. It is really quite simple: we must not forget the consequences of our actions and the additive effect of many of us living in any single watershed. We all depend on clean water, humans and non-human beings alike, and it is time to work together. We cannot wait for the government to act for us in this process, nor should we expect that they could help to restore our own backyards that each of us knows so well.

During the last two years I have been working in Sanders and Mineral Counties with various landowners to improve troubled streams throughout the area. Numerous times I have grappled with explaining the web of environmental agencies and organizations that are responsible and involved with land management and stream health. I have worked with ranchers to understand the implications of the listing of the Bull Trout on private lands. I wrote a watershed conservation plan for Tamarack Creek, a tributary to the Clark Fork River in Mineral County. More recently I assisted in starting-up the Rock Creek Watershed Council in Noxon, Montana. Through all of these experiences it became evident that what was missing from the picture was a guide to forming watershed groups and creating watershed plans for people interested in watershed conservation. For many of you, these actions are based in common sense and years of knowing how streams function and change as you’ve lived near them for as long as your memory reaches back. I hope this guide provides clarity in understanding the regulatory framework surrounding water in Montana, and a useful template for creating a watershed plan with your neighbors in the drainage. For the rest of you new to watershed issues, I hope this gives you the steps you can follow in arming yourself to be a powerful and competent watershed resident. In Montana, if we act quickly we still have a chance to protect our natural systems and the headwaters to the western and central United States. As David Brower realized in the flowering of his life at age 90:

“By setting a goal now, we have a chance to restore what we can of what was needlessly and thoughtlessly lost.” —D. Brower
1.0 An Introduction to Watershed Conservation

"The health of our rivers is the best measure of how we live on the land." - L. Leopold

Water plays a leading role in shaping human societies and the natural communities and landscapes that surround them. Water defines where human settlements can be sustained, if agriculture and other natural resource activities can be conducted, and the types of habitat and wildlife a landscape will support. There is a new approach to protecting water that is gaining popularity with community groups and water protection agencies across the nation. Watershed conservation is based on the growing understanding of how land use affects the health of lakes, streams and other aquatic ecosystems. Communities are participating in watershed conservation to answer questions like: how do we improve the water quality in our streams and lakes? Why have the fish gone away? How do we bring them back? How do we stop the streambanks from falling into the stream during high flows? How do we cleanup our drinking water? Why are we seeing more floods? All of these questions stem from symptoms of unhealthy or unbalanced watersheds.

During the past 200 years, most of our nation’s streams, rivers and lakes have been greatly altered in ways that are difficult to correct. Humans have dredged, dammed, diked, straightened, dewatered, polluted, interrupted, and/or constricted waterbodies to accommodate the demands of society. As a result, approximately 85 percent of the nation’s inland waters have been manipulated by human-made dams and other structures (Williams et al. 1997). Additionally, 40 percent of the lakes, rivers, and estuaries that have been surveyed by the US Environmental Protection Agency are not clean enough to be safe for human swimming and fishing activities (Firth 1999).

In the past, efforts to protect lakes and streams have been hampered by a limited understanding of ecology, the structure of environmental laws and the bureaucracy that surrounds resource management and conservation. Resource managers and environmental laws often
separated land and water resources, water quality and quantity, and divided the landscape into political units rather than ecological units. Because of this framework, agencies and landowners have made some big mistakes in caring for the systems that sustain us. Through these mistakes, some very important lessons have been learned. These lessons have become a part of conserving natural resources and ecosystems on private and public lands today. Some of these lessons include: the need to involve professional scientists in understanding and conserving ecosystems and watersheds; the need for a growing federal role to protect land and water as ecosystems and pollution do not stop at political boundaries; and that a lack of coordination between land and water resources can result in ineffective restoration and management programs (Doppelt et al. 1993, Kennedy 1999). These lessons led to the passage of national laws like the Clean Water Act (CWA). The CWA supports partnerships between federal and state agencies to set minimum national water quality standards, while providing financial assistance to local watershed groups to restore water resources around the country.

Since the passage of the Clean Water Act in 1972, federal efforts to restore national water resources have been joined by private landowners, local citizens and conservation groups. There is a growing understanding of the critical role citizens play in protecting water and watershed ecosystems. In many cases, local communities are improving watershed ecosystems by actively participating in resource conservation in their area. During the last 20 years, private landowners and local community groups have called for a larger role in planning and implementing restoration and protection of their own watersheds. The watershed conservation movement is finding strength in joining community concerns and local knowledge with the ecological training and larger picture provided by scientists of natural resources and environmental agencies. This movement realizes that healthy watersheds support self-sustaining, resilient natural biological communities; water purification and cycling; and the maintenance of long-term soil productivity (Williams et al. 1997).
Today there are over 1500 watershed groups (also called watershed councils and watershed initiatives) across the United States (Lant 1999). Up to 400 of these groups exist within in the Pacific Northwest, and most have originated since 1990 (Kenney 1999). The newness of these organizations is both a blessing and a weakness for individuals looking to join in these efforts. There is not a recipe, nor a series of “tried and true” guidelines for, watershed councils and watershed conservation in today’s political, social and economic environment. For this reason, there is a broad spectrum of potential approaches and ample freedom in designing solutions to many conflicting issues in natural resource management.

Watershed conservation is based on a broadly accepted body of scientific understanding and information about land and water ecosystem characteristics and connections. This guide is intended to help community groups rise to the challenge of conserving their watersheds. Through understanding the basic principles of watershed conservation ecology, watershed groups can better restore and protect the health of land and water ecosystems. Watershed conservation will continue to be a blending of science and art that will evolve and grow into the 21st Century. As our understanding of watershed ecology increases, and our experience with citizen-based watershed conservation efforts ripens and matures, the long-term benefits of these activities will revitalize natural communities in decline today. It is my hope that this guide will lead to greater respect and understanding between the different parties working to conserve watersheds, and serve as a tool to strengthen local communities and natural resource education and conservation efforts. It is high time for environmental agencies and local citizens to move forward to find solutions and share the responsibility, effort and costs of restoring the degraded watersheds of Montana.
1.1.1 The Purpose of This Citizen’s Guide

The purpose of this guide is to empower citizens to be well-informed participants in watershed planning and restoration activities in western Montana. The information provided touches on a variety of water issues ranging from aquatic ecology and stream dynamics, to water law and policy in the US and Montana. It is intended to guide citizens through the steps to restore degraded watersheds and to conserve healthy watersheds, advocating the application of scientifically based conservation principles at a watershed scale. I have included a basic introduction to watershed science, law and policy; a guide to forming and sustaining a watershed group; a model for a watershed conservation plan. In Section 3, there are two case study examples of watershed conservation efforts in Montana. There is an additional resource list for watershed information, and a glossary of common watershed terms in the appendices. The intended audience includes all participants in land and water planning and conservation activities, including landowners, elected representatives, civil servants, and any Montana citizen who enjoys clean water and healthy streams. This guide will help the reader:

1. become familiar with the basic principles of watershed science;
2. identify and utilize the educational, technical and financial assistance available through water and natural resource management agencies and their individual incentive programs;
3. understand the current state-led efforts to restore water quality, and to decrease point and nonpoint source pollution of surface waters. This approach, known as Total Maximum Daily Load (TMDL) assessment, has been successfully undertaken by local watershed groups working with state environmental agencies to improve the condition of waterbodies throughout the region; and
4. form a watershed group and create a watershed conservation plan that, if implemented, will contribute to restoring and maintaining the health of a watershed.
1.1.2 Information and Citation Format

Some of the terms included in this document may be unfamiliar or ambiguous in meaning. There is a glossary included as an appendix to clarify how I am using these terms. Many ideas presented in the document are not originally mine. For materials that have been published, I have noted the original author and date of publication in parenthesis at the end of the section or sentence containing the reference. The complete citation for each reference appears alphabetically by the author's last name in the Reference Section. For ideas that have not been published, I will try to identify those sources in the text and will also acknowledge them in the acknowledgements. I have provided many internet websites to access on-line information provided by environmental organizations and agencies. This information can assist with watershed conservation efforts; however, you do not need to use these sites to use this guide.

1.2 Building Partnerships in Watershed Conservation Planning

Today's challenge in sustaining our ecosystems lies in using scientifically based land and water conservation to reduce natural resource and watershed degradation. Over the past three decades, watershed studies of landscapes, aquatic ecosystems and hydrology have progressed rapidly in their sophistication and scope. Volumes of publications exist for academics and agency personnel interested in watershed science and management; however, landowners and land managers are often unaware of this literature, or unable to spend the time deciphering the meaning and implications of the studies and conclusions presented. Watershed conservation groups partner local citizens with technical experts to create a working group to address watershed and land management issues.

In Montana, historical land uses such as mining, large-scale timber harvests, livestock grazing, hydroelectric dams, irrigation and road construction have negatively impacted
waterbodies across the state. Subdivision and city sprawl are joining this list, placing additional pressures on water resources. No matter where you reside, every person lives within a watershed. All of our actions - whether spraying pesticide and applying fertilizer to a field or lawn, collecting firewood or harvesting a stand of trees, fishing, boating, driving, drinking or enjoying the benefits of indoor plumbing - impact the watershed in which we reside. Water connects land to water, upstream to downstream, groundwater to surface water, and one neighbor to another. As a resident and/or landowner within a watershed, each individual is responsible for being an informed watershed citizen who responsibly manages his/her parcel, and participates in conserving the larger system as part of partnerships and watershed groups. Citizen-based cooperative groups should work to coordinate activities that occur within individual watersheds to avoid unpredicted and often synergistic effects that can result from the many activities within a basin. This type of conservation strategy should improve many of the degraded watersheds and tributaries along portions of the Clark Fork, Blackfoot, Bitterroot, and Flathead Rivers.

Across Montana, citizens and state agencies have increasingly taken a watershed approach to water quality improvement and ecosystem management. This approach has emerged as a viable framework for implementing a grassroots approach to natural resource planning. These locally based efforts illustrate a shift of power away from federal and state governmental resource managers to greater local responsibility and control (Griffin 1999). A locally based planning and management team is often comprised of watershed residents, landowners, environmental agency resource managers, environmental and wildlife interest groups, commercial resource extraction interests, and just about every other party interested in resource management. These groups are able to utilize first-hand knowledge and experience of watershed residents and users, and the scientific and technical expertise of resource managers and agency personnel. Financial support for planning, project implementation and long-term monitoring is available through federal and state environmental agencies. Often local schools and institutions...
voluntarily help with the development and implementation of conservation plans. Watershed conservation plans should be tailored to the local ecosystem yet consider conservation goals of the larger basin each watershed lies within. If watershed councils meet these challenges, they may provide an effective vehicle for improving the health of water resources throughout the region.

An additional benefit of locally based watershed conservation efforts is that these groups are not confined to traditional jurisdiction-based management alternatives common in US Forest Service and other management agencies. Watershed councils may adopt a broader view of the conflicts and potential solutions to resource problems than the traditional agency-by-agency or resource-by-resource approach illustrated throughout the history of resource management (Griffin 1999). Agencies are bound by policies often set through legislation and a formal decision making process; watershed groups have no such understanding or contract. By taking a watershed-scale, locally based approach to address management decisions, the land and water interactions that impact local ecosystems can be assessed and protected, and the restoration of native fisheries, water quality, and riparian ecosystems may be achieved.

One of the strengths in taking a watershed approach to resource conservation is that it adopts an ecosystem-based, rather than a property or jurisdictional approach, to land management. Most river systems, and many large lakes, are either international or interstate waterbodies, and the smaller watershed basins generally cross county lines, and private and public land boundaries (Kenney 1999). A watershed group can coordinate conservation efforts, or instigate efforts where there are none, across political boundaries to manage human impacts on entire watershed areas. These groups are able to address all of the parts of a watershed ecosystem, not just the parts under an agency’s jurisdiction unit.

Water has been called “nature’s premier solvent (Kenney 1999).” Water moves toxic chemicals as well as nutrients that are essential to life, and is therefore capable of poisoning or
over fertilizing land and water systems. When viewing water resources from a watershed scale, water becomes much more than a solvent. Water shapes land and water ecosystems and creates the variety of habitats on which all forms of life depend. In this way, water blends and links activities that have traditionally been planned and implemented in isolation, making a holistic approach to managing water and land resources essential to sustaining the long-term health of natural ecosystems. Current efforts to manage natural resources sustainably, and to protect watersheds across the Pacific Northwest, recognize the connection between land and water resources, and involve the local citizens in planning and conservation activities.

1.2.1 Ways Humans Impact Watersheds

There are many ways of defining watershed health. The following definitions are useful in watershed conservation as they are meaningful to most people, and are used by environmental agencies in their conservation efforts. A healthy watershed is one that is capable of supporting the "beneficial uses" a state has outlined for a particular waterbody. These uses include the ability to support wildlife populations and human activities. An ecology-based definition for watershed health is based on a comparison of a degraded stream with a "reference" stream in an area where human activities have minimally impacted the aquatic ecosystem. Streams of similar size, flowing through similar elevations and geologic landforms, and in similar climates should support similar plant and animal communities. Reference systems provide living examples of the conditions restoration activities should strive for. Keep these definitions in mind when considering the human impacts on a watershed.

Many human activities can harm lakes, streams and other waterbodies. Examples of negative impacts can be found when humans alter the physical structure of a lake or stream, or change the biological community or chemical properties of water quality. Humans channelize rivers and disrupt the connection between natural wetlands and streamside communities, human-made dams
change a flowing river habitat into lake/reservoir habitat. Building in floodplains and attempting to prevent floods depletes groundwater systems and fertile soil deposited on floodplains during flood events. Such changes greatly alter the potential habitat a watershed supports.

Habitat loss is the primary culprit behind the decline of many populations of fish and other aquatic life (Williams, J.E. et al. 1997). Beyond physical alterations, humans also impact biological elements of a watershed by introducing non-native species, over-harvesting native fish and other wildlife communities, and creating conditions that are inhospitable to native species and easy for non-native competitors to invade. In general, the risk of extinction for aquatic animals is much greater than for terrestrial species in the US (Williams, J.E. et al. 1997). Table 1.2.1 describes some of the impacts human activities have on a watershed. We are only beginning to understand the importance of groundwater and surface water exchange in maintaining water quality, and many of these systems have been disrupted by past development and management activities. Through understanding the impacts of our actions, we can reduce human-caused degradation to watersheds.

Water pollution can result from many human activities and can directly and indirectly degrade the quality of water resources. Point source pollution comes from human activities that discharge wastewater into lakes, streams, or ground water and causes 10 percent of the waterbodies in Montana to fall below state water quality standards (Higgins 1996). Often this type of pollution is discharged through a pipe or culvert, and contains chemical contaminants that can cause problems that range from rendering a waterbody toxic to humans and aquatic life, to increasing the nutrient levels in surface water causing nuisance algae problems. Common sources of point source pollution include industrial and municipal wastewater discharge, leaking underground storage tanks, and the run-off or seepage from feed lot operations.

Nonpoint source pollution is caused by human activities over a large land area and is the cause of degradation for 90 percent of the impaired or degraded waterbodies in Montana (Higging
### Table 1.2.1 Ways Human Activities Can Impact a Watershed

<table>
<thead>
<tr>
<th>Human activity</th>
<th>Impacts on the stream/aquatic ecosystem</th>
<th>Impacts on the riparian community</th>
<th>Impacts on the uplands/forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing livestock</td>
<td>can breakdown banks, widen the stream, increase sediment in surface waters; excessive sediment can</td>
<td>removal or degradation of riparian vegetation*; increased water temperatures; increased bank instability; introduction of weeds</td>
<td>weeds decrease range productivity; increased soil compaction</td>
</tr>
<tr>
<td></td>
<td>suffocate fish and eggs; manure increases nutrients in water, increasing algae levels and lowering nighttime dissolved oxygen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farming/cropland</td>
<td>irrigation decreases surface water flows increasing water temperature; contamination from pesticides/herbicides; increased nutrients in water from fertilizer; increased water temperature from removal of over-hanging vegetation</td>
<td>removal of riparian community*; decreased streambank stability; potential for over spraying/application of pesticides and fertilizers that may damage riparian plants</td>
<td>removal of forest cover; decreased water availability during summer; less groundwater recharge from precipitation</td>
</tr>
<tr>
<td>Clear-cuts/ large-scale timber harvesting</td>
<td>increased surface water run-off; increased high flows during spring melt; decreased base flow during dry months; decreased large woody material in stream system; increased sediment delivery to stream</td>
<td>removal/damage to riparian vegetation during harvest operations*; increased road crossings and culverts; increased wind throw</td>
<td>decreased forest cover; decreased tree species diversity; changes in watershed hydrology; increased soil compaction; introduction of weeds; wildlife habitat fragmentation; increased soil erosion</td>
</tr>
<tr>
<td>Road construction</td>
<td>increases runoff and delivery of petrochemicals and other pollutants from road surface, increases dust and soil erosion</td>
<td>loss of riparian community; decreased streambank stability</td>
<td>increased soil compaction and erosion; interruption of subsurface water movement; introduction of weeds; wildlife habitat fragmentation</td>
</tr>
<tr>
<td>Mining</td>
<td>disruption of surface and groundwater hydrology; metal contamination of stream sediment and aquatic life; acid run-off and toxic deposits</td>
<td>damage/removal of the riparian community*</td>
<td>forest removal; increased road construction; geologic and hydrologic alterations; soil toxicity; reduced vegetation; increased soil erosion</td>
</tr>
<tr>
<td>Residential development</td>
<td>stormwater diversion and increased flooding; septic systems can increase nutrient loading and fecal coliform contamination of ground and surface waters; alteration of floodplains; river constriction can increase flooding; streambank armoring prevents aquifer recharge through surface and groundwater exchange</td>
<td>removal of riparian community*; decreased streambank stability; armoring of streambanks</td>
<td>removal of forest cover; increased road construction and soil compaction; wildlife habitat fragmentation; alteration of hydrology and increased surface water run-off with increased impervious surfaces</td>
</tr>
</tbody>
</table>

*Damaging/removing riparian vegetation may increase bank erosion, widen the stream channel, decrease stream depth, increase invasion of weeds, increase water temperature, speed runoff, reduce trapping of sediment/pollutants, decrease fish and wildlife habitat, decrease macroinvertebrate communities and increase bank damage by livestock.
Nonpoint source pollution is caused by many human activities, including farming and ranching, forest harvesting and associated road construction, urban construction, septic system placement near floodplains and groundwater, mining and other landuses that cause polluted runoff. The types of pollution caused by these activities include increases in sediments, metals, and nutrients (nitrogen and phosphorus from animal and human waste). Many waterbodies are also harmed by the amount of water withdrawn for irrigation, commercial activities, and human drinking water supplies. This type of impact is similar to nonpoint source pollution in that streams and creeks often support many water withdrawals within the watershed area that in combination impact the aquatic community found within the stream. These activities have a cumulative or combined impact on a watershed and render many streams nearly dry during hot summer months when irrigation demands are highest. As a result, the stream community and the plant communities that depend on the stream and groundwater systems for survival can be significantly harmed.

In Montana, most point sources of pollution are associated with industrial activities and municipalities, and are regulated by state and federal environmental agencies. These activities are subject to a permitting system, and wastewater treatment must meet standards specified by regulations associated with the national Clean Water Act. Nonpoint source pollution is both more widespread and less regulated than point source pollution. For this reason, it is generally addressed on a site-by-site basis, if at all. Watershed councils are focusing their efforts on decreasing nonpoint source pollution as it can often be remedied through education and assistance provided to local residents and other watershed stakeholders. For instance, by modifying grazing practices to decrease the amount of time cattle are allowed to graze and linger in streamside areas, damage to the floodplain and streambanks can be avoided. As a result the amount of soil, sediment and cattle waste the stream receives is greatly reduced.
As the population of the United States increases, we are placing ever-increasing pressures on the support systems of nature (i.e. water and nutrient cycles, and air purification by forests and plant communities) while increasing the physical and biological stresses and pollution loading to these systems. As development and urbanization continues, we are also simultaneously decreasing the landscape area that remains in a “natural” state, and thus capable of performing the services we depend upon. There is a growing understanding of the need to rebalance human activities with natural processes of the landscape they occur within.

The benefits of healthy functioning ecosystems are not familiar to most people and cannot be easily replaced. Throughout history, humans have clearcut, farmed and managed ecosystems for food products, economic and societal gains. Our increased understanding and appreciation of the far reaching benefits of healthy ecosystems causes many to question the wisdom of ever expanding demands on these support systems. In terms of magnitude of impact, humans have become a force comparable to land formation processes, wildfire, evolution and climate. We have created a technology that enables us to build human communities larger than any previously reached in history, yet we cannot replace lost ecosystems and species. By carefully managing natural resources and minimizing our impacts on watersheds, we can better protect natural ecosystems for the benefit of future wildlife populations and human communities.

1.2.2 Goals and Principles of Watershed Conservation Planning

A growing trend in land conservation efforts focuses on balancing lands devoted to human activities with those needed to provide support services to human activities and the ecosystem. This new land management approach, termed “ecosystem management,” has emerged during the last 15 years (Montgomery et al. 1995). Ecosystem management seeks to achieve a more sustainable relationship between human needs and environmental constraints. This approach integrates scientific knowledge and understanding of ecological principles and
processes, community values, economics and politics towards the goal of protecting long term ecosystem integrity (Grumbine 1994). In other words, ecosystem management is the result of applying ecological knowledge to resource use and land management. Watershed conservation is an approach to land management based on the application of these principles at a watershed scale, with the primary goal of sustaining watershed integrity. Watershed conservation planning has evolved as a successful land management approach as the management area is defined physically by topography and the stream system.

Historically, conservation planning has been the process wherein human actions are evaluated, scheduled and managed such that human needs are met while the degradation of ecosystems and their support systems is minimized. The core of conservation planning lies in ecosystem management where long term, or intergenerational sustainability, must be a priority rather than an afterthought of planning activities (Christensen et al. 1996). The problem driving conservation planning is that as human demands continue to grow, degradation continues to increase, and ecosystems are pushed beyond their limits.

Since the Industrial Revolution, rivers have been dammed, diverted, channelized, and polluted chemically and biologically. Today the need for conservation planning on private lands, in cooperation with efforts on public lands, can no longer be ignored or avoided. Most floodplains and riparian areas in Montana are on private lands, and the importance of conservation activities on these lands cannot be overstated. In assessing species that have been listed as threatened or endangered on the Endangered Species List, 50 percent have no known occurrences on federal lands and up to 78 percent of the listed species in the US have fewer than half their known occurrences on federal lands (Noss, R.F. et al. 1997). By understanding the parts and processes that comprise a functioning watershed ecosystem, human actions can strive to sustain these systems rather than degrade them. The foundations of ecosystem management and
watershed conservation create a platform upon which citizens can build sustainable approaches to land management and ecosystem protection.

Sustaining ecosystems and their services have become core principles in the discussion to integrate human needs and desires with the long-term health of ecosystems. To understand the variety of services that healthy ecosystems deliver to human societies, the Ecological Society of America has developed a list of goods and services provided by nature that humans depend upon (Christensen et al. 1996). This list is broken down into three categories:

- **Ecosystem goods** include commodities that have economic value to humanity; including food, construction materials, medicinal plants, rangeland, irrigation water, wild genes for domestic plants and animals, tourism and recreation.

- **Ecosystem services** that sustain humanity include moderating floods and low flow cycles, regulating climate, cleansing air and water, maintaining plant and animal communities and populations, pollinating crops and other important plants, generating and maintaining soils, storing and cycling essential nutrients, absorbing and detoxifying pollutants, providing beauty and inspiration.

- **Ecosystem processes** that provide the goods and services humans depend upon include cycling and storage of water and other materials like nutrients, toxins, and sediment; biological productivity; decomposition; and the maintenance of biological diversity. These processes are normal functions occurring within a healthy ecosystem, and without functioning ecosystems, goods and services are lost or degraded.

Historically, land use and resource management plans were based on maximizing the productivity of a prioritized resource rather than prioritizing the processes that sustain watershed ecosystems. The US Forest Service managed huge areas for the type and quantity of timber that could be commercially extracted, sometimes devastating critical parts of a forest ecosystem and...
entire watersheds. Dams provide “cheap” electricity, but they also interrupt flooding cycles, fish migration, and the natural movement of sediment downstream. In watershed conservation the overarching goal is to maintain long-term watershed integrity, and the natural ability of the system to support normal ecosystem processes. Watershed conservation recognizes that altering the water cycle causes many unexpected effects that can degrade the physical, chemical and biological components of a watershed. This degradation can harm land and aquatic species, and human uses. Watershed conservation can help to conserve biodiversity by protecting critical habitat and ecologically sensitive areas from human activities. Some of the common goals and principle of conserving watersheds and biodiversity are presented in Table 1.2.2.

1.2.3 Watershed Conservation, Preservation, and Restoration: A Management Approach

By assessing and planning watershed activities for an entire watershed, the causes of degradation can be reduced or even eliminated while efforts to restore processes can speed watershed recovery. In planning, it is important that the underlying characteristics of watershed ecology, river/stream dynamics, and aquatic and terrestrial ecosystems are understood and create the foundation for goals and actions. To manage human actions and to sustain the long-term health and integrity of both land and water ecosystems, three types of management strategies are needed. These three strategies are:

1. The conservation of areas that can be used sustainably by humans for products and services we depend upon.
2. The preservation of critical parts and processes that sustain the watershed ecosystem, especially those we cannot replace.
3. The restoration of parts and processes whose integrity has been damaged or impaired.
Table 1.2.2 Some of the Goals Common to Conserving Watersheds and Biodiversity

Some of the goals and principles common to watershed and biodiversity conservation (adapted from Grumbine 1994; Noss et al. 1997):

1. **Biodiversity in land and water ecosystems is valuable and worth maintaining.** To achieve this, maintaining or restoring populations of all native species in natural patterns is a critical element in the conservation of individual species and natural ecosystems. Furthermore, maintaining healthy ecosystems is usually more efficient, economical and effective than a species-by-species approach.

2. **Species well distributed across their native range are less susceptible to extinction than species confined to small portions of their range.** Riparian and floodplain communities provide an important zone of connection and overlap between land and water, upstream and downstream habitat, and surface and ground waters for animal and plant species. If a species is confined to an isolated habitat, connection to other suitable habitat areas is critical. For instance, bull trout require cold water, high in oxygen for reproduction and early life stages. Bull trout spend summer months in the Clark Fork River and spawn in small, tributaries during the fall months. If these small systems were closed-off or if their quality was compromised, the remaining bull trout populations would dwindle.

3. **Sustain ecological and evolutionary processes within a natural or historic range of frequency or variation.** In watershed ecosystems, stream dynamics including flooding and seasonal flows, water temperature variations, species blooms and die-backs, and the migration patterns of different species create the habitat living parts require. Many aquatic species depend on seasonal flow and temperature changes to time the steps of their life cycle. Small changes in flow and temperature cycles can throw off these life cycles. Processes on the land that sustain riparian forest communities also impact the quantity and quality of the aquatic ecosystem.

4. **In designing a watershed conservation plan, consider areas of high productivity and high biodiversity that need increased protection from human influences (i.e. riparian areas and wetlands).** Also consider species of special concern (i.e. threatened or endangered species identified by the US Fish and Wildlife Service).

5. **Conservation activities must be adaptive and resilient to a changing environment.** Nature changes over time and from one area to another. No plan can be devised that will anticipate all future conditions and the full spectrum of ecosystem possibilities. Adaptive management based on monitoring of human activities and ecosystem response will result in more sustainable management.

6. **For the purposes of conservation, ecosystem boundaries should be determined by reference to ecology and landscape, not political boundaries.** Watershed boundaries are among the clearest natural boundaries on a landscape.

7. **Encourage sustainable human activities and uses of the environment, while phasing-out degrading activities.** Historically, cattle grazing has been an economic staple in Montana. Current efforts to graze pasture lands and riparian areas more sustainably employ a rotational grazing system that limits the amount of time a herd is allowed to feed and linger in sensitive streamside vegetation. Human needs must be accommodated and incorporated within a conservation plan. However, if they are the cause of degradation, efforts to restore an ecosystem without alleviating the human-caused degradation will be futile.
Watersheds perform many important functions including catching, storing, purifying and distributing water (Williams et al. 1997). Watersheds also support a variety of habitats (forests, grasslands, wetlands, streams and lakes), and sustain human needs and economies. Watersheds can be conserved by limiting natural resource harvesting to avoid damaging the long-term productivity and services of the watershed ecosystem. In river conservation, an increasing number of individuals are calling for the prevention of river degradation, rather than delaying action until waterbodies are damaged and in need of restoration (Doppelt et al. 1993).

Natural resource conservation planning and management is the careful, planned use of natural resources that prioritizes the long-term sustainability of ecosystem goods and services. For example, to harvest wood products sustainably, tree stands can be logged to leave sufficient trees for forest regeneration and habitat needs, to protect against soil erosion, and to minimize surface water run-off. Sustainable ranching often utilizes a system of pasture rotation and fencing to protect wetland and riparian vegetation, and to avoid the impacts of prolonged overgrazing and high-density cattle pressures.

The Natural Resource Conservation Service (NRCS) is the county-based branch of the Department of Agriculture specifically charged with assisting landowners and land managers with designing conservation plans to maintain the long-term health of natural resources and the ecosystems that produce them. In Montana, the NRCS has developed a series of Best Management Practices (BMP’s) outlining methods to minimize the negative impacts of logging, ranching and farming activities. A watershed conservation plan will address the cumulative effects of many human activities within a watershed area, and use BMP’s to restore and maintain the health and function of the watershed ecosystem.

There are portions of every watershed that need to be maintained in largely natural conditions because they are integral to the natural functioning of processes that sustain the watershed ecosystem. These areas include the streamside or riparian community, the headwaters or small
streams and springs that create the “source” of many creeks and rivers, wetlands, and critical wildlife habitat. The preservation of these areas can result in more resilient ecosystems that recover from natural disturbance and natural catastrophe faster than if the system is pushed to the limit by human resource use and development. Large rivers undergo natural cycles of flooding and drought. If a system has been altered by human construction in the floodplain, high floodwaters can cause increased erosion and the addition of excessive soil and building materials into the river when floodwaters are constricted and stream velocity increases. As a result, residents may attempt to deal with this by further reinforcing streambanks with rock and cement to increase bank stability along their property. In later years, the neighboring properties will receive even higher floodwaters with increased velocity as the flows were merely deflected downstream. Rivers and floodplains evolve to accommodate high flow events. If humans build outside floodplain and flood prone areas, critical elements of a watershed will be protected, as will human property.

Restoration of degraded portions of a watershed will likely improve the recovery rate of the entire system. Watershed restoration is the process of re-establishing the natural ecosystem structure and function found within a watershed (Williams, J.E. et al. 1997). This cannot be accomplished through a single activity as watersheds are the product of the land and water ecosystems that comprise them. Most restoration activities attempt to repair some part of the physical structure of a stream system that was lost due to human activity, or attempt to replant riparian vegetation that was removed by logging or grazing. In most ecosystems, human impacts have resulted in the loss of parts and processes that sustain natural communities. Fortunately, stream and river communities are among the most resilient and dynamic of ecosystems and can usually recover from human impacts once these impacts are minimized or removed (Williams, J.S. et al. 1997).
1.3 Watershed Science

Understanding watershed science is essential to the creation of a successful watershed conservation plan that maintains the quality and quantity of water flowing through a watershed. Watershed science addresses interactions between the living and non-living aspects of a basin, including soils, climate, water, geology, vegetation, wildlife and humans. Physical, chemical and biological processes are linked within a watershed; each process affects the other kinds of processes and impacts downstream and downslope elements and communities. By recognizing the link between landuse and stream health, well-planned management activities can avoid unnecessary damage and many unintended impacts on an entire watershed. Every property owner within a watershed is linked to neighboring property owners, uplands and the aquatic ecosystem through connections between land, water and air. Because of such connections, every watershed citizen has a responsibility to understand the principles of watershed science and management decisions that will maintain the health and integrity of the overall system and the services it provides.

A watershed is an area of land from which all of the rainfall and melted snowfall drain into a common waterbody (see Figure 1, reproduced with permission from the Lane Council of Governments). In western Montana, watersheds include steep, forested slopes in the headwater areas with narrow, rocky creeks that flow down to broader grassy valleys below. The headwaters of a stream refer to the smallest tributaries or stream branches where surface water first collects into a channel. Headwater creeks usually begin below natural springs, glaciers, snow banks or lakes. As the stream's physical character changes from the cold, high mountain streams to the lower, broader river systems, so does its biological community. The physical structure and water quality characteristics define the habitat and associated biological community that can inhabit an area. Watersheds are viewed as a series of interconnected ecosystems that interact to maintain a
Figure 1  Diagram of a Watershed

A watershed is an area of land between two ridgelines, wherein all of the rainfall and melted snowfall drain into a common waterbody. Within most watersheds there are many human activities impacting land and water ecosystems. The cumulative or additive impacts of these activities can degrade the parts and processes that maintain the overall health and integrity of a watershed ecosystem.
dynamic equilibrium (Heede 1985). There is no single static state humans can manage for because no two watersheds are alike, and each watershed is constantly changing over time.

The watershed of a large river system is often called a basin. The Clark Fork River Basin, the Columbia River Basin, the Blackfoot River Basin and the Flathead Lake Basin are all examples of large watersheds. Each basin or watershed is unique. These ecosystems are shaped by the physical, biological, political and social forces that exist within any watershed. There are some concepts common to all watersheds.

**Watershed science concepts:**

1. **Connections.** Watersheds are composed of many connections between water, land, air, and life. As a result of these connections, human actions and natural changes have unexpected, indirect effects. Conservation plans must include an understanding of the physical, chemical and biological parts and processes that interact within a watershed. Every action has multiple reactions, and impacts mainly travel downstream or downhill. The interconnected nature of a watershed requires that we consider the cumulative impacts of all land use and resource use activities within a watershed in assessing the pollution loading and human induced stress on a given system. The health of a river basin depends on the health of the many smaller watersheds that make it up. In western Montana, there are many small watersheds that are tributaries to the Clark Fork, Flathead and Bitterroot Rivers, which in turn feed into the Columbia River basin as the waters make their way towards the Pacific Ocean.

2. **Change.** Watersheds change over time. These changes include seasonality, climate cycles, community succession, and human modifications. Watershed processes change watershed parts, which then alter the processes (i.e. the water cycle shapes the watershed, and vice versa). Conservation efforts must distinguish human-caused change from natural dynamics.
and watershed variation. The latter we would do well to learn to live with since opposing
natural change often causes many other problems. These efforts must also consider the
cumulative effect of many small changes within a watershed. Rivers are one of the most
resilient ecosystems, and they can often recover with little human assistance once the source
of degradation is eliminated. The benefits of healthy ecosystems and restoration efforts travel
downstream and downslope, just as the degradation moves through a watershed.

3. **Conditions.** Watersheds are not all alike. There is not just one healthy condition. Steep
headwater streams naturally become flatter, warmer river systems, as the distance from their
headwaters increases. To identify healthy conditions for a particular watershed, it is
compared to a relatively undisturbed watershed that is similar in certain physical features.
These less disturbed watersheds are called reference watersheds. Such “healthy” watersheds
can be used in establishing goals for restoring watershed integrity.

4. **Capacity.** Watersheds have a limited capacity to assimilate stresses, and to supply goods and
services to humanity. Watershed goods include the products humans use, namely fiber, wood,
fish, and water. Watershed services include the maintenance of soil productivity, water
purification, flood control and nutrient cycling. As population numbers increase, our
demands increase, and goods per capita and services often decline as a result. Employing
watershed conservation helps humans to live within the limitations of natural ecosystems.

These concepts provide a background for understanding the complexity of a watershed
system. Due to the multi-layered and interconnected nature of watershed ecosystems, it is
difficult to understand how watersheds function without conceptually breaking them down into
individual components. These components are more familiar to humans as we are able to interact
with only one or a few parts of each ecosystem at a time in our daily activities. For instance, while fishing, a person can experience many elements of the aquatic ecosystem. Trying to simultaneously understand how the stream fits into the geology of the basin, local forest dynamics and impacts of a downstream hydroelectric dam can both overwhelm the sharpest of minds, and take the fun out of fishing. The following parts and processes of a watershed are important to consider when managing human impacts on a watershed ecosystem. Consideration of each component in isolation, and then in combination with the others, will provide a more detailed understanding of the interactions and interdependence of the watershed system as a single, large ecosystem.

Watershed parts and processes include:

1. **Waterbodies or Aquatic Ecosystems.** Each lake and stream is comprised of living and non-living components. This includes the surface and groundwater, plants, fish, aquatic insects, amphibians, bed material or substrate, etc. Some of the living components can migrate away from pollution and degraded habitat areas while others are unable to move to healthier areas. As a result, species that are immobile act as indicators of local habitat quality and can be collected and assessed to monitor trends through time. Often aquatic insects are sampled as indicators of water quality (dissolved oxygen levels, water temperature, and toxic pollutants). These parameters are also critical to native fish communities that are not as easily sampled, as they may move about in search of more suitable habitat during stressful periods. A watershed's water quality is the product of the watershed's climate, geology, soils, geomorphology, vegetation, landuse and various human activities. Water quality is more than just chemicals found in the water; it includes the habitat quality and the health of the community the system can support. Many chemical pollutants have maximum limits recommended by the Environmental Protection Agency to protect human health and aquatic
life. States are currently developing similar criteria to evaluate and protect physical habitat and biological communities.

2. **The Riparian Community.** The riparian community is the streamside vegetation found where the land and water meet. As this area often floods, it is also part of the floodplain. If periodically underwater, and able to support a specific type of plant community, it is also called a wetland. The presence of streamside vegetation and a well-established floodplain result in increased streambank stability and improved fish habitat. Root systems and woody stems decrease the velocity of floodwaters and shear stress on streambanks and floodplain soils during high flow periods. Streamside vegetation also contributes to the water quality and habitat found within the stream. For instance, leaves falling into water provide a source of nutrients, organic material, and macroinvertebrate habitat. Plants and trees that shade streams influence water temperature, provide cover for fish, and contribute to channel shape and pattern. Riparian areas are important for economic and ecological reasons that include maintenance of water quality and the aquatic ecosystem, flood dissipation and water storage, groundwater recharge, wildlife and fisheries habitat, biological diversity, migration corridors, agricultural and ranching activities, timber production, recreation, and human enjoyment. The importance of riparian areas is far out of proportion to the relatively minor area of land they occupy in most watersheds (Williams, J.E. et al. 1997). Increasing efforts are being made to protect these areas from degradation caused by human resource use, structural flood control and mitigation actions, and the presence of livestock. Healthy riparian areas benefit both land and water ecosystems and human communities. In Montana, many of the best riparian areas are on private lands (Ehrhart et al. 1997) and require special consideration in planning efforts.
3. **Upland Ecosystems.** "Upland ecosystem" refers to the forest, prairie, and shrub dominated ecosystems growing away from the stream channel and riparian vegetation. These communities play a critical role in the water cycle by intercepting, storing and utilizing a large amount of precipitation that falls within a watershed. Forest cover and the presence of riparian vegetation decreases the rate at which surface flow reaches a stream channel. Forests increase water infiltration into the soil and plants use water, decreasing the quantity of water available for overland and subsurface water flow. Removing forests and increasing soil compaction reduces water infiltration, increases soil erosion and surface runoff, which delivers sediment to the stream. Furthermore, increasing the amount pavement and development within a watershed can lead to higher stream flows and more frequent flood events as less water infiltrates into the soil (Bosch and Hewlett 1982, Coughlan and Running 1997, Burton 1997). Healthy forests provide diverse habitat for wildlife, air purification and recreational values for humans. For instance, trees that fall into a stream system, or those that are delivered to a creek during landslides and other storm-related events, contribute a valuable component to mountain stream ecosystems. Logs, commonly called large woody debris once they become part of a stream system, increase the number of pools and log jams needed for healthy, thriving fish populations and diverse macroinvertebrate communities.

4. **Stream Dynamics.** Stream banks develop to accommodate the typical pattern of stream flows they experience. If the rate or amount of water delivered to the system as overland flow is increased through forest removal and soil compaction, the balance between the movement of sediment and the erosion of streambanks can be lost. If this balance is destroyed, streams can over-widen, down-cut their channel bottom, and erode along portions of their banks. The process of large-scale sediment erosion and lateral movement naturally occurs during high flow years, however human activities can exacerbate the erosive potential of any stream.
Streams have a tendency to constantly change and move within their floodplain, often flowing through multiple channels, or switching from one mainstem to another over the years. This lateral movement is a natural part of stream behavior. But, if a stream changes dramatically from the historical stream width or depth, there may be a problem.

1.4 Legal Tools for Watershed Conservation

There are many tools available to assist citizens with watershed conservation efforts. These tools range from technical reports to federal laws that protect public involvement in natural resource management. Not every watershed conservation effort requires that all of the tools are used, but knowing where to find them and how to use them can only strengthen the movement to protect water resources. Water use is a point of interest, if not heated debate and contention, for residents of Montana. By understanding the basics of water law and policy, any individual can navigate through the basics of water protection and use, or at least know whom to ask and where to find help.

Federal, state and local governments and agencies regulate water resources. This multi-jurisdictional layering of regulatory and enforcement powers renders the entire water system, from irrigation infrastructure to dam regulation, an interesting and complicated can of worms. Watershed conservation is built upon state and federal water protection laws and policies. By understanding a few of the basic tenants of the Clean Water Act and how water policy is implemented in Montana, a citizen can become a strong advocate for water conservation and watershed planning in their community.
1.4.1 The Clean Water Act as a Watershed Conservation Tool

In 1972 the Clean Water Act (CWA) was passed to restore and maintain the ecological integrity of our nation's waters. Under the CWA, states are required to establish water quality standards that define the goals and limits for all waterbodies within their jurisdiction (River Network 1999). These standards are based in part on the information gathered by resource agencies as they assess waterbodies. This Act provides numerous avenues through which public involvement and citizen participation are protected and expected. A summary of the CWA is available online at http://www.epa.gov/region5/defs/html/cwa.htm.

The CWA guides local, state and federal efforts to assess, regulate and protect water resources. The CWA is one of the strongest environmental laws states and citizens can use to protect water resources. In some cases, citizens can drive state efforts to regulate activities within a watershed by holding local agencies to their responsibilities specified in the CWA. If state efforts fall short of federal requirements outlined in the CWA, citizens and watershed groups can turn to federal assistance and various legal options to persuade state agencies to perform their duties and complete their responsibilities. The following summary is meant to be an introduction to water quality standards and protective measures that exist within the CWA, and a starting point for where to look for information on your local water resources and where to begin watershed conservation efforts.

Under the CWA, every state must establish three components of water quality standards: designated uses, water quality criteria and an antidegradation policy. These categories are intended to work in combination to catch many types of water degradation that states are charged with regulating (River Network 1999). The CWA calls on agencies to assess whether waterbodies meet all standards and support their designated uses. If waterbodies do not meet their designated uses, agencies must determine why, and undertake a restoration program called a Total Maximum Daily Load assessment (TMDL).
The 3 Kinds of Water Quality Standards developed under the Clean Water Act:

- **Designated Uses**: Designated uses are both human and ecological water uses that are officially recognized and protected by state and federal environmental agencies. Every state is responsible for designating at least two uses for each water body, namely, that waterbodies of the nation are to be fishable and swimmable provided the natural condition was sufficient before human impacts degraded them. Other designated uses include drinking water, agricultural use, and industrial use (not including waste disposal). Fishable means that a waterbody supports a viable fish community, and that the fish are safe to eat. Most states recognize that supporting a fishery requires supporting a healthy aquatic community. Supporting an aquatic community requires water quality sufficient to support healthy populations of native aquatic life (including fish, aquatic insects and algae). These uses are typically used by the state to designate water quality classifications. In Montana, streams are divided into Class A (supports all uses), Class B (supports all uses, but drinking water requires water treatment) and Class C (supports all uses except drinking because waters are too salty). Class B and C waterbodies are further divided into subclasses 1, 2 and 3 based on temperature and ability to support cold water fisheries.

- **Water Quality Criteria**: To protect designated uses, water quality criteria are defined for chemical, biological and physical parts of an aquatic ecosystem. These limits are critical in setting a foundation for assessing if designated uses can be met in your individual watershed. Numeric criteria are specific, measurable, quantitative water quality limits for many water pollutants, usually expressed as maximum or minimum acceptable concentrations. Narrative criteria describe a desired goal or condition in qualitative terms. For instance, not every pollutant has numeric criteria established. To
keep our waters swimmable and to cover pollutants for which there is no specific limit, narrative criteria may say that discharges must not cause eye irritation or noxious smells.

- **Antidegradation**: The CWA antidegradation policy requires that states do the following: protect a water body from any activity that would interfere with an existing use; protect from future degradation high quality waters that meet or exceed state standards; and provide "outstanding waters" of significant ecological and recreational values the strictest protection to ensure the continuation of these uses. Every state must adopt an antidegradation policy and implementation plan that follows national guidelines. This policy is perhaps one of the strongest and least utilized components of the CWA and provides the best protection against future degradation of water resources. Montana has a Nondegradation Law that spells out our nondegradation policy and is implemented by the Department of Environmental Quality.

1.4.2 **Water Pollution Assessments and “Impaired” Waterbodies**

Since long before the passage of the Clean Water Act, states have been working to regulate activities that degrade the quality of water resources, and to assess and restore waterbodies throughout their jurisdiction. The CWA greatly increased the effectiveness of these efforts by requiring minimum treatment standards strengthening water quality standards, funding water improvement programs, and providing a framework to coordinate federal and state regulatory activities. Section 303(d) of the Clean Water Act is an important tool for citizen and agency led watershed conservation efforts. This section requires that all states evaluate if the waterbodies under their jurisdiction are able to support their designated and existing uses, and that steps are taken to restore these uses if they are not being met. Each waterbody is evaluated according to the numeric and/or narrative criteria for physical, chemical and biological parameters the state has
defined. If a waterbody fails to meet any of these standards because it is too polluted, or the physical habitat is too degraded, it is placed on a list of impaired waterbodies compiled for each state called the 303(d) List. This list is submitted to the EPA every two years in a report called the 305(b) Report.

The 303(d) List includes the following information for each waterbody: a watershed number generated by the US Geological Survey that is used to locate the waterbody; the name of the waterbody; the causes of impairment; the designated uses the waterbody supports; and the relative priority (high to low) the state places on developing a restoration plan for the waterbody. Once a waterbody is on the 303(d) List, the CWA requires a restoration plan for it. These plans are called Total Maximum Daily Load (TMDL) assessments and require the identification of the causes of impairment, sources of pollution, and the amount of pollution reduction or other actions that will be needed to restore the waterbody. See Table 1.4.2 for criteria required by the EPA and Montana Department of Environmental Quality for the completion of a TMDL.

In Montana, the Department of Environmental Quality (DEQ) is responsible for assessing and evaluating the ability of waterbodies within the state to meet their designated and existing uses. In 1998, 800 Montana waterbodies needed restoration or TMDL plans (the list is available from the DEQ and on-line at http://www.deq.state.mt.us/). The strength of the TMDL assessment is that it takes a watershed-based approach to evaluating and restoring waterbodies and water quality. For instance, if a stream is listed as failing to support the native fish population due to increases in sediment loading, a TMDL identifies the source of sediment, the amount of sediment load that must be reduced, and the methods to be employed in reducing delivery to the system. The state is obliged to assist these efforts by providing technical and financial support.

Across Montana, local watershed groups are driving the creation of watershed conservation and TMDL plans for the basin in which they live. It is important that a watershed group contact the regional Department of Environmental Quality TMDL coordinator if they decide to do a
The Montana DEQ and the EPA require the following issues to be addressed in a watershed plan for it to serve as a TMDL. It is important to consult the regional DEQ water quality specialist in preparing a TMDL for an impaired waterbody. The DEQ is authorized to approve or disapprove TMDL plans. The following 8 criteria are adapted from the TMDL Checklist for EPA Region VII.

1. TMDL plans must result in the maintenance and attainment of water quality standards established by the state of Montana.

2. TMDL plans must have a quantified target or endpoint that relates to achieving the water quality standard or restoring the impaired beneficial use(s).

3. TMDL plans must include a quantified pollutant reduction target that can be expressed in any appropriate manner that is linked to achieving the water quality standards target. For instance a 40% reduction in sediment delivered to a stream measurable at some designated place, a quantified decrease in nitrogen and phosphorus levels in surface water, etc.

4. TMDL plans must consider all significant sources and causes of the pollutant or problem of concern, including public and private lands, commercial activities, etc.

5. An appropriate level of technical analysis, which depends on the complexity of the water quality problem, must support TMDL plans.

6. TMDL plans must contain a margin of safety and consider the inherent uncertainty of watershed dynamics and the effects of seasonality on the water quality problem(s).

7. TMDL plans must identify responsible parties for actions indicated, individual allocations of pollution loads and reductions, and management practices to be adopted.

8. TMDL plans must involve some level of public participation or review. The earlier the community is notified of efforts to establish a TMDL, the better.
TMDL for an impaired waterbody (in western Montana, Roxann Lincoln is the TMDL coordinator (406) 444-7423). The TMDL coordinator will assist the group with writing a TMDL plan that will satisfy state requirements, while achieving the goal of improving water quality. Handing a completed TMDL to the DEQ without their participation and guidance in writing the plan is not advised. It is important to include the DEQ from the beginning in planning and writing a TMDL.

A good TMDL is really a watershed conservation plan that assesses a multitude of problems. These problems include pollution loading, habitat degradation, loss of riparian community, loss of normal stream flow patterns, etc. These plans are based on the principles of watershed conservation whereby areas capable of supporting resource uses are utilized for sustainable economic and recreational activities, and sensitive or critical support regions are protected in a largely natural state. By creating watershed conservation plans that meet federal and state requirements, local groups are opening the doors to financial and technical assistance provided by state agencies that previously were available only by hiring private consulting firms.

Currently, efforts are being made to address the large backlog of streams on the 303(d) List. The only way to remove a waterbody from this list is to complete an acceptable TMDL plan, or to find evidence that the waterbody is meeting all of its designated uses. The time is ripe for local participation in discussing which uses can and should be supported, which uses are actually being realized, and what will be required if watersheds are to meet the goals local communities are developing in their conservation plans.

1.4.3 State and Federal Laws That Protect Water Resources

In Montana and throughout the nation, a variety of laws protect water quantity and quality, the streambed and banks of a waterbody, and riparian and wetland communities. Some of
these laws, like the Clean Water Act, are national programs to restore and maintain the integrity, designated uses, and navigability of surface waters. Others represent Montana's additional efforts to maintain the high quality of surface and ground waters that exist within state boundaries.

According to the Montana Constitution, all persons have the right to a clean and healthful environment (Bryan, M. and M. Kakuk 1997). With this right comes the responsibility to safeguard the environment and state waters from degradation. The state constitution established that all surface and groundwaters within the boundaries of the state are the property of the state for the use of its people (Westesen and Bryan 1997). As such, an individual possessing a water right in fact possesses a right to use an allotted amount of water so long as she/he meets state guidelines for reasonable uses, and does not interfere with a senior water user's right (i.e. one with an older water right). A water right is required for any activity that withdraws surface waters in the state of Montana. On Native American reservation lands, the history and policy of water rights differ from those found under state and federal authority.

Table 1.4.3 lists many of the laws that are important to consider when creating a watershed conservation plan. These laws are designed to protect critical natural resources and human health from pollution and ecosystem damage. The agencies responsible for regulating and enforcing environmental standards also provide technical expertise and legal support for many conservation efforts. In Montana, both county and state governments have adopted an approach to watershed restoration and conservation based on incentive programs and public education. Under extreme cases of water quality degradation or if human health or property is threatened, state and federal agencies can intervene on private or public lands to prevent degradation or stop a degrading activity that is underway.
### Table 1.4.3 Important Federal and State Laws for Watershed Conservation

<table>
<thead>
<tr>
<th>Federal laws</th>
<th>Purpose (and implementing agency)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clean Water Act</strong></td>
<td>To restore and maintain the physical, chemical and biological integrity and beneficial uses of national water resources. (Environmental Protection Agency)</td>
</tr>
<tr>
<td><strong>Endangered Species Act</strong></td>
<td>To protect endangered plants, animals and their habitats. This Act prohibits any action that harms or kills a listed species, or any action that damages its habitat. (US Fish &amp; Wildlife Service)</td>
</tr>
<tr>
<td><strong>Safe Drinking Water Act</strong></td>
<td>Provides the EPA with the authority to establish and enforce federal drinking water standards. These standards establish maximum levels of contamination for toxic chemicals and waterborne diseases and bacteria. The SDWA also requires all states to develop Source Water Assessment Plans for drinking water supplies. (Environmental Protection Agency)</td>
</tr>
<tr>
<td><strong>National Environmental Policy Act</strong></td>
<td>NEPA is the foundation for many national efforts to protect our environment. It requires federal review of major federal activities that may cause degradation to the environment. (All federal agencies)</td>
</tr>
<tr>
<td><strong>Comprehensive Environmental Response, Compensation and Liability Act (Superfund)</strong></td>
<td>Requires the cleanup of abandoned toxic or hazardous sites, accidents, spills, and other releases of contamination into the environment. It has established a Federal fund to pay for the cleanup of abandoned or uncontrolled hazardous materials, but charges cost to responsible party if available. (Environmental Protection Agency)</td>
</tr>
<tr>
<td><strong>National Wild and Scenic Rivers Act</strong></td>
<td>If designated as a river of outstanding value, the WSRA protects a river system and seeks to maintain it in a free-flowing condition, capable of supporting exceptional biological, cultural and historical values. (Environmental Protection Agency)</td>
</tr>
<tr>
<td><strong>Federal Agricultural Improvement and Reform Act (Farm Bill)</strong></td>
<td>The Farm Bill provides financial incentives to American agricultural communities to address and remedy environmentally degrading farming practices. This bill supports incentive programs administered by the Natural Resource Conservation Service (USDA).</td>
</tr>
<tr>
<td><strong>National Forest Management Act</strong></td>
<td>To protect biodiversity in National Forests and the public's right to participate in forest planning and management. The NFMA specifies that timber is only to be harvested in ways and in areas that do not compromise the condition of a watershed. (US Forest Service)</td>
</tr>
</tbody>
</table>

### Montana laws

<table>
<thead>
<tr>
<th>Montana laws</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stream Protection Act</strong></td>
<td>The purpose of this act is to protect and preserve fish and wildlife resources within the state, and to maintain streams and rivers in their natural or existing condition. (Department of Fish, Wildlife and Parks)</td>
</tr>
<tr>
<td><strong>Streamside Management Zone Law</strong></td>
<td>This law prohibits the following timber harvest activities within 50 feet of any waterbody: broadcast burning; off road operation of wheeled or tracked vehicles; clear-cutting, road construction unless to cross a stream; handling, storing, applying or disposing of hazardous or toxic materials; casting road material into a stream, etc. (Department of Natural Resource Conservation)</td>
</tr>
<tr>
<td><strong>Floodplain and Floodway Management Act</strong></td>
<td>To restrict floodplain and floodway areas to uses that will not be seriously damaged, or present a hazard to life, if flooded. Administered by the local floodplain administrator or DNRC.</td>
</tr>
<tr>
<td><strong>Natural Streambed and Land Preservation Act</strong></td>
<td>Minimize soil erosion and sedimentation of waterbodies, and protect and preserve streams and rivers in their natural or existing state. (Conservation Districts)</td>
</tr>
<tr>
<td><strong>Water Use Act</strong></td>
<td>To provide a permitting system for water rights administration; to record, maintain and adjudicate water rights. (Department of Natural Resource Conservation)</td>
</tr>
</tbody>
</table>

Note: According to these laws, state/federal permits are required for activities that impact waterbodies. Contact the county Conservation District wherein the action is proposed for required permit applications and assistance.

(River Network 1999; Montana Association of Conservation Districts et al. 1997)

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1.4.4 State and Federal Environmental Agencies Involved in Watershed Conservation

Environmental agencies provide a valuable source of professional resource managers and ecologists for assistance with conservation planning and restoration actions. Citizens can benefit from working with those agencies that are responsible for project review and permitting for many activities that may occur within a watershed. By working together, projects can be planned and coordinated to avoid or reduce cumulative impacts that could degrade a watershed. Furthermore, the information and permits maintained by the environmental agencies provide an invaluable source of background and historical information for many watersheds in Montana.

Appendix B provides a list of the primary agencies and organizations participating in watershed management and conservation in Montana. For each of the federal agencies, there are similar state agencies responsible for the implementation of federal policies and programs. Generally, permits are required for any activity that impacts a streambed or banks, discharges into a waterbody, withdraws water from a watercourse, or negatively impacts the riparian community. Table 1.4.4 presents a list of the most common permits required for local activities that may impact a waterbody. Failure to obtain the necessary approval can result in the closure of an initiated project, fines, and the forced removal and clean up of a constructed project, plus expenses incurred to restore degraded terrestrial and aquatic communities. The permit system is designed to assist landowners with the sound design and thoughtful planning a successful project requires.

There are 4 or 5 environmental agencies that watershed groups commonly work with on a regular basis. Local conservation districts are valuable source of natural resource and watershed information. Conservation districts commonly assist watershed groups with understanding and identifying natural resource problems, with contacting appropriate agencies, general start-up activities, and state and federal permit requirements for projects. The Natural Resource
### Table 1.4.4 Common Permits Required for Protection of Water Resources

<table>
<thead>
<tr>
<th>Permit Type</th>
<th>Permits Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stream Alteration Permit (310 Permit)</strong></td>
<td>Required under the Montana Natural Streambed and Land Preservation Act. These are the most common permits issued by local Conservation Districts for activities impacting streams including: installation of any material on a streambank (i.e. rip rap, fencing to stabilize slope), temporary stream crossings during low flow periods, irrigation diversion structures, bridges etc. The person initiating the project must complete a permit application available at all conservation district offices prior to beginning any activity, and approval is required.</td>
</tr>
<tr>
<td><strong>Dredge and Fill Permit (404 Permit)</strong></td>
<td>Required under the Federal Clean Water Act. Projects that include construction, road building and maintenance, culvert installation, stream modification, large vehicle crossing on or near a stream, or any activity that may contribute a “significant” amount of sediment, dredging or fill material to a waterbody or wetland. This permit is issued and reviewed by the US Army Corps of Engineers and the EPA. Permit information and assistance is available at all conservation districts.</td>
</tr>
<tr>
<td><strong>Montana Water Right Permit</strong></td>
<td>Required under the Montana Water Use Act. Any person, agency, or governmental entity intending to acquire new or additional water rights, or to change an existing water right, must obtain a water permit. This applies to any surface water appropriation, and groundwater appropriation over 35 gallons per minute or 10 acre-feet per year. Water right applications are available at county clerk and recording’s offices, and all eight Water Resources Regional Offices of the DNRC in most major Montana towns and cities. Most western Montana river and lake basins are currently closed to new water rights/use permits.</td>
</tr>
<tr>
<td><strong>Floodplain Development Permit</strong></td>
<td>Required under the Montana Floodplain and Floodway Management Act. Anyone planning new construction, the placement of fill, roads, bridges, irrigation structures, homes or additions within a designated 100-year floodplain must obtain a permit from the Floodplain Management section of the DNRC. Contact a local floodplain administrator (in most county planning offices) within the county or the DNRC in Helena prior to initiating the project.</td>
</tr>
<tr>
<td><strong>Septic System Permit</strong></td>
<td>Required under county septic system regulations. Any person intending to construct, alter, extend, or operate a sewage treatment and disposal system must obtain a permit from the county. Conventional systems must be 100 feet from the 100-year floodplain, and 6 feet above groundwater (Montana Association of Conservation Districts 1997). Contact the sanitarian of the county wherein the project is to occur before beginning installation.</td>
</tr>
<tr>
<td><strong>Other Permits</strong></td>
<td>The DEQ and the Federal Energy Regulatory Commission must be contacted before mining or dam construction activities are initiated below the high water mark on any lake or stream in Montana. Also, the DEQ must be contacted before any liquid or solid is discharged into any surface or ground waterbody, or for any temporary violation of Montana Surface Water Standards.</td>
</tr>
</tbody>
</table>

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Conservation Service (NRCS) works with the conservation district to improve land use practices and to conserve land and water resources. To assist landowners with improving their land use practices, NRCS has a number of programs for landowner education and habitat protection, with some funding assistance for implementing approved land use practices. NRCS is also available for technical advice for watershed groups.

The Montana Department of Fish, Wildlife and Parks (FWP) provides wildlife information, fish habitat and fish population surveys, and technical guidance for local conservation efforts. FWP has a fisheries restoration program (Future Fisheries Program) to assist watershed groups and landowners with funding for projects to restore and enhance fish habitat. The US Forest Service and the Bureau of Land Management play an important role in watershed conservation in Montana. These two agencies manage public lands throughout the state. They are a valuable source of forest, water and soil inventories, technical assessment and guidance for conservation efforts. The Department of Environmental Quality also protects state water quality and oversees the Total Maximum Daily Load Assessment Program. They are responsible for pollution assessment and allocation of Nonpoint Source Pollution funding (319 grants) available from the US EPA to improve water resources. Appendix B is intended to guide citizens through the hierarchy of legal authority, and the opportunities and incentive programs that exist for land and water conservation projects.
2.0 Guidelines for Establishing a Watershed Conservation Plan

Once you've waded through the basics of watershed science and conservation policy, it's time to roll up your sleeves and get to work on writing a watershed conservation plan. Watershed planning is a process whereby a local community works with resource managers to identify goals and priorities for a watershed. This process involves identifying where the group wants to go with their planning efforts, the condition of the watershed (a watershed assessment), what they will need to meet these goals, and how they will keep on track as they plan and implement watershed projects. In most cases, watershed groups rely on the assistance of a watershed coordinator to facilitate water conservation planning and project design. The watershed coordinator assists in overcoming conflicts and struggles that may be unavoidable when gathering together the variety of landowners, resource interests and land managers found in a watershed. Local conservation districts may recommend watershed coordinators in their area, or a qualified and inclined watershed resident may choose to take on the challenge of coordinating a watershed group.

State and federal environmental agencies have been working to manage natural resources for decades, and are available to assist local residents with many elements of watershed planning. In this way, watershed planning is based on a partnership between local efforts and state and federal resource management agencies. These partnerships have been utilizing education, innovative restoration technology, and demonstration projects to encourage the cooperation and participation that are critical for successful watershed conservation (Harrington, M and C.A. Hartwell 1999). As our population grows and demands on natural resources increase, conflict between various uses of water and watersheds seems unavoidable. This conflict can result in ecosystem degradation if management decisions are not based on careful planning and scheduling that prioritizes watershed integrity. For instance, by staggering irrigation timing and water
withdrawal from a stream, minimum flows to sustain a local aquatic community and fishery can be achieved. Without this type of planning and cooperation, many streams are rendered dry during the hot summer months when irrigation needs are highest, and streamflow is at a minimum. By making resource management decisions in a cooperative forum that includes all of the resource managers, residents, recreators, and conservation interests within a watershed, unintended and often unnecessary harm can be avoided.

Increasingly watershed groups are being recognized as a critical forum for conflict resolution and effective resource management across the nation. In many areas, watershed groups and agency partners are forming solutions to past resource management nightmares by emphasizing problem solving as opposed to punishment, balancing competing interests and goals within a watershed, and providing economic incentives in the private-sector (Harrington, M. and C.A. Hartwell 1999). Watershed groups and agency partnerships are effectively addressing resource problems that have plagued rural towns and communities since the mid-1900’s when our use of natural resources clearly began to exceed the capacity of ecosystems to sustain themselves and the services humans depend upon. Through working together to manage natural resources sustainably, people with diverse interests can find common ground. State agencies, local communities, private landowners, commercial operations and public land managers have benefited from these cooperative projects for the last three decades. Watershed conservation that emphasizes healthy ecosystems and sustainable resource management has the best chance of supporting present and future human needs.

There are a number of watershed councils across Montana that have begun watershed conservation planning during the last 5 years. These watershed councils vary in group structure, leadership style and conservation strategy as each watershed is unique in the management issues it raises. For instance, in Sanders County there are currently 4 watershed groups in operation. One of these, the Elk Creek Watershed Council, was formed over two years ago when the
watershed residents came together to address streambank erosion and wildlife habitat concerns in the watershed. By 1999, a series of bank stabilization, streambank revegetation and habitat enhancement projects have been completed, and the group now meets every other month to monitor the condition of the projects and the health of the watershed. Another of these groups, the Rock Creek Watershed Council, was recently formed to address fishery degradation, groundwater contamination, and a proposed copper and silver mine that may be constructed in the headwaters of the watershed. These efforts are receiving sustained attention and assistance from the surrounding community and management agencies, and serve as demonstration projects for similar groups in the region.

In forming a watershed group, it is important to remember that there are a series of steps to take before any work on the ground is done (US Environmental Protection Agency et al. 1998; California Coordinated Resource Management Planning 1990; Montgomery, D.R. et al. 1995). The watershed conservation plan will serve as a guiding document and record for decisions made and activities the watershed group oversees. The amount of time necessary to complete each of these steps varies according to the politics that exist within the watershed, the complexity of the problems identified, group participation and agency support. By keeping these five phases in mind, the path to establishing a watershed conservation plan will be easier to follow. These five phases are:

1. Getting organized and forming a watershed group.
2. Assessing the condition of the watershed and collecting background information.
3. Watershed planning: developing watershed goals, writing and adopting a watershed management conservation plan, and securing funding.
4. Implementing the watershed plan.
5. Monitoring the effectiveness of projects and adapting conservation strategies as needed.
2.1 Getting Organized, Forming and Sustaining a Successful Watershed Group

The first step in watershed conservation is to clearly identify watershed problems, and to begin meeting to discuss land and water concerns within a watershed. The Montana Water Center maintains a list of most of the watershed and environmental groups in the state, and can be consulted for pre-existing groups in most areas (see their website at http://water.montana.edu). Most conservation districts are familiar with local watershed councils and can provide information on start-up activities that can save a newly forming group both time and money. They may also have recommendations for individuals to contact with previous experience in watershed coordination and grant writing - critical services in starting up and sustaining any watershed group. Conservation Districts can also access DEQ grants to support the initiation of a watershed group in their county. Often the first meetings are attended by people previously involved with resource management in the area (i.e. agency personnel, conservation interests, the local conservation district, landowners, etc.).

Watershed conservation planning and restoration actions rely on the cooperation and participation of the people that live, depend upon and recreate within a watershed (Montgomery, D.R. et al. 1995). These people have a stake in the present and future condition of the watershed and are therefore referred to a “stakeholders” in most planning efforts. Early involvement and long-term commitment of the stakeholders can be tricky to secure, and frustrating to maintain. When considering the potential stakeholders for a watershed area, the list may be huge and daunting. In general, the categories that are represented in many watershed councils include: academics, agency personnel, natural resource business, elected officials, special interest groups, politically active people, tribes, and interested citizens not belonging to any of the other categories (Griffin, C.B. 1999). Inviting these participants to join in a watershed conservation effort can be achieved through the usual methods of giving public notice. Specifically, printing a short article in the local newspaper; making an announcement at the monthly conservation district
meeting; contacting special interest groups via telephone or internet and telling them to pass the word; posting fliers announcing a first meeting at local colleges/high schools, the post office, grocery stores, and local bars; and mailing an announcement to all of the residents and landowners/managers within the watershed area. Try to get the media to cover the first meeting and be sure to tell them when the next meeting will be.

It is important that the local community, private interests and landowners be notified when start-up activities begin. By notifying stakeholders through mailings or publicity in local newspapers, it is more likely a broad range of participants will join the conservation efforts. The participation and input of stakeholders is critical in minimizing opposition to the conservation plan. An ongoing outreach and education effort will be needed because new stakeholders may join the group over time, and some participants may want to be kept abreast of issues and decisions without having to join in the planning. It is important to initiate a watershed group before creating a conservation plan.

The implementation of a watershed conservation plan will depend on the commitment of a number of the stakeholders to long-term participation, problem solving, project implementation and monitoring. If the group is established in an environment where every member's position is respected and worthy of consideration, long-term voluntary participation is more likely to be achieved. It is important that trust and respect are established between group members, and that each participant has the authority to speak on behalf of their interests and the issues they represent. Efforts to design a conservation plan can be initiated once parties that could stop implementation have been involved in the planning process. If these parties refuse to participate in planning efforts, the watershed coordinator can act as a facilitator to assist with communicating the watershed goals the community has identified and the need for stakeholder support. The Department of Environmental Quality will insist that future watershed activities comply with the pollution abatement and management actions outlined in an approved Total Maximum Daily
Load (TMDL) plan. For this reason, it behooves all of the stakeholders to participate in designing and implementing a TMDL they will be required to comply with.

If a watershed group is still unable to secure participation from a critical stakeholder, continue positive methods of encouragement that include promoting environmental values and knowledge, and watershed awareness (Lant, C.L. 1999). In time and with a bit of luck, a resistor may come around and see the benefits of the group's efforts. Another stakeholder with similar interests may be able to convince the wary nonparticipating party of the benefits of watershed conservation. Success is still possible even if some of the stakeholders choose not to participate (California Coordinated Resource Management Planning 1990).

Due to the mission of resource and environmental agencies, it is common to have a representative from the US Forest Service, Montana Department of Fish, Wildlife and Parks, the Natural Resource Conservation Service, and the local Conservation District at most meetings. All of these agencies have a responsibility to manage the natural resources within the state; however, they cannot implement management decisions on private lands where change is often needed. The Department of Environmental Quality (DEQ) is responsible for assessing the ability of state waterbodies to meet their designated uses, and for approving TMDL plans to restore these uses. The regional DEQ watershed quality specialist should be consulted once a watershed group begins designing a TMDL plan.

Maintaining volunteer landowner and citizen participation is a common problem many watershed groups encounter. Agency personnel are obligated and interested in attending locally organized watershed conservation group meetings, but the local citizenry may be more difficult to attract. Often watershed groups struggle to avoid a "round table" of agency personnel throughout their conservation efforts. By involving local residents, creating a board of directors, allocating responsibility and empowering non-agency participants, a sense of ownership and commitment will grow within participants for both the planning phases and final projects undertaken by the
group. Volunteer projects are found to work only when the volunteers set the priorities (Harrington, M. and C.A Hartwell 1999). Many times conflicts and long-standing disagreements between neighbors are overcome when both parties are listened to. Collaboration and consensus, or reaching resolution after all points of view have been voiced and weighed in making decisions, is one of the strengths of planning efforts driven by local groups at a watershed scale (Griffin, C.B. 1999). Table 2.1 outlines steps to consider in forming and sustaining a watershed group.

2.2 Writing a Watershed Conservation Plan

Once a watershed group has formed, the watershed planning area needs to be clearly defined. Selecting an appropriate watershed size can be a tricky step because the management area needs to be large enough to impact the problems the group wants to remedy, while small enough to make decision making and project implementation feasible. Some resource managers and conservationists recommend defining the management area according to the "problemshed" that influences it (Griffin, C.B. 1999). A problemshed is defined by the nature of the resource problem, and the appropriate land area that must be managed to impact the problem. For instance, a watershed group can consider a relatively small management area if they are addressing weeds in a confined pasture, while restoring fish populations may require a large, complex river system that may span numerous watersheds. Watershed groups must remember that they will require the approval and participation of private landowners to implement any project planned on private lands. They should therefore consider their ability to do something within the problemshed as they design watershed goals and objectives.

The discussion to identify resource concerns and watershed conservation areas (or problemsheds) should include regional and national goals to maintain or restore watershed ecosystems and water resources, while addressing local problems and concerns. In many cases,
Table 2.1 Steps to Consider in Forming a Watershed Group

1. Watershed groups are created to solve existing land and water problems, and/or to avoid potential problems that may result from future activities. Unplanned activities are more likely to cause problems than those that are planned. It is critical to include all of these concerns in the conservation plan a watershed group creates.

2. Contact the county-based conservation district for information on local watershed projects and citizen groups. Get names and contact information for watershed leaders/coordinators and similar projects in your area. Conservation districts can often provide up to $5,000 (from the DEQ) for watershed planning.

3. Having a watershed coordinator/facilitator is important in starting-up and sustaining a watershed group. An ideal watershed coordinator is someone who lives in the watershed or neighboring area, with natural resource management, grant writing and good people skills. Any combination of these traits can work. The coordinator can arrange for the physical requirements of the first meeting (a meeting facility, publicity, coffee, etc.) and plan for future activities between meetings. By paying a coordinator to lead monthly meetings, plan agendas and keep meeting minutes, the group will proceed through planning and assessment phases more rapidly and more smoothly. Watershed coordinators can also apply for grants to support the activities the council will oversee, including: hiring a watershed coordinator, assessing a watershed, designing restoration projects and implementing a monitoring program.

4. Plan and hold first informational meeting where resource concerns are presented, the need and purpose for establishing a watershed council is explained, etc. If a watershed coordinator has been nominated, have her/him review the county records for all of the landowners in the watershed. Mail an announcement inviting watershed residents, the conservation district, governmental agencies and special interest groups to the first meeting. Also, post fliers in common public areas (grocery stores, bars, post offices) to publicize the meeting. Try to get media coverage at the first meeting, and remember to tell them when and where following meetings will be held. Meeting facilities are often free if they are held at community centers, firehouses, and other established meeting places.

5. If some of the stakeholders are reluctant to participate, have a participant with similar interests contact them and explain the benefits of watershed conservation and what the group will be trying to accomplish. Be patient, it may take some people a while to participate in conservation efforts.

6. Start meeting regularly. Agree upon a meeting format, acceptable conduct, if decisions will be made by consensus, etc.

7. During the first few meetings, explain the importance of long-term commitment and involvement of the stakeholder group. The first year is usually the most time consuming as the conservation plan is written, funding is secured, projects are implemented, etc. Afterwards, meetings can be less frequent and based on need.

8. Some of the stakeholder will be interested in what the group is doing but unwilling to participate in regular meetings while others may take time to join in the efforts. For these reasons, an ongoing education and outreach effort is important to maintain volunteer participation and interest.

9. Design a mission statement the watershed council supports. This statement will be based on the common vision of the stakeholders and guide future activities the group will undertake. Also, create a list of land and water concerns, and define goals and objectives as watershed assessments and field data are gathered. This information will be the beginning of a draft watershed conservation plan (see Appendix A).

10. Review and modify draft plan and refine an implementation strategy. Identify existing and potential funds, and create a monitoring plan.
watershed stakeholders may choose representatives for private landowners, conservation interests, commercial interests, or other special interests to form the watershed board of directors or some sort of formalized decision making body. The agency participants in the watershed council often form a technical advisory committee to evaluate data, feasibility of different alternatives under consideration, potential projects and benefits to natural resources and watershed health.

A template for a watershed conservation plan is presented in Appendix A. The outline is intended to guide citizens through the process of assessing and planning future watershed conservation actions. It does not, however, include a few of the critical steps in watershed planning, namely securing funding to support watershed conservation projects and land management actions, and hiring technical consultants and/or a watershed coordinator. In many cases, the watershed coordinator will write a majority of the grant proposals submitted by the watershed group as grant writing is a meticulous and involved process that benefits from an experienced hand. As previously stated, however, start-up funding is often available through the local conservation district.

2.2.1 Assessing Watershed Condition and Problem Identification

There are many approaches to assessing the condition of a watershed. These approaches vary from scientific data gathering and analysis to the first hand experience and knowledge of watershed users. Oftentimes watersheds are divided into terrestrial (land) and aquatic (water) communities, or into physical, chemical and biological aspects to focus the assessment process. On a cautionary note, these divisions are somewhat arbitrary, and we must keep in mind that all parts of a watershed affect one another.
A preliminary watershed assessment should attempt to gather the existing data, information and first-hand knowledge available for a watershed system. It therefore involves resource agencies, local residents, nonresident users and conservation interests that have studied and spent time within the watershed and its tributaries. This preliminary assessment should attempt to identify areas where further study and evaluation are necessary before any conservation projects are undertaken. However, information on a watershed will never be complete; at some point action must be taken despite remaining uncertainties. The technical advisory team should advise the watershed group when sufficient information has been gathered to begin action.

**Step 1: Background information**

People who live and use the land and water resources can assist in identifying problems that exist within a watershed. Loggers are often familiar with the condition of unpaved roads and culverts, and areas with beetle infestations or tree disease. Local residents and weekend recreators are familiar with fishing holes and recent fish catch, and remote areas accessed only by trails. Farmers and ranchers note the condition of the streamside vegetation, pasture quality, water quantity and clarity of streams through their lands. Hunters attempt to track migration patterns and game populations during different seasons and between different years. These types of information can be useful in identifying areas where problems may exist.

Federal and state agencies have attempted to assess wildlife population viability (especially of game species) and plant community health found within many Montana watersheds. The Montana Department of Fish, Wildlife and Parks has fish population and habitat surveys for many of the streams, and wildlife information for land communities. Similarly, US Forest Service and the Department of Natural Resource Conservation have inventories of wildlife and forest condition, fire histories, past stream
modification activities, roads, weeds, private grazing allotments, aerial photos, and recreation use on public lands. The Natural Resource Conservation Service has soil inventories and aerial photos in areas where they’ve developed management plans, and can conduct site visits to assess soil type, and the potential for soil erosion. Within each county, the County Assessor’s Office maintains records on public and private land ownership.

The Department of Environmental Quality has assessed many waterbodies in Montana as required under the Clean Water Act and the Montana TMDL program. The DEQ maintains a list of waterbodies that do not meet their designated uses (the 303(d) List of Impaired Waterbodies). The DEQ also maintains records on wastewater discharge permits, waste sites, subdivisions and feedlots throughout the state. Conservation districts maintain records for 310 Permits that have been issued for actions that impact streambanks or streambeds on private lands. Local government (city and county planning and health departments) can provide information on septic systems, surface and groundwater quality, roads and other infrastructure within their jurisdictions.

The records maintained by federal agencies are available to the public as required by the Freedom of Information Act (see the Federal Code of Regulations part 7, or the US Department of Agriculture’s web site at www.usda.gov/news/foia/main.htm). In most cases, agency personnel are more than willing to open files and assist where they can in land and water conservation. However, if cooperation fails, mentioning (and if necessary utilizing) the public’s right to obtain most federal agency records is usually compelling. To create the best picture of current and past human impacts within a watershed, all of these sources of information are valuable in directing future conservation efforts.
Step 2: Assessing a watershed and identifying causes of degradation

Once the background information on a watershed has been collected, the watershed council can work with the Department of Environmental Quality to design an assessment and monitoring program to address the goals for the watershed. Assessment of the condition of land and water ecosystems is critical to developing effective conservation projects and evaluating their progress. A holistic approach has been recommended by watershed professionals and scientists who guide citizen and agency-driven watershed conservation efforts. A holistic approach evaluates water quality, habitat structure, energy and nutrient sources, flow regime (high and low flow cycles), and biotic interactions. The following assessment methods outline a variety of approaches a watershed council may choose to pursue or support.

- Citizen Monitoring

Local citizens can provide a useful picture of the watershed they spend time in, and can be a valuable work force for long-term watershed monitoring. There are several approaches to monitoring. Each approach depends on the amount of time the monitors want to contribute, if they enjoy being out in the field, if they are comfortable walking through a stream, or if they are interested in technical training to collect specific types of data. Irrespective of the monitoring activity, local citizens can be an excellent way to create a long-term monitoring program that agency personnel could not sustain in every watershed in the region.

There are many sources of information available to citizens for stream monitoring. The Adopt-A-Stream Foundation's Stream Keeper's Field Guide (Murdoch et al. 1996) outlines data collection to assess watershed condition and a waterbody's biological, chemical and physical condition. Also, conservation districts, NRCS, the DEQ and the Department of Fish, Wildlife and Parks can assist in establishing a monitoring system.
that citizens can carry out. The Montana Volunteer Monitoring Network hosts workshops to train citizens how to design and implement a successful monitoring program and can be contacted through the Natural Resource Information Service (see their website at nris.mt.gov/wis/volwatmon.htm). The following description is intended to provide examples of some of the ways citizens can participate in watershed monitoring.

1. **Visual survey:** Walking along a waterbody is the best way to identify potential problem areas. While walking, look for areas where human activities have removed riparian vegetation or forest cover, areas with streambank erosion, bare hillslopes that may fail, weed invasion, stream crossings for livestock or vehicles, any pipe that may be discharging into the system, and anything else that catches your eye. Note these areas on a map and sketch in their approximate location. Repeat the visual survey annually. If possible, bring along someone from the technical team to participate in the first visual survey at least.

2. **Photo monitoring:** Establishing points where regular photographs of the stream and surrounding riparian community are taken is an easy and meaningful way to track change. Photograph areas where erosion or other problems have occurred in the past, or where management practices have changed. Consult the technical team for ideas. Photo monitoring is an effective way to watch a riparian community grow back once grazing practices change, or to watch a streambank rebuild if a restoration project is undertaken. Choose an obvious landmark (i.e. a big boulder, a tree, a bluff or bridge), or mark the monitoring site with a permanent fixture if you cannot use a substantial landmark. Hammering a stake into the ground is a cheap and effective method if a preexisting structure cannot
be found, but may prove challenging to relocate from season to season. Be sure to ask permission from a private landowner before marking a spot on their land.

3. **Physical assessment:** Streams are perpetually moving throughout their floodplain while they transport gravel and sediment from one area to another. Some streambank erosion is natural and healthy. Other types and rates of erosion are the result of poor landuse practices. To evaluate which type of situation exists, select a reach for monitoring (0.5-1 km long). Map and measure stream cross-sections every 100-250 meters, reach length and sinuosity (curvature) at least once each year (Murdoch et al. 1996; United States Environmental Protection Agency 1997). These measurements can detect channel changes that are not natural (i.e. rapid widening or down-cutting due to upstream or local landuse impacts). Streamflows should be measured multiple times each year to record high and low stream flows. These types of assessments can assist the watershed group in creating an image of how the stream changes from low to high flow, season to season, and year to year. These monitoring stations should be established with the guidance of the technical team and training may be necessary to assure accurate measuring techniques, etc.

4. **Chemical assessment:** There are a number of chemistry kits available to citizens through groups like the Montana Volunteer Monitoring Network and other citizen monitoring programs. Most of these kits include materials to measure the temperature, dissolved oxygen, and acidity of the water. These kits are easy to use with minimal training and can illuminate significant water quality
characteristics that influence the aquatic community found within the watershed. The technical team will most likely advise the watershed group to hire a private consultant to conduct more thorough and refined analysis if there is a need for further water quality information. Most test kits cannot adequately measure nutrients and metals in stream water. Check with the DEQ or a local college/university about such analyses. In addition, water chemistry changes so rapidly that monitoring programs must be carefully designed to provide useful information. Assessing the amount of suspended and settled sediment in a stream system is critical in evaluating water quality and the health of the ecosystem; however, it may be best left to the technical team or professional consultants given the level of training required to accurately collect sediment samples. Also, sediment needs to be measured during peak streamflows, as well as other times of the year. Wading into a stream or river during this time can be extremely hazardous.

5. **Biological community assessment and monitoring:** Collecting aquatic insects is an effective and useful way to assess and monitor the health of the aquatic ecosystem. The presence and abundance of pollution sensitive species indicates whether water temperature, water chemistry and substrate can support a pollution sensitive aquatic community. This information is useful in assessing fishery potential, and success of restoration activities. A biological assessment and monitoring program requires some training and technical advice to establish, and in many cases the insects collected are sent to someone experienced with identification. Consult the technical team for guidance with this assessment method.
• **Technical Assessments**

Before any restoration activities are undertaken a thorough understanding of the existing stream conditions should be obtained. By evaluating stream conditions and classifying the stream type, you can then determine what can be expected of it. In order to understand what is causing a problem, upstream and up-slope activities need to be evaluated. Agency and private consultants are familiar with the collection of baseline information and data to provide this picture. The DEQ and FWP can often provide a list of private consultants they have worked with on stream restoration projects. Have the DEQ and FWP review any work to be carried out by a private consultant before the project is begun. Restoration efforts will fail if they simply place a band-aid over a symptom without changing the causes that are damaging a stream. Technical assessments to evaluate current watershed condition and causes of degradation include:

1. **Fishery Assessments**: Normally conducted by the Department of Fish, Wildlife and Parks to evaluate the fish population and potential habitat within the watershed. They use these assessments to make recommendations for habitat restoration projects.

2. **Watershed Modeling and Forest/Rangeland Assessments**: Conducted by the US Forest Service and Bureau of Land Management on public lands, and by Montana Forestry Division of the Department of Natural Resource Conservation on state and private lands, to evaluate forest condition, and watershed hydrology (the interception, use, storage and run-off of surface water) for cumulative effects of past, present and potential timber harvests, proposed road construction, etc.
3. **Hydrologic and Stream Classification Surveys**: Conducted by the DEQ, US Forest Service and the BLM. These studies evaluate the stream channel structure, surface and groundwater interaction, landform age and evolution (geomorphology), and many other aspects of the hydrologic and geologic system within the watershed. This information is used to evaluate the current condition of the stream and surrounding landforms, types of activities that could benefit the stream (from changing landuse practices to implementing a restoration project), the likely effects of proposed land uses, etc.

4. **Use Support Determination**: During the next 10 years, the DEQ will continue to assess Montana waterbodies to determine the uses each stream should support, and if these uses are being met. If the uses are not being met, the waterbody will be added to the 303(d) List of Impaired Waterbodies. The DEQ is currently establishing the types of physical, chemical and biological data that will be accepted to determine if any of these components of stream health are below the limits a system should be supporting. By classifying a waterbody (Class A, B 1-3, C 1-3), the DEQ is establishing what can be expected of it, and then designating uses it should support. Then its condition and ability to supports uses is evaluated. A TMDL plan will be required to eliminated the causes of degradation and restore the designated uses to impaired waterbodies. See the DEQ website at http://www.deq.state.mt.us/ for further information.

### 2.2.2 Establishing Watershed Goals

The benefits of smaller, watershed-scale actions will be greater and more sustainable if they are planned in coordinated with larger, regional goals and programs. There are different types of national and regional conservation and water resource programs. The Clean Water Act is
the basis for many of the state-led efforts to maintain the physical, chemical, and biological integrity and beneficial uses (swimming, drinking, and fishing) of national water resources. The Endangered Species Act (ESA) was enacted to protect endangered and threatened species and their habitats. Under the ESA, the Montana Bull Trout Recovery Plan is being drafted to identify priority streams and restoration areas to preserve and restore for bull trout habitat. Similarly, a Voluntary Nutrient Reduction Plan has been outlined to reduce nutrient pollution to the Clark Fork River Basin and can be found at http://water.montana.edu/docs/lwgd/missoula.htm. Each of these laws and plans should be considered in outlining local watershed planning goals and identifying projects. The Montana Watershed Coordination Council (locate through http://water.montana.edu) and state environmental agencies (DEQ, DNRC, and DFWP) can assist in identifying and interpreting the meanings and implications of regional policies and national laws that affect watershed actions.

A watershed goal is a general statement that expresses the broad focus of watershed planning and management efforts (Council of State Governments no date). An example of a watershed goal is to restore the native cold water fishery that was once found in a stream. Local watershed groups define both short and long-term watershed goals as part of their watershed plans. Watershed goals give a group a sense of a common vision and direction, and define the purpose for their watershed activities. The Rock Creek Watershed Council (Noxon, Montana) has formalized their long-term, over-arching goals in their mission statement as:

"The Council is dedicated to serve as a forum for all interested parties and to provide for comprehensive watershed management and education in order to protect, restore and improve the surface and groundwater resources and all natural resources of the drainage for the enjoyment of the public and benefit of area communities, now and in the future."

These goals will serve as the foundation for any projects implemented and future management decisions will be evaluated against both the mission statement and more specific goals the council will establish. The Elk Creek Watershed Council (Noxon, Montana) has
identified specific goals that are included in their Total Maximum Daily Load (TMDL) assessment. In the TMDL, the Council identified how they will reduce the amount of sediment delivered to Elk Creek. The overall goal of the TMDL is to restore the quality of the creek to support native aquatic life populations. Goals adopted by other watershed groups in western Montana include: maintaining the quality and quantity of drinking water sources, implementing sustainable timber harvesting programs, weed control, landowner education, changing current grazing management strategies, and reestablishing riparian communities. In general, watershed plans need both broad and specific goals and a time line within which these goals will be met. This framework will define the direction and format under which the watershed council will proceed, the types of funding they can qualify for, the technical assistance that will be required, educational opportunities the community may benefit from, governmental agencies and other watershed groups to consult.

2.2.3 Developing Watershed Objectives and An Implementation Strategy

The success of a watershed conservation plan hinges on identifying the source of your watershed problem, selecting and successfully implementing meaningful projects, and monitoring the impacts of these projects. Once a watershed has been assessed, causes of degradation are identified, and broad conservation goals are agreed to, it is time to outline the steps a watershed group will take to restore the watershed and implement more sustainable land management practices. Usually several actions will be necessary to accomplish each goal. Watershed objectives are specific, measurable actions that are developed to support each aspect of a goal (Council of State Governments no date). It is important to make these objectives as specific, measurable and action-oriented as possible. Also, the time frame and person/party responsible for carrying out the objective should be included in the description. Keep the desired outcome in mind when formulating objectives. Does the group want to improve awareness about an issue,
gather watershed information, or encourage action among a target audience? The complete list of watershed objectives creates the implementation strategy the watershed group will follow.

For example, if a watershed group identifies one of their goals to be the creation of a partnership of stakeholders and other interested parties to address and restore watershed problems, the watershed objectives may be to:

1. **Build awareness of the value of a water resource in the community:** Mary Jo will make presentations in both local high school science classes during March. Joseph will visit the ranchers along Dirty Creek during winter to talk about individual problems each landowner has identified, and invite them all to participate in the planning effort.

2. **Publicize upcoming planning meetings:** Two weeks prior to the meeting, Henry will post fliers at the Post Office, store and gas station to announce our first informational meeting. He will also send out an announcement to the local newspaper to be published the week before each meeting.

3. **Identify watershed problems:** During the first 3 meetings (Jan-March) the entire group will discuss watershed problems they've experienced. John from US Forest Service, Barbara from Fish, Wildlife and Parks, and Peggy from the conservation district will present their opinions on forest, watershed and fishery health Jan.-Feb.

4. **Complete a technical watershed assessment during the coming year:** The consulting firm has not yet been identified but John (USFS) and Barbara (FWP) will review proposals after bids have been taken during February.

### 2.2.4 Monitoring Restoration Actions and Adaptive Management

Once a project has been completed, monitoring the project and resulting benefits to the ecosystem are critical components in the long-term success of any conservation effort. A holistic
monitoring plan usually employs both citizens and technical experts, and assesses multiple aspects of a watershed. Short-term monitoring evaluates if a project was installed completely and correctly, while long-term monitoring evaluates if it is working and resulting in the desired improvements. For example, long-term monitoring evaluates if a project is able to weather seasonal extremes and continue to perform as planned, if the biological population it was designed to help shows signs of improvement, etc.

It is important to link the monitoring plan to the goals and restoration projects that were undertaken. For instance, a goal may be to improve fish habitat found within a watershed. This goal requires both a short and long-term monitoring plan to gauge if the actions completed meet the objectives of the watershed group. The short-term monitoring may include a visual survey by citizens and experts to check on in-stream structures after they have been installed. Each year the project should be resurveyed by citizens to assess if it withstood the winter and spring extremes, and if repair is needed. The technical team may have an expert conduct a field assessment to gauge if the stream structure, deep pool frequency and riparian community are showing signs of improvement. Every three years the Department of Fish, Wildlife and Parks may conduct an extensive fish population survey to monitor changes in community composition. This type of approach can maximize the benefits of community participation, expert assistance and state resource managers’ cooperation and conservation efforts.

Restoration and land management actions may have unpredictable results due to the complex and ever-changing nature of natural communities. This type of uncertainty can be reduced with careful monitoring of key parts of a watershed. The assessment and monitoring methods previously described in Section 2.2.0 provide a strong foundation for understanding and measuring the condition of aquatic and land ecosystems, and technical advisors can assist in developing more complex monitoring programs if they are necessary. Adaptive management is a strategy that acknowledges the inherent uncertainty that exists in managing natural ecosystems.
giver their interconnected nature and natural complexity. Adaptive watershed management is based on making management decisions that use the best available scientific information and technical advice, and monitoring both intended and unintended effects of an implemented project. Through careful monitoring, adaptive management plans and actions are modified when an undesirable impact is found. Adaptive management espouses proceeding with caution, and when choosing between different restoration alternatives, prefers actions that are reversible over those that cannot be undone. Such a flexible approach is critical to the conservation of watersheds.

Wildlife is an example of a critical component in need of an adaptive management strategy in watershed conservation. For instance, if an area is designated and managed as bull trout habitat, and monitoring identifies that bull trout have not utilized the area in the last 5 years, management needs to accommodate this reality and change accordingly. Perhaps bull trout cannot access the protected area due to culverts, or perhaps there is insufficient water quality to keep them where the plan has allocated. Monitoring their population numbers, migration patterns, and habitat will probably illuminate where they are spending dry summer months and where efforts should be focused if trout protection is a goal of the conservation plan. Most types of wildlife are somewhat unpredictable in their behavior and monitoring habitat quality, population, and migration routes and barriers will create a picture of how they truly utilize a watershed. It is important to remember that fish do not necessarily change their habits and behaviors when people place a fish ladder in a stream and hope the fish know how to climb.

There are many references and expert opinions available on designing and implementing a monitoring program. Recommendations are available through state management agencies, the EPA and citizen monitoring guides for designing and implementing a monitoring system that will assist in measuring the health and change of aquatic and land ecosystems. Also, see the section on technical expertise at the Water Center's website at http://water.montana.edu. I have included an Additional Resource Section (Appendix C) with complete citations and details on how to find a
variety of watershed conservation information. The Additional Resource Section is organized from introductory materials on watersheds to more technical guides. Local people that live, work, play or manage resources in the watershed are a valuable part of knowing a watershed. With the knowledge, technical and financial assistance available through state and federal agencies, watershed groups and their local communities are an important link in watershed conservation and the restoration of waterbodies throughout the nation. The long-term successes of healthy ecosystems and the associated environmental and economic benefits from sustainable resource management will support these communities during the coming decades and into the 21st Century.
3.0 Case Studies: Different Stories of Watershed Conservation

The following case studies are based on examples of different watershed conservation efforts in Montana. The first example illustrates the strategies a local group utilized to gather stakeholders, assess their watershed, plan and implement a series of restoration projects in the Elk Creek watershed. This group was also able to complete a TMDL assessment that has been approved by the DEQ and EPA. The second group is an example of a basin-scale effort to write a water management plan and guide watershed conservation in the Upper Clark Fork River. Each of these groups has been able to overcome struggles that accompany planning and conservation efforts common to both small and large watersheds.

3.1 The Elk Creek Watershed Council

Across Montana, examples of ecological benefits achieved through combining local citizen efforts with county and state agencies are sprouting up. The Elk Creek Watershed Council is a prime example of the strengths of these cooperative efforts to protect and improve water and wildlife resources in a rural community in western Montana. Elk Creek lies within the Green Mountain Conservation District (GMCD) of Sanders County, Montana. In 1995, after a string of high run-off events, the residents of the Elk Creek Watershed joined together to form a watershed council. To date, this council has installed nearly 30 stream restoration projects, revegetated severely degraded portions of the riparian community, and continues to monitor the condition and health of the Elk Creek watershed (Miller, Mike 3 Nov. 1999). This council provides many insights into how a local community can mobilize and actively participate in watershed conservation and habitat protection. It is also an example of how a local resident can become a leader in these efforts by serving as a watershed coordinator, linking citizen concern with the technical and professional assistance available through environmental agencies.
Elk Creek is a tributary to the Clark Fork River, and drains a watershed of approximately 55 square miles. Within this watershed there are approximately 70 landowners, half of whom have creek-front property. During the winter of 1995, and again in the spring of 1996, there was a series of rainstorms that caused very high run-off in Elk Creek and neighboring watersheds. The high streamflows and saturated soils led to massive streambank erosion in many parts of the watershed (Miller, Mike 3 Nov. 1999). Local residents and the Green Mountain Conservation District (GMCD) were motivated by the bank erosion, potential loss of property, threats to county roads, and declining fish populations to improve the conditions of the watershed. During this period, GMCD had been looking to startup citizen-based watershed groups within the county. They decided to approach Elk Creek residents because of the interested landowners and identified resource concerns within the watershed.

Around the time of the flood events, Jill Davies (an Associate Supervisor at GMCD) contacted a number of the watershed residents to discuss the benefits of forming a watershed group for Elk Creek. Davies pointed out the need for restoration and the potential funding that would be available for stream restoration projects if a watershed group were created (Miller, Mike 3 Nov. 1999). Jill Davies was joined by Mike Miller (another local resident and property owner) in contacting watershed residents and initiating the watershed council. Both Davies and Miller were familiar with stream ecosystems and natural resource conservation because of their educational and professional backgrounds in science and natural resources. In preparing for the first meeting, other watershed residents were identified through county property records. Landowner names and addresses were compiled to create a mailing list to invite all of the watershed residents to the first informational meeting.

During these first meetings, Mike Miller was elected to be the chairperson and watershed coordinator for the group. The Green Mountain Conservation District assisted Davies and Miller with identifying agency contacts and expanding the list of potential interests in the Elk Creek
watershed. The Department of Environmental Quality and the Department of Natural Resource Conservation gave short presentations to support and encourage the watershed effort. The US Forest Service and the Department of Fish, Wildlife and Parks also voiced their support and offered to assist with future watershed projects. By the fall of 1995, the watershed council was officially formed, and monthly meetings were scheduled for the coming year.

The story of the Elk Creek Watershed Council has many happy moments and successes. In gathering together the stakeholders in the watershed, there was nearly complete interest and enthusiasm from all of the watershed residents (Miller, Mike 3 Nov. 1999). A few of the cattle ranchers within the drainage were reluctant to leap into conservation efforts that may directly impact their private operations, but all agreed that the creek needed some help. The agencies and GMCD supported the residents in their planning efforts by giving advice on how to start-up the watershed group, where to look for project funding, and applicable watershed programs that the group could benefit from. A technical advisory team was formed of agency personnel.

During the first few months, the ECWC established a mission statement and set of watershed goals. Everyone on the Council agreed that during the next 20 years they wanted to see Elk Creek running its full length with good water quality; healthy fish populations; a well managed riparian habitat; and happy neighbors in a healthy watershed. In these meetings the watershed council brainstormed ideas and created a list of watershed concerns including: bank erosion, degradation of the riparian area, livestock grazing on the creek, road impacts, potential impacts from US Forest Service management activities, low fish numbers, dewatered sections of the creek, and the condition of a culvert at the bottom of the watershed (Miller, Mike 3 Nov. 1999). To assess the general condition of the creek and riparian community, Davies and Miller walked the entire creek system mapping and photographing problem areas. The group agreed that this preliminary assessment was a start, but a technical assessment would be needed to identify specific projects.
In 1996, the ECWC received a grant through the Future Fisheries Improvement Program (Department of Fish, Wildlife and Parks) to conduct a technical assessment of the watershed. This funding was used to hire Watershed Consulting, LLP to complete an assessment of the stream, a landform analysis, and a hydrologic and fishery assessment of the watershed. Watershed Consulting, LLP then ranked the degraded parts and processes they had identified from high to low priority for restoration activities. Meanwhile, the watershed council had identified their own priorities for stream projects the group would support. The top priorities were to protect valuable human structures (residences, bridges and roads), decrease the amount of sediment in the creek, and improve fish habitat. Both the council and the consultants agreed that virtually all of the problems were caused by human impacts on the streamside and riparian areas (Miller, Mike 3 Nov. 1999). Council members then participated in designing and implementing a stream monitoring program that followed the Adopt-A-Stream guidelines to assess water quality, establish photo-monitoring sites, conduct a fishery evaluation, and survey stream cross-sections and stream profile.

Since the technical watershed assessment and citizen monitoring program were begun in 1995, nearly 30 projects have been completed along Elk Creek. The majority of these projects have been designed to reduce sediment and improve fish habitat while protecting human property. In 1997, the watershed council was approached by the Department of Environmental (DEQ) to discuss the possibility of completing a Total Maximum Daily Load plan given the types of assessments and restoration projects they had completed for the watershed. After the spring run-off in 1998, the DEQ and the Environmental Protection Agency assessed the condition of Elk Creek and decided that the causes of impairment had been addressed and the proposed TMDL was accepted.

Today, the RCWC meets every-other-month to discuss the condition of the watershed, new concerns, and the remaining two projects that are to be completed by 2001. Miller still
serves as the watershed coordinator and chairperson of the council, and recently a board of
directors was established to streamline the decision making process for small issues that arise.
Many of the landowners that were eager to create a watershed council in 1995 remain a part of
the core group of individuals who monitor and participate in the group’s activities. Both Miller
and some of the other councilmembers have been invited by the Bull Trout Recovery Team and
the Water Resources Technical Advisory Committee (Avista Utilities) to participate in
identifying problems and creating recommendations for the Lower Clark Fork River and other
tributaries in the basin. In many ways, this Council has become part of the fabric of the local
community and an integral part of conservation activities in their region.

3.2 The Upper Clark Fork River Basin Steering Committee

The upper Clark Fork River basin has been heavily impacted by mining, smelting, logging,
residential development and irrigation activities during the past 100 years. These activities have
impacted the condition of stream and riparian communities by contributing many types of
pollution to water and land resources, and by removing parts and processes that sustain these
ecosystems. Approximately 140 miles of the Clark Fork River have been designated as the
nation’s largest Superfund site due to the heavy metal concentrations that remain from past
mining activities (Harrington, M. and C.A. Hartwell 1999). Peak water demands during hot,
summer months exceed the amount of water in the river’s mainstem. Periodically, algae blooms
have reached “nuisance levels,” degrading aquatic habitat and recreational uses. There are over
160 “impaired waterbodies” in the upper Clark Fork River basin (Mueller, Gerald 17 Nov. 1999).
In this environment of competition and crisis for water resources, a locally based watershed group
has made progress in their efforts to plan for future human needs, while simultaneously protecting
the river basin from further degradation.
In 1991, after nearly 6 years of negotiations between local irrigation districts and the Department of Fish, Wildlife and Parks (FWP) over water use in the Clark Fork River, the Upper Clark Fork River Basin Steering Committee (the Steering Committee) held its first official meeting. This planning group was formed out of the desire of FWP and the Granite Conservation District (representing irrigation interests) to negotiate future water use and conservation in the basin. They also wanted to avoid expensive legal costs that are often incurred in allocating water reservation rights. The Steering Committee was the first Montana watershed group choose a cooperative and voluntary process to settle water allocation and conservation issues in an area the size of the upper Clark Fork River basin (Mueller, Gerald 17 Nov. 1999).

The story of the creation of the Steering Committee began when conflicting water reservation claims were filed with the Department of Natural Resource Conservation for the upper Clark Fork River and its tributaries. FWP was interested in maintaining instream flows (the water in streams and rivers) to benefit the aquatic communities within the basin, and Granite Conservation District was planning on constructing two dams to impound basin waters for future irrigation needs (Mueller, Gerald 17 Nov. 1999). It appeared that these two uses were in conflict and mutually excluding until all interests negotiated how the needs of water users in the basin could be met, while the streams and rivers in the watershed were protected from further degradation.

The Upper Clark Fork River Basin Steering Committee is a voluntary watershed group of 22 members, and has been facilitated or coordinated since its inception by Gerald Mueller, a local professional facilitator. The story of this watershed group is unique for many reasons. The Steering Committee was created through legislative action driven by negotiations between FWP and Granite Conservation District. Notably, the Steering Committee has succeeded in maintaining participation of traditionally conflicting environmental and natural resource interests. Mueller attributes the group's success to the personal interest of the participating committee members in
conserving water resources in the basin, and the consensus process the group has used to make decisions (Mueller, Gerald 17 Nov. 1999). Long-term participation of local interests has been critical in establishing the trust that has driven many of the creative (and sometimes unorthodox) agreements in the Upper Clark Fork River Basin Water Management Plan the group completed in 1994 (Mueller, Gerald 17 Nov. 1999). Today, the Steering Committee is one of the oldest watershed conservation groups in the region, planning for one of the largest watershed basins addressed by a volunteer group.

The following chronology is intended to highlight the path the Steering Committee has taken, and to provide examples of methods citizens may employ in forming their own watershed conservation groups. During their first year, the Steering Committee outlined how they would negotiate the various interests of committee members, and how planning meetings would be conducted and facilitated. A purpose/mission statement was agreed upon, and ground rules for meetings were outlined. Mueller was to be the facilitator, and as such, was responsible for planning where meetings would be held; drafting an agenda prior to each meeting that outlined topics to be addressed; recording “meeting minutes”; and in general, keeping the peace by holding participants to the groundrules the Committee had agreed upon. Mueller recommended that consensus-based decision making, where every committee member possesses equal power to veto the group’s decisions, be adopted by the Committee (Mueller, Gerald 17 Nov. 1999). This format, in addition to groundrules based on treating all committee-members with fairness and respect, created an environment where participants felt safe to voice their concerns and needs. Mueller attributes the continued participation of committee members to the environment that resulted from these codes of conduct. Local community members were encouraged to attend meetings; everyone listened to the concerns that were presented; and in time, voting committee members forged strong relationships based on a mutual desire to find the best way to manage water resources in the basin (Mueller, Gerald 17 Nov. 1999).
The Steering Committee provides watershed planners with a number of lessons on sustaining volunteer participation in watershed conservation. The local people that joined the Committee shared the following characteristics:

- every person felt that they would be personally affected by the results of the planning efforts;
- every person on the committee was empowered to directly influence the outcome of decisions through the consensus process; and
- the committee sought actions to meet everyone's needs, rather than compromises that failed to meet anyone's needs (Mueller, Gerald 17 Nov. 1999).

Today, the Steering Committee is viewed as a success by local communities and natural resource agencies at state and federal levels. This planning group has written a Water Management Plan for the Upper Clark Fork Basin - their original charge when they formed in 1991. They have based this plan on ecological principles and processes that influence the Clark Fork River, and have empowered local landowners and water users who directly impact the use of water resources to make the necessary changes to protect the river basin. The participants in this planning effort represent the political interests that exist throughout the basin including: natural resource agencies, irrigation districts, conservation districts, river users and advocates, and local landowners. The recommendations in the Water Management Plan are based on scientific assessments of the impacts of human activities on land and water ecosystems of the Clark Fork River watershed.

After the last decade of negotiations, the core committee members that continue to meet regularly have grown to be strong advocates for the river basin, sharing their concerns and lives during many months of planning meetings. The conflicts that nearly drove the two sides into the courtroom during the 1980's have been replaced by the commitment the group shares to find
solutions to water management conflicts. The Steering Committee continues to be one of Montana's most successful basin-scale planning and conservation groups due to the hard work, creativity and determination of local communities, natural resource agencies and conservation interests to protect rural communities and the natural landscape of Montana.
References Cited


Miller, Mike. Elk Creek Watershed Council Coordinator. 3 Nov. 1999. Telephone interview.


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Appendix A: Watershed Conservation Plan

PLANNING AREA:

Watershed name: _______________________________ Area

Part of:
Larger river basin: _______________________________

USGS Hydrologic Unit(s): _______________________________

NRCS unit(s): _______________________________

Located in:
state(s): ____________________ county (counties): ____________________

legal description (i.e. reference township and range demarcation from USFS maps):

______________________________

Attach a topographic map with watershed boundaries outlined.
(maps available from USFS).

Attach a general description of the planning area, including:

Watershed info:
climate info (mean annual & seasonal precipitation, typical temperature range)
elevation range
mountain ranges or other major geological features
soil types
natural community types, habitat types
wildlife of particular concern to local community
threatened or endangered species, species of special concern
land uses (types & areas)
water uses (types, volume of offstream use; is basin adjudicated, closed, overappropriated?)
population (human, livestock)

Waterbody info:
for each major waterbody give:
type (lakes, streams, ponds, wetlands, aquifers)
dimensions (length, width, depth, volume, mean & seasonal volume discharged)
designated uses (under the Clean Water Act), impaired uses and causes of impairment
is it on MT DEQ’s 303(d) List of Impaired Waterbodies in need of a TMDL?

Note: Most of the above information can be found through Natural Resource Information Service, the USFS, BLM and Natural Resource Conservation Service. DEQ can assist with designated uses and causes of impairment for waterbodies on the 303(d) List (see DEQ web page).
## OWNERSHIP OF PLANNING AREA
*(attach a map)*

### PUBLIC

**Federal:**
- U.S. Forest Service: __
- BLM: __
- Other: __

**State:**
- DNRC: __
- DFWP: __

**Local:**
- __

**Other public or conservation lands:**
- __

### PRIVATE (total)

- __

**TOTAL**

### PRIVATE
*(List each private property owner, total acreage and township and range for each parcel)*
ECOSYSTEM GOODS & SERVICES IN THE PLANNING AREA

Describe the resource uses and ecosystem services in the planning area (i.e. agriculture, grazing timber, recreation, wildlife habitat, streamflow maintenance, water purification, flood absorption, etc.). Also, note if the watershed contains habitat for threatened or endangered species, wetlands, public lands that are roadless, wildlife over-wintering habitat, etc.
CONSERVATION ISSUES IN THE PLANNING AREA
List conservation issues that have been identified. Consider bank stability, the presence and condition of the riparian community, all point and nonpoint source pollution, road condition and maintenance, noxious weeds, culvert placement and maintenance, fish habitat and migration barriers, plant community health, weed infestations, grazing practices and cattle impacts, residential development and septic systems, flooding problems, inadequate streamflows, stream channel modifications, groundwater depletion or contamination, etc. Also, consider loss or depletion of ecosystem services (e.g. flood absorption).
WATERSHED OBJECTIVES/IMPLEMENTATION STRATEGY:
Using the list of 'conservation issues', develop a list of watershed goals and SMART objectives. For each objective, list actions expected to advance the objective and generate an implementation strategy for each action that details: start date, who will be responsible for the project, and potential funding sources. Include monitoring to assess the effect of conservation activities, and adaptive management plans to modify actions or objectives as necessary.

Watershed Goal

Objective:

Actions proposed to accomplish objective:

1. Monitoring & adaptive management plan for other actions

   Participants and their roles:

   Start date and completion: __________________________
   Potential Funding: __________________________

2. __________________________

   Participants and their roles:

   Start date and completion: __________________________
   Potential Funding: __________________________

3. __________________________

   Participants and their roles:

   Start date and completion: __________________________
   Potential Funding: __________________________

Note: Continue listing planning objectives until all of the goals of the watershed conservation plan have been addressed.

Copy this page as needed
LIST OF SUPPORTING AGENCIES AND ORGANIZATIONS
Create a list of all participants that are supporting the watershed council including local conservation districts & other government agencies, conservation & other community groups, private individuals and corporate interests. Consider all parties directly or indirectly involved with conservation efforts.

Federal Agencies and contacts

State Agencies and contacts

Local Organizations and contacts

Private Landowners and contacts

Corporate Organizations and contacts

This template was designed in cooperation with Laurel Graham, Natural Resources Program Management, Silver Star, Montana, and Vicki Watson, UM Watershed Health Clinic
Appendix B
Primary Agencies and Organizations Participating in Watershed Conservation

Federal Agencies

- United States Environmental Protection Agency (EPA)
  The EPA is responsible for many issues pertaining to human health and the environment, including the implementation of the Clean Water Act. This agency shares regulatory and enforcement authority with other federal agencies to control hazardous materials, environmental pollutants, flood control, wetlands protection, wastewater discharge, public drinking water supplies, wildlife protection, and recreation. The EPA has developed the National Office of Wetlands, Oceans and Watersheds, to establish and direct efforts in watershed and water quality protection, aquatic and marine ecosystem assessment and restoration.
  
  Incentive programs:
  There are many grants available to non-profit groups and organizations for projects to restore and protect threatened and degraded ecosystems. See http://www.epa.gov/owow.

- United States Department of Agriculture (USDA)
  1. Forest Service (USFS): The USFS has responsibility for management and protection of national public lands. Their tasks include watershed protection; timber, range, fire and habitat management; road maintenance; weed control; etc.

  2. Natural Resource Conservation Service (NRCS): NRCS provides conservation training, planning and management to private landowners. NRCS is designed to enhance public educational opportunities and implementation of conservation programs; to provide assistance for approved conservation projects; and to improve agricultural operations to minimize environmental degradation. They administer federal funds through their incentive programs to achieve these ends.
    
    Incentive Programs include:
    A. Wildlife Habitat Incentives Program (WHIP)
    B. Environmental Quality Incentives Program (EQIP)
    C. Wetland Reserve Program (WRP)

  3. Farm Service Agency (FSA): FSA is a conservation and assistance agency that provides farmers and ranchers with opportunities to implement land conservation plans to reduce soil erosion and related resource problems. FSA administers farm commodity, crop insurance, farm credit, and conservation programs for farmers.
    
    Incentive programs include:
    A. The Conservation Reserve Program (CRP)
    B. The Agricultural Conservation Program (ACP)
• United States Department of the Interior
  1. Fish and Wildlife Service (FWS): FWS is responsible for the implementation of the Endangered Species Act and other habitat/wildlife conservation activities. They assess and monitor species of concern, and possess regulatory and enforcement power for conservation measures outlined through legislative decisions. They also manage wildlife refuges.

  Incentive Programs include:
  A. Partners for Fish and Wildlife Program
  B. North American Wetlands Conservation Program

  2. The Bureau of Land Management (BLM): The BLM is responsible for the protection and management of national public lands under their jurisdiction, including rangelands, forests and prairie systems.

  Incentive programs include:
  A. The Challenge Cost Share Program

• The Army Corps of Engineers, The United States Department of Defense: The ACE is responsible for maintaining the navigability of surface waters; wetland protection; the protection of human health and property; large-scale flood avoidance projects; and certain river channelization, levee creation and maintenance, and dredging operations.

Montana State Agencies
• The Montana Department of Environmental Quality (DEQ): The DEQ is responsible for administering many of the programs and policies created by federal law and delegated to the EPA. The DEQ possesses the authority to regulate and protect state surface and groundwaters, streambeds and banks, floodplains and wetlands. The state is divided into 3 regions (western, central and eastern Montana), and each region has a coordinator who works on watershed and TMDL issues.

  Incentive programs include:
  A. The nonpoint Source Pollution Prevention Program (also called the 319 Program, named after the section of the Clean Water Act where it appears). The 319 Program assists many types of activities associated with the planning, coordination and implementation of nonpoint source pollution mitigation and monitoring projects.

• The Montana Department of Natural Resources Conservation (DNRC): The DNRC manages and protects natural resources within the state of Montana. They manage water rights under the Water Use Act, and are the primary administrator for federal funds for many watershed conservation activities.

  Incentive programs include:
  A. 223 Grant Program: grants and loans to Conservation Districts for natural resource related projects, namely all phases of watershed planning and implementation activities.
  B. Conservation Education Mini-Grant Program: for curriculum development that includes environmental issues, teacher-initiated projects, etc.
C. Watershed Planning Assistance Grant Program: for start-up or continuation of local watershed planning activities, collection of baseline resource information, development of a watershed plan, educational workshops, etc.

D. Administrative Grants Program: to provide assistance to local conservation districts for operational and administrative purposes.

E. Montana Reclamation and Development Grants: for projects that repair, reclaim, and mitigate environmental damage to public resources from mineral extraction; including data collection, project planning and implementation activities.

F. Range Improvement Loan Program: low-interest loans for private landowners to implement range improvement practices that include stockwater development, cross-fencing, implementation of grazing systems, reseeding, and weed management.

G. Renewable Resources Grant and Loan Program: funding for data collection, planning and project implementation for renewable resource activities that include water, forestry, resource education, and waste management projects undertaken by any non-governmental entity.

- The Department of Fish, Wildlife and Parks (FWP): FWP is responsible for managing and protecting wildlife and wildlife habitat within state boundaries. Specifically, FWP regulates harvest of wildlife and protects habitat through enhancement of public education opportunities the implementation of conservation management projects. They provide technical advice to local Conservation Districts and many watershed groups.
  
  Incentive programs include:
  
  A. Future Fisheries Improvement Program: to restore and maintain native fish populations and their habitat.
  
  B. Montana Waterfowl Stamp Program: to protect and enhance waterfowl populations.
  
  C. Upland Game Bird Habitat Enhancement Program: to protect and enhance game bird populations.

- Montana University System and Extension: Provides educational and technical assistance for natural resource management issues and problems. The Montana Water Center (see their website at http://water.montana.edu) can assist with identifying appropriate faculty and staff experts for resource management questions.

County Agencies

- Soil and Water Conservation Districts (CD's): Local CD's assist landowners with planning and project implementation to conserve natural resources, resource education, weed control, etc.

- Offices of Planning and Grants (OPG): Most urban areas have an OPG for planning and administration activities necessary to sustain infrastructure, emergency preparedness, development, city improvements and planning documents.

- Water Quality Districts (WQD): WQD's are a part of city/county government and as such, are recognized institutions (supported by local taxes) to protect water resources. Missoula's WQD is the oldest in Montana, and is responsible for monitoring and
protecting surface waters and the Missoula aquifer. The Missoula WQD is responsible for the passage of the Aquifer Protection Ordinance, the Septic Ordinance and other enforcement actions that have been taken to protect the quality and quantity of water under their jurisdiction. WQD's are an effective way to protect and conserve water resources in more populated areas where long-term, costly studies and records are needed to protect and plan for future water resource needs.

- Health Departments: The Health Department is responsible for monitoring and enforcement of state and federal standards that protect human health from exposure to chemicals and pollutants. The Health Department is responsible for notifying the public when a health threat has been detected.
Appendix C
Additional Resources

Key handbooks and field guides
(organized from introductory materials to more technical guides)


NOTE: There are many more guides available for free through the internet provided by local conservation organizations, agencies and information clearing houses on Best Management Practices for grazing, forestry, mining; case studies; etc.
Key watershed related web sites

1. Montana Water Center/Montana University System at http://www.montana.edu/ This website provides links to many water and watershed related websites.


3. US Environmental Protection Agency’s public education program on water quality and stream restoration at http://www.epa.gov.owow

4. The US Environmental Protections Agency has recently completed an internet site on model and real-life examples of local ordinances that address: aquatic buffers, erosion and sediment control, open space development, stormwater control and maintenance, post construction run-off control, and forest and wetland protection (look under miscellaneous). The site also includes examples of supporting materials such as: meeting notices, check lists, and links to other web pages. See http://www.epa.gov.owow/nps/ordinance

5. The US Geological Survey has on-line water information (maps, streamflow data, etc.) as http://water.usgs.gov/

6. The Montana Rivers Information System (MRIS) is a database containing information on fish and stream information. Other stream or reach level data include angling use, fisheries resource classification, protected designation, instream flow reservations, stream channel conditions and other data for over 4,500 streams and rivers in the State of Montana. The database is managed and maintained by the Fisheries Division of the Montana Fish, Wildlife, and Parks and is annually updated through interviews with MFWP, USFS, USFWS and BLM fisheries biologists. The system is available through NRIS's Water Information Home Page or directly at http://web1nris.state.mt.us

Text books and other reference materials available at most college/public libraries or through individual publishers:


5. Brower, David. Let the Mountains Talk, Let the Rivers Run.
Appendix D
A Glossary of Common Ecological and Watershed Related Terms


A
adaptive management: A management strategy that acknowledges the inherent uncertainty that exists in managing natural ecosystems given their interconnected nature and natural complexity. Adaptive watershed management is based on making management decisions that use the best available scientific information and technical advice, and monitoring both intended and unintended effects implemented project. Through careful monitoring, adaptive management plans and actions are modified when an undesirable impact is found. Adaptive management espouses proceeding with caution, and when choosing between different restoration alternatives, prefers actions that are reversible over those that cannot be undone.

anadromous fish: Fish that leave freshwater and migrate to the ocean to mature then return to freshwater to spawn.

algal/algae bloom: Rapid growth of algae in a waterbody, commonly stimulated by nutrient enrichment.

antidegradation policy: A policy every state must outline and follow for protecting all existing uses, keeping clean high quality waters at that high quality, and giving strict protection to outstanding waters within their jurisdiction. Antidegradation policies are required from each state under the Clean Water Act

aquifer: An underground bed of saturated soil or rock that yields significant quantities of water.

B
bank stabilization: Implementing measures along a streambank to prevent or reduce bank erosion.

base flow: Portion of stream discharge derived from such natural storage sources as groundwater, large lakes, and swamps but does not include direct runoff or flow from stream regulation, water diversion, or other human activities.

basin: See river basin.

basin closure: The legal termination, either temporary or permanent, of the issuance of water rights in an entire river basin, or upstream of a designated location on a river.

beneficial uses: The use of water for the benefit of the appropriator, other persons, or the public, including but not limited to agriculture, domestic, fish and wildlife, industrial, irrigation, mining, municipal, and recreational uses.

best management practices: Methods adopted by resource users to control nonpoint source pollution or maintain the health and integrity of the watershed.

benthic: Bottom dwelling or substrate-oriented; at or in the bottom of a stream or lake.
bioengineering: Combining structural, biological, and ecological concepts to construct living structures for erosion, sediment, or flood control.

biological diversity (biodiversity): Variety and variability among living organisms and the ecological complexes in which they occur; encompasses different ecosystems, species, and gene forms.

biological integrity: The ability of an ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region; a system’s ability to generate and maintain adaptive biotic elements through natural evolutionary processes.

biological oxygen demand (BOD): Amount of dissolved oxygen required by decomposition of organic matter in water.

biomass: Summed mass or weight of individuals in one or more species, usually related to a defined area or volume; a measure of the abundance of a life form.

braided stream: Stream that forms an interlacing network of branching and recombining channels separated by branch islands or channel bars.

C

carrying capacity: Maximum number of organisms that can be sustained in a habitat over the long term. Usually refers to a particular species, but can be applied to several species with similar resource needs.

channelization: Artificially straightening the meanders of a river; often accompanied by placing riprap or concrete along banks to stabilize the system.

check dams: Series of small dams placed in gullies or small streams in an effort to reduce the erosive power of water.

Clean Water Act: Passed in 1972, this federal act directs the Environmental Protection Agency to set nationwide criteria and policies to restore and protect water quality.

combined sewer overflow: Overflow from sanitary and storm sewers.

confluence: Joining. Commonly used in reference to where two rivers or streams join into one.

consensus: A process whereby every decision must be approved by all participating persons, and every person maintains the power to veto the final decision of the group.

conservation: Sustainable use of ecosystems and their associated resources and services; the continuing protection and management of ecosystems in accordance with principles that prioritize their optimum long-term ecological, economic and social benefits.

cumulative impacts: The combined effect on an ecosystem’s integrity of all of the land and water uses within a watershed or basin. These impacts can have a synergistic impact that is greater than simply adding them together.

D
designated use: Designated uses are human and ecological water uses that are officially recognized and protected under the Clean Water Act.

dewatering: the action of diverting water from a stream to offstream use, depleting the water resource and possibly interfering with other uses.
discharge: An outflow of water from a stream, groundwater system, pipe or watershed.

disturbance regime: Characteristics (timing, duration, and intensity) of natural (occasionally artificial) disruptions such as floods, wildfires, volcanoes, etc. Natural disturbance regime is the regime that occurred before human-caused disturbance became significant.

diversity: The richness and variety of species, habitats, or ecosystems.

E

ecological restoration: Involves replacing lost or damaged biological elements (populations, species) and reestablishing ecological processes (dispersal, succession) to more natural levels.

ecosystem: A biological community together with the chemical and physical environment with which it interacts.

ecosystem management: Management that integrates ecological relationships with sociopolitical values toward the general goal of protecting or restoring ecosystem integrity over the long term.

effluent: A waste liquid discharged from a manufacturing or treatment process into the environment.

enhancement: To improve stream or watershed quality. Enhancement activities include restoring large woody debris to a stream to improve fish habitat, revegetating riparian vegetation, decreasing point source pollution caused by logging activities to improve water quality, etc.

ephemeral: Streams and creeks that flow only during periods of intense rainfall or high groundwater. See perennial and intermittent.

erosion: The wearing down or washing away of the soil and land surface by the action of water, wind or ice.

eutrophication: A process in which a waterbody becomes more nutrient-enriched, aquatic life increases, and dissolved oxygen and other water chemistry parameters fluctuate more widely, reducing the suitability of the habitat for some life forms.

F

floodplain: The relatively flat area found along a stream through which the stream flows periodically when it overflows its banks. Floodplains slow and absorb high flood waters, and depend on the sediment deposited during flood events for normal ecosystem processes.

G

goal: General statements that express the broad focus of the entire planning and conservation effort. A goal of many watershed conservation efforts is to restore wildlife habitat populations and beneficial uses. Compare to objective.

groundwater: Water in porous material beneath the ground surface that supplies springs and wells.

H

habitat: The environment where a plant or animal grows or lives.
**habitat modification**: Activities that destroy or degrade the physical integrity of an aquatic or terrestrial ecosystem. In an aquatic system, habitat modification results from changes in streamflows, lake levels, water temperature.

**headwaters**: Upper tributaries of a river or stream; the water source from which the stream or river originates.

**hydrologic cycle**: The constant circulation of water from the sea, through the atmosphere, to the land, and back to the sea by overland, subsurface, and atmospheric routes.

**impacted waters**: Waters that do not fully support their designated uses.

**infiltration**: Water that seeps into the soils.

**instream flow**: Water in streams or rivers that is used for nonconsumptive purposes such as the preservation and enhancement of fish, wildlife, recreation, navigation, and power generation.

**intermittent stream**: A stream that has flowing water only part of the year.

**irrigation**: The controlled application of water to cropland, hayland, and/or pasture to supplement water supplied by nature.

**lentic system**: Aquatic ecosystems that consist of relatively slow-moving bodies of water (i.e. lakes, ponds and wetlands).

**Lotic system**: Aquatic ecosystems that consist of relatively fast-moving bodies of water (i.e. streams and rivers).

**macroinvertebrates**: Macroinvertebrates are animals without backbones yet are large enough to be visible to the naked eye. In this guide, macroinvertebrates refers to insects that live in a waterbody during any part of their life cycle, plus other stream bottom dwellers (clams, worms, snails, crabs, shrimp, beetles, etc.).

**mainstem**: A wider, deeper stream or river channel that is joined by smaller, headwater tributaries.

**meander**: The curves in a stream as it flows through its floodplain.

**mitigation**: An action designed to lessen or reduce adverse impacts; frequently used in the context of minimizing harm to the environment.

**mixing zone**: A designated portion of a waterbody wherein mixing of an effluent is not yet complete, hence a state waives water quality standards. Standards apply below the mixing zone, where mixing is thought to be complete.

**monitoring**: A method of evaluating the condition of a stream or specific part of an ecosystem. Monitoring systems use physical, chemical and biological measurements to track the condition and changes in a watershed or stream ecosystem.
natural flow: The flow of a stream as it would be if unaltered by any upstream activities, including: diversion, storage, import, export, or changes caused by development in floodplains, etc.

nonconsumptive use: The use of a resource that does not decrease the supply, flow or level (i.e. canoeing, fish spawning, etc.).

nonpoint source pollution: Contamination that originates from activities over a broad area of land. Also called polluted run-off or seepage.

nutrients: Elements or compounds essential to life, including carbon, oxygen, nitrogen, phosphorus, and many others.

objective: Specific, measurable actions developed and implemented to support each aspect of a goal. Compare to goal.

perennial stream: A stream that flows year-round.

plan: A compilation of goals and objectives, policy statements, and implementation strategies for guiding actions or decisions to meet perceived needs or to avoid problems.

point source pollution: Pollutants discharged from an identifiable point including pipes, ditches, channels and sewers. All point sources of pollution require a discharge permit from the state.

precipitation: Water falling, in a liquid or solid state, from the atmosphere to a land or water surface.

reach: Any designated part of a stream along its length.

recharge: The addition of water to rivers or aquifers which tends to raise or maintain the water table.

rehabilitation: To restore a portion of a watershed to good health. Rehabilitation projects include replanting riparian vegetation in areas where clearing has occurred; restoring the physical structure to a stream to improve a fishery; etc.

remediation: To correct or remove causes of degradation; to put right. Watershed remediation may include removing dams, culverts, restoring a river's access to its floodplain, etc.

restoration: A holistic process aimed at reestablishing ecosystem structure and function (ecosystem parts and processes).

return flow: A portion of water diverted from a source which returns to the stream unconsumed, often further downstream and later in time.

riparian vegetation: The plant community adjacent to a stream or lake that requires shallow groundwater. Common riparian vegetation includes sedges, willows, alders and cottonwoods. Riparian vegetation is important to the aquatic community as it provides organic material, shade and cover while stabilizing streambanks and serving as a buffer between landuses within the watershed and the waterbody itself.
riprap: Rock, concrete or other materials placed along a streambank as a protective layer to prevent or reduce bank erosion.

river basin: Like a watershed, this term refers to the area from which water drains into a single waterbody. Commonly this term is used to refer to a greater land area than a watershed.

runoff: See surface runoff.

S
salmonid: Fish of the family Salmonidae, including: salmon, trout, chars, whitefish, ciscoes, and grayling.

sediment: Fine soil-like particles produced by the weathering of soil and rock. Suspended sediment is that which is suspended in the water column of a stream or lake.

surface runoff: Precipitation (rain or snow) that reaches the ground and remains on the surface, until it runs off into streams and lakes as overland flow. Compare to infiltration.

surface water: Water on or above the surface of the land, including lakes, rivers, streams, ponds, flood water, and runoff.

T
terrestrial: Living or growing on land.

topography: The three-dimensional shape of the land surface.

Total Maximum Daily Load (TMDL): A watershed-wide pollution budget and associated clean up plan. TMDL refers to the maximum amount of pollutant or disturbance that a waterbody can assimilate without unacceptable change (impairment). TMDLs are required for waters on a state’s list of impaired waterbodies.

tributary: A smaller feeder stream that empties into a larger mainstem stream.

W
water body: A stream, river, lake, wetland or ocean.

water budget: An accounting of the inflows and outflows of water to and from a system.

water right: A legal right to use a specified amount of water for beneficial purposes (under the doctrine of prior appropriation which holds in the western US).

water quality criteria: Numeric or narrative descriptions of the conditions considered necessary to protect a desired water use as required under the Clean Water Act. See designated use.

watershed: The entire surface drainage area that contributes water to a water body (river, lake or wetland). Also called a catchment area or a drainage basin.

watershed integrity: the capability of a watershed to support a healthy, viable biological community and the hydrologic, evolutionary and habitat requirements a watershed ecosystem depends upon. Tangible measures of watershed integrity include: water yield and quality; species composition, diversity, and abundance; wildlife use; and genetic diversity.
**weed**: Plants that threaten the welfare of an ecosystem or human commodity by competing with other plants.

**wetland**: A landform characterized by the presence of water, saturated soils, and water-loving vegetation.