
CARMEL RIVER WATERSHED STEWARDSHIP MANUAL

*A User's Guide
for Landowners and Residents*



Resource Conservation District of Monterey County
& members of the Carmel River Task Force
January 2013

CARMEL RIVER WATERSHED STEWARDSHIP MANUAL

A User's Guide for Landowners and Residents

This manual is built upon the work of
Yolo County Resource Conservation District
and the *Capay Valley Conservation and Restoration Manual*

TABLE OF CONTENTS

Introduction..... 3

The Watershed

 Carmel River Watershed..... 5

 Carmel River Watershed Map 11

 Watershed Processes.....12

Conservation and Stewardship Practices16

 Practices for Your Home18

Residential Property and Landscape Management.....18

 Gutters and Downspouts.....19

 Rain Water Catchment Systems21

 Water-Wise Landscaping..... 23

 Rain Gardens..... 25

 Permeable & Pervious Hardscapes..... 27

 Garden Swales.....29

 Home Composting32

 Practices for Your Property33

Fire Management 34

 Fire Protection for Your Home35

 Brush Pile Reduction37

 Prescribed Burns..... 39

Equestrian and Livestock Management..... 41

 Horse Manure Management..... 43

 Tracking Pasture Health 45

 Matching Stocking Rate to Carrying Capacity.....49

 Swinging Flood Gate on a Fence.....51

 Wildlife-friendly Range Fence.....53

 Stock Pond Habitat Enhancement..... 55

CONTENTS, CONTINUED

Practices for Large Acreages and the Watershed	59
<i>Vegetation Management</i>	60
Hedgerows	61
Vegetated Filter Strips	65
Riparian Buffers	67
Native Perennial Grass Establishment.....	69
Cover Crops	71
Invasive Weed Control.....	73
<i>Drainage/Erosion Management and Bank Stabilization</i>	75
Rural Road Management.....	77
Erosion Control Blankets	79
Mulching	81
Straw Wattles	83
Willow Wattles.....	85
Live Staking and Pole Planting.....	87
Brush Layering.....	89
Brush Mattress.....	91
Gully Repair.....	93
Headcut Repair.....	95
Management Resources	
Native Plant List for the Carmel Valley	97
Invasive Weed Control in Monterey County.....	101
Plant Materials Sources	105
Vendors & Suppliers.....	106
Cost-Share Programs.....	107
Permits and Regulations.....	110
Twelve Practical Tips for Getting Your Project Approved.....	113
List of Carmel River Watershed Stakeholders.....	114
Glossary.....	120
References.....	126
Images and Sources.....	129

INTRODUCTION

Purpose Of this Manual

Do you find yourself constantly battling unwanted weeds on your land? Are you challenged by trying to match your animals' needs with the capacity of your property? Don't know what to do about that gully that just gets larger every year? The *Carmel River Watershed Stewardship Manual* provides potential solutions to these and many other resource concerns in Carmel Valley.

This manual was developed with input from resource management professionals, local stakeholders, community groups, organizations, and agencies. Its purpose is to provide techniques to support solutions for many of the resource issues (e.g. erosion, groundwater overdraft, invasive plants) experienced in the Carmel Valley. Techniques range from roof runoff management to rural road erosion control to wildlife-friendly pond and pasture management.

In the manual, techniques are referred to as 'practices' Think of each practice as a tool in a land stewardship toolbox. Remember that it is critical to know what you are doing and why you are doing it before using a given tool, and that the necessary first step in treating a resource concern is distinguishing the symptom (e.g. an eroding streambank, gully, or a field of thistle) from the source of the symptom (i.e. the problem) to enable you to develop an appropriate plan that addresses the problem fully to insure the symptom(s) won't recur. Where possible, it's a good idea to seek professional guidance in this process to ensure that 1) you choose the correct "tool" or "tools" to best fix the problem, and 2) you implement your chosen tool(s) for maximum effectiveness. A number of resource professionals are available for free, confidential on-site consultation in the region, and in some cases, rebates or cost-share assistance is available to reduce the cost of implementation. These resources are listed below, at the back of the manual, and in context with each practice.

We've designed this manual to be easy to use, update, and share. In most cases, the essential techniques for each practice have been condensed and refined to fit on one page, front and back. The information contained on the practice pages is intended to be succinct, yet informative enough to enable you to ascertain the relevance and feasibility of the practice for your situation. Each practice sheet provides references with more detailed information for planning and implementation. Professional resources include: the Resource Conservation District of Monterey County and the USDA Natural Resources Conservation Service, Salinas Field Office for technical assistance and cost-share programs; Cal-Am Water Company for rebate programs and educational information; and Monterey Peninsula Water Management District for technical assistance and educational information. Please refer to the Cost-Share Programs section in this manual for more details and contact information.

This manual is a working document. It was compiled and written for you to use, with information that is relevant and useful to the residents and landowners of the Carmel River Watershed. The format is designed to allow users to add pages as the community identifies new needs and seeks out new solutions to resource issues. Suggestions, comments, and additions should be directed to the Watershed Coordinator at the RCD of Monterey County.

As a final note, there are several resource concerns that are not directly addressed in this manual. These concerns include flooding, soil quality (e.g. compaction, salinity, alkalinity, etc.), and crop predation by wildlife, among others. It is possible that techniques to deal with these concerns will be added to this manual in the future, as interest and demand dictate. We understand that there are several important techniques or issues that are only mentioned briefly in this manual. We encourage you to contact the

agencies and read the materials referenced throughout the manual to learn more about these techniques or issues.

How To Use this Manual

The manual does not need to be read from cover to cover to be useful. The introductory sections on the Physical Setting and History of the Carmel River Watershed, and Basic Watershed Processes provide useful information on how watersheds function and the unique features of Carmel Watershed. Knowledge of watershed function and form can aid in understanding the processes affecting your property.

With that information, you can identify the causes of a problem on your property and decide what needs to be done to rectify it. The practices in this manual are divided into categories based on their relative proximity to your home: *Practices for your Home*, covering residential property and landscape management; *Practices for your Property*, including fire management and equestrian and livestock management; and *Practices for Large Acreages and the Watershed*, including vegetation management and drainage/erosion management and bank stabilization. Most categories are not mutually exclusive - some practices are applicable to situations that occur in all three categories. Vegetation management practices are applicable in residential as well as rangeland areas. A list of the practices described in this manual can be found on page 17.

The appropriate practices for your resource concerns may be obvious from the titles listed in the Table of Contents, or you may need to read about each practice to find the one (or more) that fits your project's needs. Each practice is described briefly in a stand-alone document. These practice summaries begin with a description of the practice and the conditions or situations where the practice can be effectively implemented. If relevant, there is a list of materials and equipment required to implement the project, followed by a more detailed section on practice implementation, information about maintaining the practice and a list of the documents referenced for that specific practice and important references for the more detailed information you will need for undertaking the practice yourself or with professional assistance. In some cases the implementation section extends beyond the one to two paragraph format to allow for a more detailed discussion of the practice.

Additional useful information can be found at the end of the manual. These resources include native plant lists, a listing of local plant material suppliers, erosion control products and irrigation system suppliers, contacts for technical assistance, a description of public and local programs for project technical and financial assistance, detailed information on potentially necessary permits and regulations, a listing of watershed resource and 'stakeholder' organizations, a glossary of terms used in the manual, and a list of useful reference materials.

Acknowledgments

This manual was adapted from the *Capay Valley Conservation and Restoration Manual*, developed by the Yolo County Resource Conservation District. Funding for development of the original manual and its adaptation for the Carmel River Watershed was provided through the Watershed Coordinator Grant Program, administered by the California Department of Conservation. The manual adaptation would not have been possible without hours of skilled design and editorial work volunteered by Kathleen Robins.

CARMEL RIVER WATERSHED

Introduction

A watershed is more than a physical landscape defined by its highpoints and the outlet from which all water flows. Watersheds support a variety of resources, uses, activities and values, where everything is linked in such a way that that eventually all things are affected by everything else in the watershed.

Regional Setting

The Carmel River forms the spine of a dynamic Monterey County watershed that has complex patterns of land use, physical conditions, and natural resources. The river flows northwest from its headwaters in the conjoined uplands of the Santa Lucia Mountains and the Sierra de Salinas, entering Carmel Bay near the town of Carmel-by-the-Sea. The River is 36 miles long, and drains 255 square miles of national forest, range, farm, and urban lands.



The Carmel Valley is the northernmost of a series of northwest-southeast trending valleys dissecting the rugged Santa Lucia mountains of the California Coast Ranges. The Sierra de Salinas forms the northeastern divide of the watershed and the northern terminus of the Santa Lucia Mountains forms the southwestern divide. Like the neighboring Salinas River and most other watersheds near the California Coast Ranges, the Carmel watershed owes its overall geometry and physical orientation to its bedrock framework, myriad faults, and climate and river erosion.

It is estimated that the Carmel River watershed has been home to humans for 6,000 years, and currently hosts approximately 12,000 people. It provides essential habitat for many important wildlife species, including migratory and resident birds; at-risk species such as Pacific lamprey, western pond turtle, and California tiger salamander; and federally-protected steelhead trout and California red-legged frog. The watershed's size, location, climate, topography, and complex geology provide the foundation for diverse plant communities comprising redwood forest, Monterey pine forest, coastal scrub and prairie, oak woodlands, riparian forest and coastal marsh. Interior plant communities include chaparral, grasslands, and mixed oak savannah woodlands, and coniferous forest at the highest elevations.

Habitat & Vegetation

The dominant plant communities and habitat zones that occupy the Carmel River Watershed include the following:

The **upland zone** extends from the high mountain ridges all the way to the valley floor. This zone offers

habitat for deer, coyote, and other terrestrial, land-based wildlife. This plant community typically includes drought tolerant plants and oak woodlands. **Mixed oak woodland** habitat covers most north and east facing slopes, steep drainages, and many ridges between the steep canyons. The most common trees found in these woodlands are coast live oak, blue oak, black oak, California bay laurel, big leaf maple, toyon, coast redwood, and buckeye.

The **California Annual/Perennial Grassland** is the most widespread plant community in the watershed. The grassland plant community occupies the tops of ridges, slopes and the valley floor. Grasslands within the watershed support diverse plant communities and provide important habitat for a number of birds and animals.

Riparian areas are narrow bands of vegetation adjacent to streams that are dependent upon the elevated water table associated with the river. Although a relatively small portion of the watershed, riparian areas play a critical role in overall health of the watershed. They reduce the energy of flood flows, recharge the groundwater aquifer, provide shading to maintain cool water temperatures, help trap sediment and excess nutrients, and provide cover, food, breeding areas and water for wildlife. Clean gravel, abundant food sources, a variety of pools and riffles, plenty of places to hide, and clean, cool water are all important elements of good stream habitat.

Trees like willows, cottonwoods, sycamores, and big-leaf maples dominate riparian areas. A variety of shrubs grow under the trees including poison oak, elderberry, California blackberry and California wildrose.

The Carmel River Lagoon and Estuary play critical roles in supporting habitat critical to the survival of fish and reptiles in the river system. The Carmel River Estuary, partly-owned and managed by the California Department of Parks and Recreation, represents the interface between the watershed and the Pacific Ocean. Most of the estuary and present wetlands lie within the Carmel River Lagoon and Wetland Natural Preserve, part of the Carmel River State Beach. Watershed and ocean processes, and the seasonal relationship between the quantity and quality of water, sediment and physical energy dynamics provided by the Carmel River control the estuary hydrology and morphology.

The estuary has been altered historically, primarily west of Highway 1, where levees were constructed to reduce the size of the estuary and control flood flows to accommodate farming, which continued through the 20th Century. The estuary is generally physically closed off from the Pacific Ocean from approximately May through October, during which time water levels are sustained by the groundwater migrating down the river valley to the ocean. During winter high flows, an opening to the ocean is made through the barrier beach by the Monterey County Resource Management Agency to prevent flooding of homes and infrastructure in low-lying areas to the north. The estuary supports abundant wildlife, coastal bird and fishery populations, and is recognized as one of the most important ecological sites along the Central Coast. In particular, the estuary habitat is critical to a significant population of native steelhead, and also supports the California red-legged frog. A number of estuary enhancement projects have been implemented in the State Park in recent years, funded by the California Department of Transportation, the State Coastal Conservancy, the Big Sur land Trust and the Monterey County Water Resources Agency.

Fish and Frogs

The steelhead trout (*Oncorhynchus mykiss*) and California red-legged frog (*Rana draytonii*) are two key wildlife species in the watershed that are currently listed as threatened at the federal level.

Detailed biologic information and data gathered since the mid-1980's on steelhead numbers and habitat, channel form, water quality, and riparian vegetation confirms that many reaches of the Carmel River and

its tributaries can provide high quality, productive habitat for steelhead. However, the current steelhead population is below historic numbers for the Carmel River and is well below populations found in Northern California coastal streams.

Likely factors contributing to this decline include habitat fragmentation and degradation, impaired fish passage, water diversions that alter natural streamflows, and introduced non-native predator species. Other contributing factors may include water and air pollution and events outside of the watershed such as changes in the ocean-going steelhead population. The numbers of returning steelhead adults hit a low in the early 1990s, and the run was declared to be nearly extinct by the California Department of Fish and Game (McEwan and Jackson, 1996). The most significant fish passage problems are at the main stem dams and reservoirs, but passage in tributary drainages may also be hindered by poorly designed and constructed culverts. Water diversions from the basin reduce flows for adult migration and juvenile rearing. Habitat degradation from within stream channels, loss of riparian vegetation, and reductions in water quality also limit the population.

The number of returning adults has rebounded from the drought years of 1987-1991 when only a handful of fish were counted and appears to have stabilized in the range of 300-800 fish passing San Clemente Dam each year. Upstream of Los Padres Dam, adult returns have averaged 122 fish since 1992 after the end of the last drought. Since 1995, the number of adults counted at San Clemente Dam has ranged from a low of 388 fish in 2004 to a high of 861 fish in 1998, with a clear upward trend during the seven-year period immediately following the 1987-1991 drought. There has also been a sharp recovery of the juvenile population since the 1987 to 1991 drought.

The listing of California red-legged frogs (CRLF) in 1996 as a threatened species by the U.S. Fish and Wildlife Service (USFWS) has triggered additional scrutiny of water extraction and land management practices in Carmel Valley and has required development projects to undergo extensive investigations and monitoring for CRLF. Although these frogs are found in many areas within the watershed, it is unclear whether the population is growing, shrinking, or stable. Most of the information gathered about this species is from observations in the Carmel River lagoon, along the main stem, and at San Clemente Reservoir.

The cumulative effect of human influences has resulted in a fragmented environment in the lower 27 miles of the river that requires intensive management efforts. Between Los Padres Dam and the Narrows (a narrow stretch of canyon just downstream from Garland Park), flow releases from storage are required in summer to maintain aquatic habitat. The lower 10 miles of the river (downstream of the Narrows), where the impacts from water extraction are concentrated, requires irrigation and maintenance of streamside vegetation, reconstruction of streambanks after high winter flows, annual CRLF and steelhead rescues, habitat enhancement activities, and extensive monitoring. Regulation of water extraction from the basin is in effect under orders from the California State Water Resources Board (Order No. 95-10 and subsequent related orders). A program to mitigate for the effects of water extraction on the main stem is carried out locally by the Monterey Peninsula Water Management District under its Mitigation Program.

Water Supply, Land Use and Urbanization

The Carmel River watershed provides the majority of the drinking water for residents of the watershed and surrounding communities. Water from the Carmel River has been exported to the Monterey Peninsula since 1882 when the first dam on the Carmel River was built. As the demand for water increased, two more dams were subsequently built. The San Clemente dam was built in 1921, with a capacity of 1,300 acre feet. Las Padres dam, with 3,200 acre feet of storage capacity, was completed in 1949. As of 2012, the San Clemente dam is functionally non-operational due to siltation, and is slated for

removal, while the Los Padres dam's function is solely for habitat management.

Beginning in the 1950s, suburban development, groundwater pumping and other natural events including fire and drought, created conditions that resulted in extensive bank erosion, riparian habitat degradation, incision in the river channel, and a reduction of the rate at which groundwater infiltrates into the soil and recharges the aquifer. These conditions directly impacted groundwater, and adversely impacted property and wildlife habitat in the watershed.

While flooding, bank erosion, and significant vegetation loss have occurred at various times, they have become increasingly persistent, causing damage to the Valley's resources and raising concern from residents. The origins of this instability are complex, and have been traced to a variety of causes that include the particular terrain and flow regimen of the Carmel River, early clearing and grazing of the Valley for agriculture, impoundment of water and sediment retention at San Clemente and Los Padres dams, development of the floodplain, vegetation removal, groundwater pumping, fire suppression in the surrounding watershed, and periodic floods and droughts. In summary, over a two hundred year period, the watershed has been disrupted by extensive damage to the physical environment, adversely affecting private property, fish and wildlife resources, visual quality and recreational values.

Water Quality

The Carmel River watershed is composed of the many ephemeral and perennial tributaries that join together to form the Carmel River. Eleven principal tributaries drain into the Carmel River: Potrero Canyon, Robinson Canyon, Garzas Creek, San Clemente Creek, Pine Creek, Danish Creek, Ventana Mesa Creek, Blue Canyon, Bear Trap Canyon, Bruce Creek, Cachagua Creek, Tularcitos Creek (see map, page 11). Each creek and stream in the watershed has its own sub-watershed. The health of streams in the watershed depends on many factors: water quality; water temperature; the amount of sunlight reaching the stream; the character of the stream bottom (bedrock, boulder, gravel, sand, or fine silt); and the volume and timing of water flowing through the stream. Human activities influence all of these components.

Surface water in the Carmel River comes from four main sources: direct runoff from rainfall; planned releases from upstream dams; seeps and springs of groundwater; and return flow from urban uses including irrigation, septic systems, and waste-water treatment plants.

Water quality in the Carmel River and its tributaries is critically important to the species that inhabit the tidally-influenced lagoon in the lower portion of the river. Lagoons are highly productive ecosystems that depend on high quality fresh water and adequate stream flows to support aquatic species such as steelhead trout. In turn, healthy streams and lagoons benefit the health of the coastal marine waters of the Carmel Bay and Monterey Bay National Marine Sanctuary.

Reduced streamflows and fine sediments, especially sand, are the greatest threats to stream habitat in the Carmel River watershed. Reduced streamflows from both surface water diversions and groundwater extraction reduce the quality and quantity of instream habitat. Fine sediments from erosion destroy steelhead spawning and rearing habitat by smothering gravel beds.

Flooding

Flooding along the Carmel River is generally linked to extreme weather events, and flood damage is usually limited to properties located within the river's floodplain. The earliest recorded flood along the Carmel River was the 1862 flood, when one of the greatest storms in records swept the state of California.

Storm related floods occurred again in 1911 and 1914, in 1931, in 1941 and 1943, and in 1958. With each consecutive flood, as more areas were developed and more structures were built within the floodplain, more damage to public access roads, to public infrastructure, and to private property were registered. In 1969, two distinct floods caused severe damage along the Carmel River and in other parts of Monterey, and the County was declared a disaster area. Severe floods occurred again in 1980 and 1983, affecting many properties along the river and causing damage to most access bridges. In 1995, two floods in January and March, following prolonged and sustained precipitation, affected several areas along the Carmel River, causing severe infrastructural damage to homes, roads, and bridges, and in both occasions the region was declared a disaster area.

The history of floods along the Carmel River has prompted the development of comprehensive plans to reduce flood risk and to improve emergency response strategies. Shortly after the January 1995 flood, the MCWRA made recommendations to improve the emergency preparedness and response equipment and procedures. In 2002 the Monterey County Water Resources Agency (MCWRA) developed a Floodplain Management Plan to identify the flood sources, to identify the repetitive loss properties in the County, and to establish a plan to reduce flood risks. The Floodplain Management Plan was updated in 2003, and again in 2008. In the lower portion of the Carmel River, flood damage is experienced at a higher frequency, which has prompted studies to identify flood sources and local management strategies to reduce flood risk.



Watershed Planning

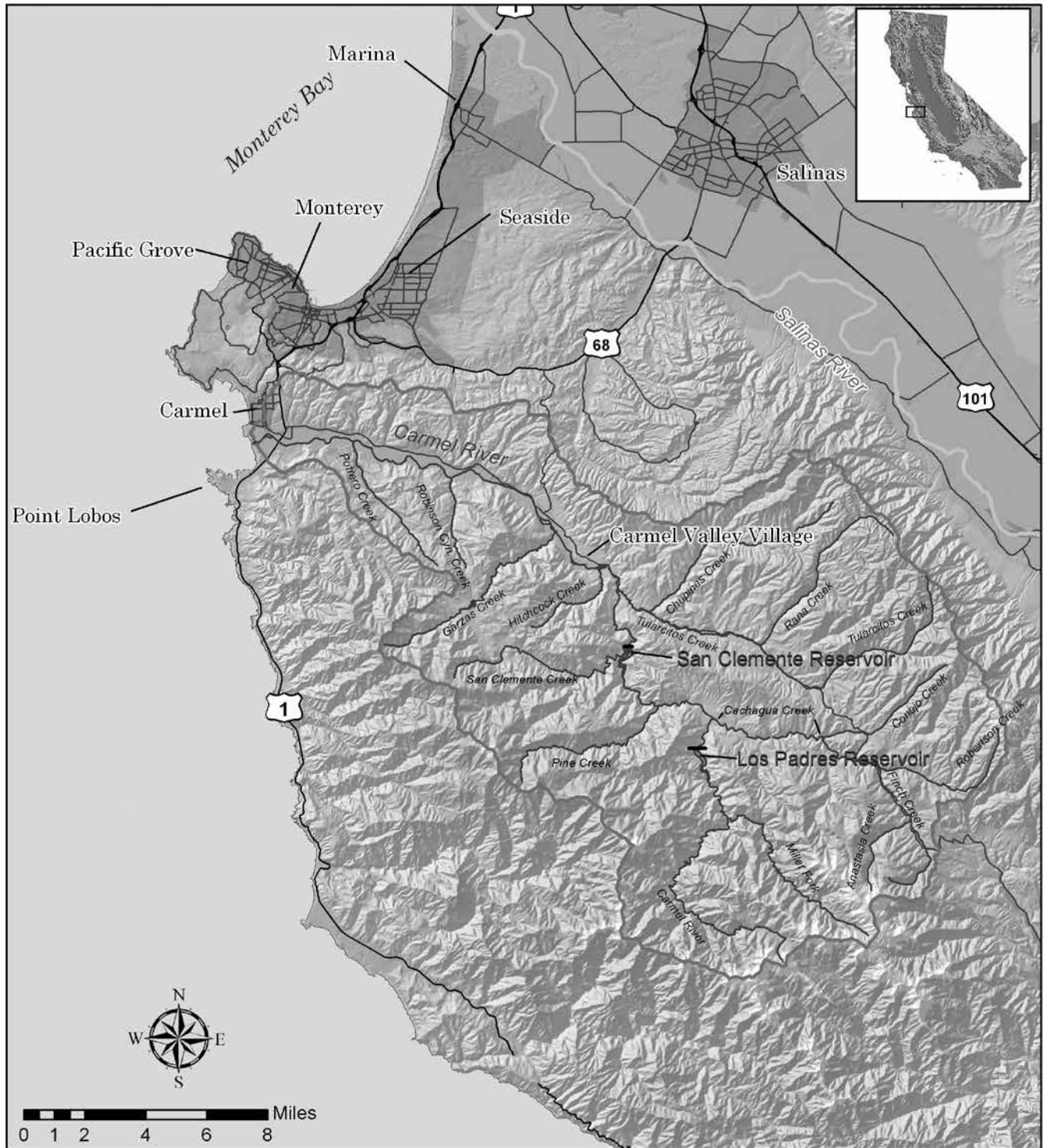
Some of the first efforts to restore the riparian corridor and stability of the mainstem of the Carmel River came from the Monterey Peninsula Water Management District's (MPWMD) *Carmel River Management Plan*, adopted in 1984. This plan identified a total of eight miles that needed restoration. Out of this effort arose the Schulte Restoration Project (1987), which was designed and funded as a demonstration project. The Schulte Restoration Project showed how river restoration could help stabilize stream banks.

MPWMD completed multiple projects similar to the Schulte Project over the last 28 years.



Since the mid-1990s, numerous private citizens and public agencies have worked together to conduct comprehensive watershed assessments and planning to provide guidance for voluntary actions to promote a healthy watershed. Outgrowths of this process include the 2005 *Carmel River Watershed Assessment and Action Plan*. This document and the above-mentioned *Carmel River Management Plan* are available online through the MPWMD and the Carmel River Watershed Conservancy websites. As a working document, the 2005 plan was revised in 2007 and under revision in 2012 in order to maximize its utility as resource for planning and acquiring grant funding to conduct the work called out in the plan itself.

CARMEL RIVER WATERSHED

Carmel River Watershed Boundary



Legend

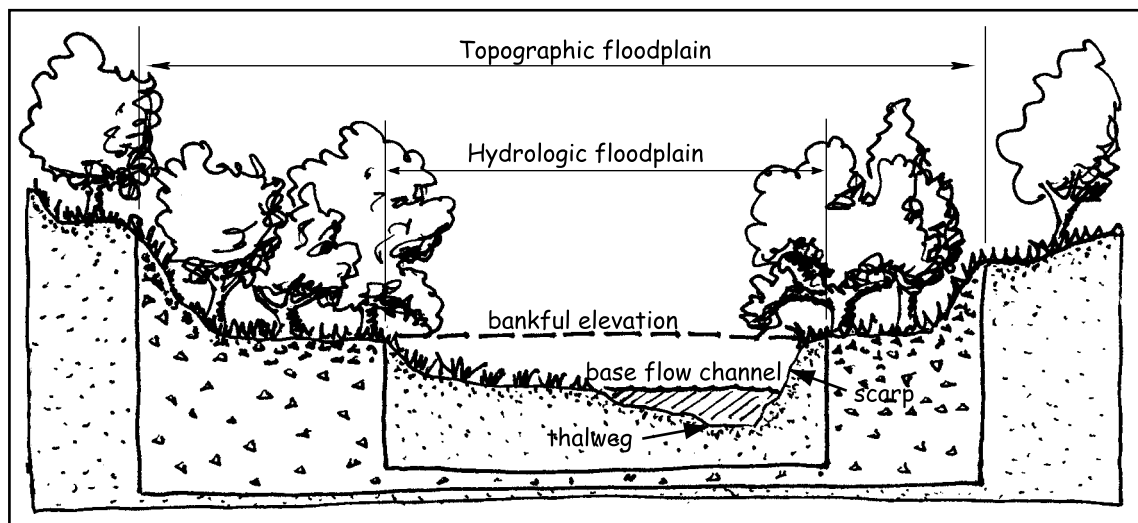
-  Carmel River and Tributaries
-  Carmel River Watershed Boundary (255 square miles)



WATERSHED PROCESSES

The purpose of this section is to give you a glimpse at the processes responsible for stream shape and function and to introduce you to some terms that will be used throughout this manual. A watershed is defined as an area of land that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel (Dunne, T. and Leopold, L.B., 1978). It may help you to think of watersheds as drainage basins. Watersheds occur at multiple scales, from small swales that may drain only an acre to large river systems that drain thousands of square miles. The smaller drainages are often referred to as sub-watersheds. Several sub-watersheds combine to form a larger watershed. Watershed boundaries are drawn along the ridgelines that surround the waterway of interest.

Since the watershed is based on the movement of water, it is important to review the means by which water can move through a system. Precipitation falls to the surface of the earth either as rain or snow. Some of the precipitation is intercepted and absorbed by vegetation before it reaches the soil surface. The precipitation that does reach the soil surface infiltrates into the soil by means of gravity and capillary action. Water will continue to move down through the soil until it reaches a zone of saturation known as the phreatic zone. The top of the phreatic zone defines the ground water table. The area above the phreatic zone is called the capillary fringe, where soil moisture is maintained by capillary forces. Between the capillary fringe and the soil surface is the vadose zone. The vadose zone is where plant roots thrive because the pore spaces between the soil particles contain a mixture of respiratory gases, capillary water, and soil microbes. When the rate of precipitation exceeds the infiltration capacity of the soil, excess water collects on the surface and flows downslope as runoff. Runoff may also occur just below the soil surface as subsurface flow.



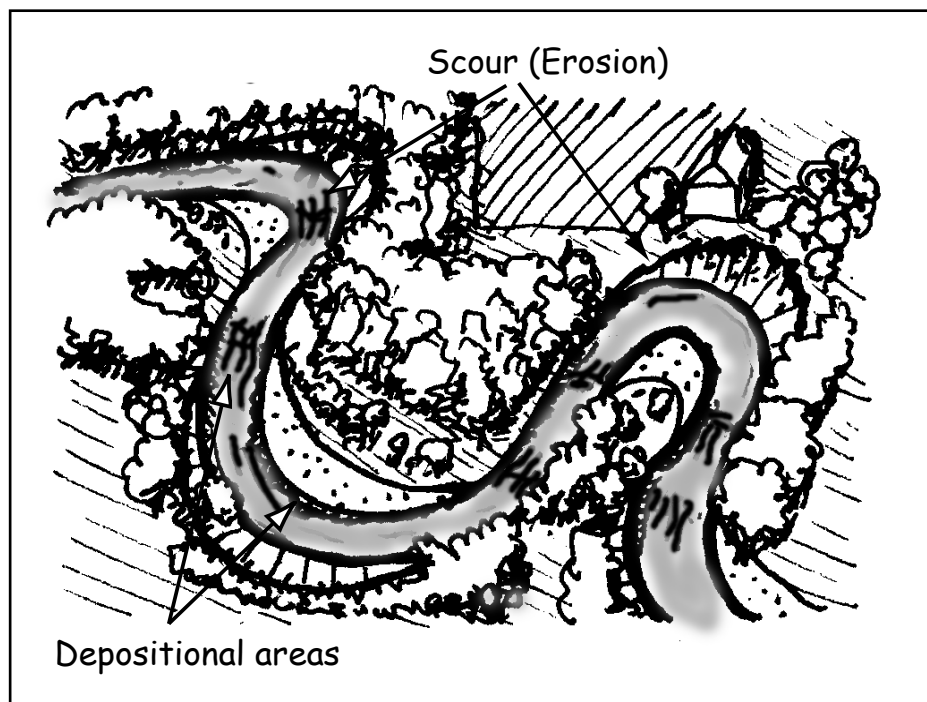
Components of the stream corridor.

A major component of the watershed is the stream corridor. The stream corridor can be thought of both temporally and spatially. The processes that formed a stream corridor are observed as many small events occurring over short amounts of time, while it is the accumulation of the effects of these events over millions of years that creates the stream corridor observed today. Spatially, the stream corridor can be considered in two dimensions: lateral and longitudinal.

Lateral components of the stream corridor include the stream channel, floodplain, and the transitional upland fringe. The stream channel is a channel that exhibits flowing water at least part of the year. The

floodplain is the area adjacent to the stream channel that is occasionally flooded during high flows. The transitional upland fringe is the area that serves as the border between the floodplain and the surrounding landscape. While stream related processes helped form the transitional upland fringe in geologic times, their current form is maintained or altered to a greater extent by recent land use activities. Therefore, the following will consider the physical processes of formation and the function of the stream channel and the floodplain.

Stream channels are formed, maintained, and altered by the water and sediment they carry. A typical cross section of a stream channel (see figure on previous page) shows the thalweg – the deepest part of the channel, the baseflow channel – the channel created by low flows, and the scarp – the sloped streambank. The size and shape of the channel are determined by four basic factors: sediment discharge – the amount of sediment moving down the stream at a given time; sediment particle size; streamflow – the volume of water moving down the stream at a given time (also



Erosion and deposition in a sinuous stream

called discharge); and stream slope – the elevation drop between an upstream point and a downstream point. Channel equilibrium occurs when all four variables are in balance. The nature of the relationship is that if one of the variables changes, one or more of the other variables must increase or decrease proportionally in order to maintain equilibrium. For example, if streamflow is increased and the slope remains the same, sediment load or particle size will increase.

The stream channel is constantly changing to maintain this equilibrium. When the stream channel is out of balance the changes can be visually recognized in the form of degradation or aggradation. Degradation is the downcutting of the stream channel. Aggradation is the deposition of sediment and suspended bed material in the stream channel. In alluvial stream systems sediment and bed material is typically scoured from the outer bends of the stream and deposited as sand or gravel bars in the straight sections and on the inside of the bends (see figure above). The size of the material that is scoured and where it deposits is dependent on many factors including streamflow (or discharge), gradient, channel area, and velocity. For example, if a bar is made up of large cobbles, it is safe to assume that a large streamflow event with high velocities was responsible for depositing the cobbles and it will take a similar event to mobilize the cobbles again.

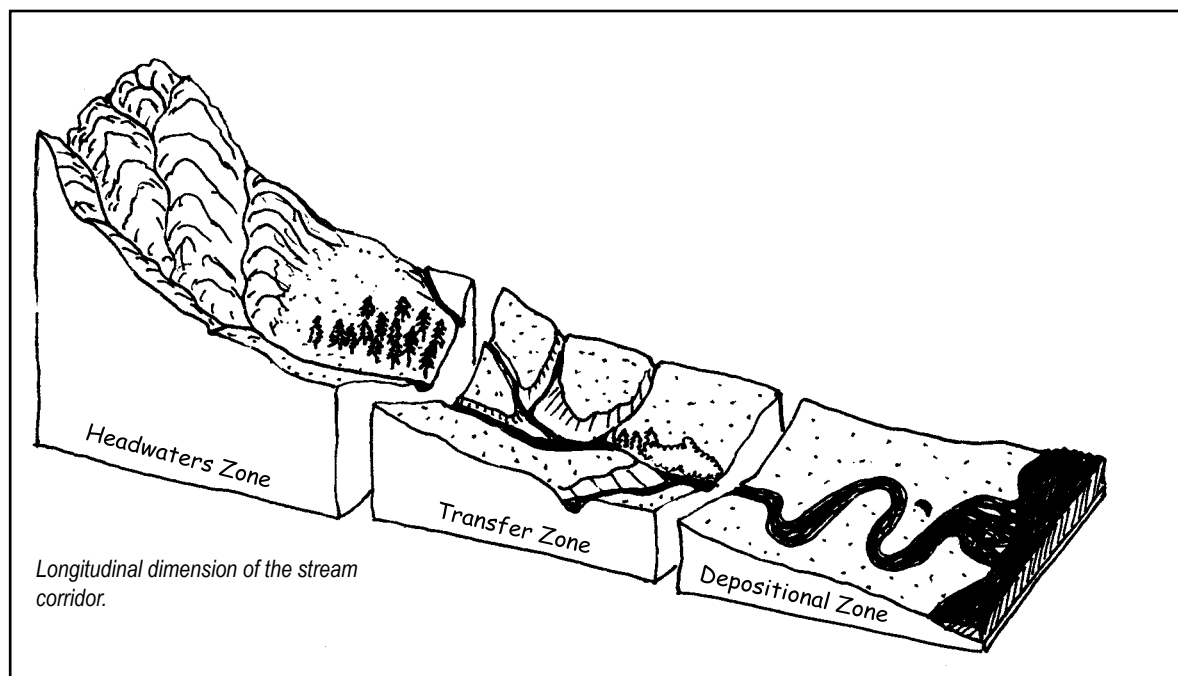
There are two types of floodplains: Hydrologic and Topographic. The hydrologic floodplain is the area up to the top of the bank of the stream channel that becomes inundated when the streamflow exceeds the capacity of the baseflow channel. The topographic floodplain is the area adjacent to the stream channel that becomes inundated when the streamflow exceeds the capacity of the stream channel (See figure on previous page). Federal and state agencies refer to the extent of the floodplain in terms of the anticipated

frequency of streamflows that result in inundation (i.e. 10-year, 50-year, 100-year floodplains). The floodplain provides temporary storage area for floodwaters and sediment produced by the watershed. The velocity of the water flowing down the stream is drastically reduced as it flows out onto the floodplain. The reduced velocity of the water causes the suspended sediment to settle out on the floodplain.

The longitudinal dimension looks at the stream corridor from its source in the mountains (or hills) to its terminus in a lake, ocean, settling basin, or a larger stream. In this sense it is similar to taking a watershed view of the stream. The overall longitudinal profile of the stream can be simplified by dividing it into three zones: Headwaters Zone, Transfer Zone, and Depositional Zone (see figure below). The headwaters zone, often referred to as the upper watershed, is typically characterized by steep slopes and a steep stream gradient and is commonly the source of much of the sediment that moves down the stream. The transfer zone is typically characterized by gentler slopes and broadening valleys, through which the stream begins to meander. Some sediment is deposited in this zone, but often only temporarily. Most of the sediment is eventually ends up in the deposition zone, which is typically characterized by broad, nearly flat valley floors. It is important to note that erosion, transfer, and deposition occur in all zones, but the zone concept focuses on the most dominant processes in each zone.

The form of the channel typically changes as it moves through the three longitudinal zones. Channel form is commonly described by two characteristics: thread and sinuosity. Streams are referred to as either single or multiple thread streams. Single thread streams, which display one channel, are most common. Multiple thread streams typically take the form of a braided stream. Braided streams typically get their start when a central sediment bar begins to form in a channel due to reduced streamflow or an increase in sediment load. The central bar causes the water to split into two smaller channels on either side of the bar. The smaller channels have a smaller cross section resulting in higher velocity flow, which erodes the banks and causes the channel to widen. The new wider channel results in a reduced velocity and the formation of a new central bar and the process continues.

Sinuosity is the term used to describe the amount of curvature of a channel. The sinuosity for a given reach is computed by dividing the channel centerline length (the distance you would travel if floating



down the stream) by the length of the valley centerline (the distance a bird would travel if flying over the stream). Streams typically become more sinuous (take on a meandering form) as their gradient or slope decreases.

Vegetation in the stream corridor also plays an important role in channel forming processes and the ecological function of the stream. Native vegetation in the stream corridor, whether it be in the channel, on the banks, or on the floodplain, can be thought to have evolved according to the physical channel forming processes described above. Vegetation plays its own physical role in affecting channel formation. This role can be indirect, such as reducing surface erosion on the upper slopes, which reduces sediment load in the stream. Vegetation can also have direct impacts on channel formation, such as riparian (streamside) vegetation that slows the velocity of the water and protects the banks from erosion. Simultaneously, vegetation in the stream corridor provides food and habitat for wildlife, fish, birds, and countless other organisms.

We hope the above gives readers a basic understanding of watershed and stream processes, and will allow them to put the following chapters of this manual into context. Our intent is to help stakeholders (everyone who has a stake in the health of the Carmel River Watershed) develop a sense of the ways we can care for the river, the watershed, and the variety of life it supports by caring for the smaller pieces of ground we have responsibility for and control over. We believe that by working with nature and understanding the natural processes of the Carmel River Watershed, we can become better stewards to the lands we rely on for our homes, sustenance, work and recreation.

*The *Basic Watershed Processes* section is based on information from *Stream Corridor Restoration: Principles, Processes, and Practices* (USDA-NRCS, 1999.).

CONSERVATION AND RESTORATION PRACTICES

The practices in this manual are divided into three categories:

1. **Practices for your Home**
2. **Practices for your Property**
3. **Practices for Large Acreages and the Watershed**

The purpose is to make it easier for you to find a practice appropriate to the application you need. The solution to a given resource concern may be found in a different category than you expect: for example, some practices such as *Gully Repair*, *Native Grass Establishment*, and *Fire Protection* can apply to situations in all three categories. The practice or practices you choose to employ should be carefully chosen to fit with your land management goals and to provide the most appropriate solution to your resource problem.

For solutions to be truly effective they need to be planned with the larger system in mind. Before installing a practice, consider how it will affect your neighbors' land. For practices in the stream corridor you need to be aware that what you do can affect the balance of the stream system, causing changes both upstream and downstream. Such changes can be detrimental or beneficial to the health of the watershed and your relationship with your neighbor. For example, stabilizing the streambank along your property may cause your downstream neighbor's streambank to begin to erode. It is important to communicate your intended actions with those who may be affected. In many cases you will find that others are dealing with the same problems as you are, and that you can save time, money and other resources by collaborating on solutions. A straight forward, no-nonsense approach that takes into account how your resource problems and solutions fit into the larger scheme of things encourages communication and collaboration among neighbors, and results in successful projects that meet everyone's needs is known as the "watershed approach."

One of the most effective ways to utilize a watershed approach to your resource concerns is to participate in a local watershed group. Local watershed groups provide an opportunity for landowners to come together to develop locally appropriate solutions to common resource concerns. Through active participation in the watershed group, landowners can create their own version of a "watershed plan." A watershed plan describes the current condition of the watershed, defines the group's goals for watershed quality, and outlines the actions needed to meet those goals. Taking part in a watershed planning effort demonstrates that activities you implement, as an individual or as part of group, have been planned to maximize benefits and reduce the potential for conflicts or harm to the environment. This can help to secure potential project funders, and win the goodwill of regulatory and permitting agencies who have interests in your actions. While a Carmel River watershed plan has already been developed, neighborhood or community groups should be encouraged to develop their own complementary sub-watershed plans if they share a common creek or set of tributaries to the river. This can enable groups to develop or plan projects that meet more immediate community needs or goals that are more tangible and achievable than those associated with an entire watershed.

If your community group is interested in such an effort or you would like to join with an existing effort, contact the RCD of Monterey County Watershed Coordinator at (831) 424-1036 ext. 3 or consult the list of stakeholder groups at the end of the manual.

CONSERVATION & RESTORATION PRACTICE DIRECTORY

Practices for your Home: page 22

Residential Property and Landscape Management:

- | | |
|---------------------------------|------------------------------------|
| 1. Gutters & Downspouts | 5. Permeable & Pervious Hardscapes |
| 2. Rain Water Catchment Systems | 6. Garden Swales |
| 3. Water-wise Landscaping | 7. Home Composting |
| 4. Rain Gardens | |

Practices for your Property: page 37

Fire Management:

1. Fire Protection for Your Home
2. Brush Pile Reduction
3. Prescribed Burns

Equestrian and Livestock Management: 45

- | | |
|--|-----------------------------------|
| 1. Horse Manure Management | 5. Swinging Flood Gate on a Fence |
| 2. Composting | 6. Wildlife-friendly Range Fence |
| 3. Tracking Pasture Health | 7. Stock Pond Habitat Enhancement |
| 4. Matching Stocking Rate to Carrying Capacity | |

Practices for Large Acreages and the Watershed: page 63

Vegetation Management:

- | | |
|----------------------------|---|
| 1. Hedgerows | 4. Native Perennial Grass Establishment |
| 2. Vegetated Filter Strips | 5. Cover Crops |
| 3. Riparian Buffers | 6. Invasive Weed Control |

Drainage/Erosion Management and Bank Stabilization:

- | | |
|-----------------------------|-----------------------------------|
| 1. Rural Road Management | 6. Live Staking and Pole Planting |
| 2. Erosion Control Blankets | 7. Brush Layering |
| 3. Mulching | 8. Brush Mattress |
| 4. Straw Wattles | 9. Gully Repair |
| 5. Willow Wattles | 10. Headcut Repair |

PRACTICES FOR YOUR HOME: RESIDENTIAL PROPERTY AND LANDSCAPING MANAGEMENT



There are a variety of things we can do in our homes and home landscapes that either reduce our burden on or enhance the quality of natural resources in the watershed. The following chapters represent a few basic methods for managing your home water, waste, and rainwater. Additional resource management concerns for the home include household water conservation, management of grey water (the water generated from the use of the shower, bathtub, hand sink, laundry, kitchen sink, and dishwasher), trash and hazardous waste, including pharmaceuticals.

Two good sources of information about greywater and its applications in good stewardship are Monterey Greywater (<http://www.montereygreywater.com>) and the Central Coast Graywater Alliance (http://www.ecoact.org/Programs/Pollution_Prevention/Graywater/index.htm). A Disposal of *all* hazardous waste is a challenge to the watershed. Trace levels of pharmaceutical compounds have been found in the drinking water supply, which has heightened concerns about proper disposal of unused prescription and over-the-counter drugs. The Monterey County Health Department, Monterey Regional Waste Management District, Salinas Valley Solid Waste Authority and the MRWPCA urge residents to return used pharmaceuticals to the place they were dispensed (www.mrwPCA.org/downloads/MRWPCA_NO_DRUGS_DOWN_THE_DRAIN_handout_rev%202012-06.pdf provides info about pharmacies with take back programs), or to follow the guidelines found on the Federal Drug Administration's website, found at <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm101653.htm> for disposal through the the waste management system.

GUTTERS AND DOWNSPOUTS

Description and Benefits

A downspout is a pipe that carries rainwater from a roof gutter down to a drain or to the ground. Gutters and downspouts are critical components of structures for handling roof runoff. However, in order to be effective, they must be properly sized, managed and maintained to prevent damage to property and the environment.



When to Use Gutter and Downspout Management Practices

All structures with roofs will benefit from the installation of gutters and downspouts.

Implementation

Properly sized gutters and downspouts are crucial for proper performance. While installation is fairly simple, calculating the correct size system for your roof can prove more difficult. You will need to know your roof area and pitch or slope and your location's annual rainfall. It is best to contact a local qualified professional to assist with calculating correct gutter and downspout sizes. Undersized gutters clog and overflow more frequently, which can damage foundations and cause erosion.

Keep in mind where your downspouts drain. Wherever possible and safe, divert downspouts AWAY from impervious surfaces such as concrete driveways, walkways, or compacted soils and instead direct them to well vegetated areas of your property to allow runoff to sink into the soil. This decreases water volume on streets and in storm drains and reduces the potential for downstream flooding. Always avoid sending runoff towards hillsides, septic system leachfields, and buildings where they could cause significant damage to property.

GUTTERS

General guidelines for selecting and installing gutters and downspouts:

Select gutters at least 5 inches wide. Use materials made from galvanized steel (29 gauge minimum) or aluminum (.025 inch minimum). To enhance flow, slope gutters according to the manufacturer's recommendations (commonly 1/16 inch to 1/8 inch per 1 foot of sectional gutter; or 1/16 to 1/8 inch per 10 feet of seamless gutters). Tilt the gutter forward keeping the front 1/2 inch lower than the back. For straight runs exceeding 40 feet, use expansion joints at connections.

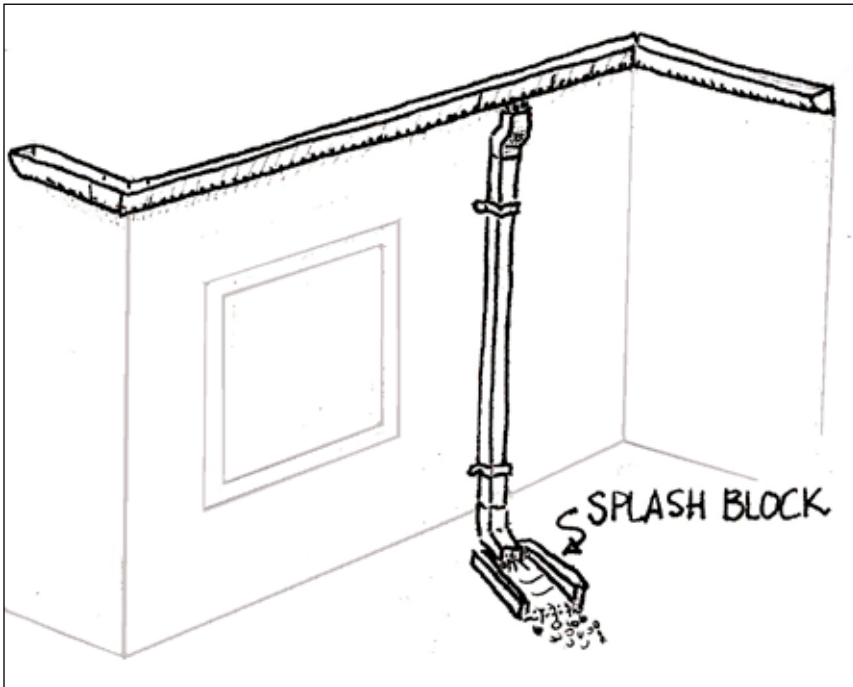
DOWNSPOUTS

Space downspouts from 20 to 50 feet apart. Adding additional downspouts can increase capacity where necessary and help slow water down and spread it out. Do not exceed 45-degree angle bends if at all possible. Where needed, use 4-inch-diameter extensions (flexible or rigid) to convey water to infiltration areas such as rain gardens and swales or to other safe outlets away from structures and steep slopes.

Do not direct downspout outlets to driveways or other impervious surfaces unless there are no safe alternatives. Instead, route them to vegetated areas.

Maintenance

Setting up a maintenance schedule is one of the easiest and most cost-effective solutions to many roof runoff issues. Clean your gutters at the beginning of each rainy season and as needed throughout the winter. In areas with dense trees or vegetation, trim trees and vines away from gutters to maintain a minimum 24-inch clearance zone. Add gutter guards to reduce debris buildup. Check your system for leaks, damaged parts, rust, and evidence of past erosion. Make sure to check hidden outlets under decks or staircases that might be forgotten. Always check and clean gutters after severe storms.



References

County of Santa Cruz Planning Department, *Santa Cruz County Stream Care Guide*, co.santa-cruz.ca.us/Planning, 2003

Resource Conservation District of Santa Cruz County, *Slow it, Spread It, Sink It - A Homeowner's Guide to Greening Stormwater Runoff*, 2009

RAIN WATER CATCHMENT SYSTEMS

Description and Benefits

Rainwater catchment systems collect the run-off from a structure or other impervious surface in order to store it for later use. Most commonly, this involves harvesting the rain from a roof. Rain collects in gutters that channel the water into downspouts and then into some sort of storage vessel. Rainwater collection systems can be as simple as collecting rain in a rain barrel, or as elaborate as harvesting rainwater into large cisterns to supply all or most non-potable water needs. Rainwater collection saves water and money for homeowners. Captured water can be reused for irrigation or other non-potable options or metered out slowly after storm events to allow for infiltration and reduced flooding.



When to use rainwater collection systems

Any property or structure in Monterey County will benefit from a rainwater collection system.

Implementation

Rainwater is usually collected in medium-sized rain barrels or larger water tanks that are placed outside buildings and connected to roof downspouts to collect runoff for later use in non-potable applications. Rain barrels and tanks have many advantages. They take up very little space, are inexpensive, and easy to install. Water tanks are manufactured for non-potable use in residential, commercial, or industrial applications, and can be installed both above and below ground. Underground tanks are excellent options for areas with limited space, but **cannot** be installed beneath the path of vehicles or heavy machinery traffic unless they have been engineered for that purpose. Extra precautions may be needed when placing tanks in locations with high water tables or saturated clay soils. Contact an experienced licensed professional for tank installations under these conditions.

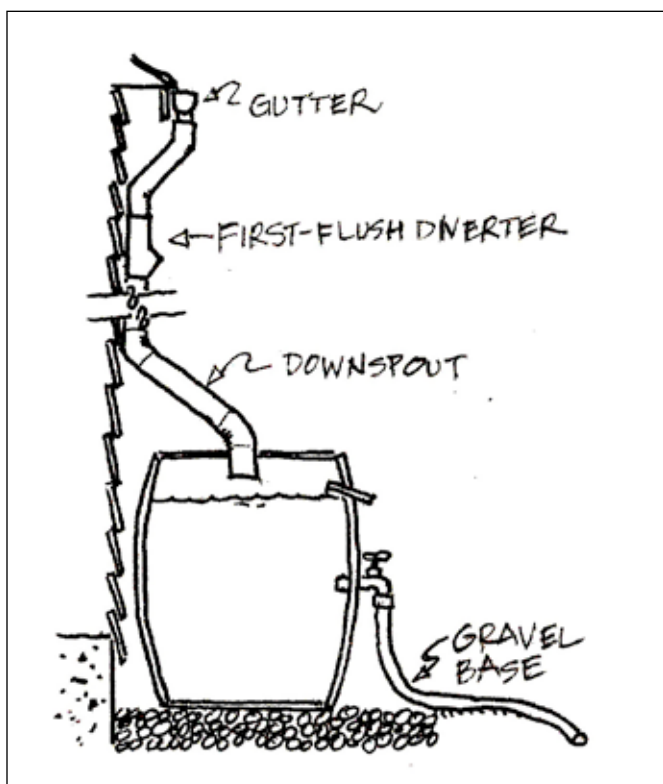
Components of a rainwater collection system:

- *Catchment surface* - This is normally a roof, but there are other options (even parking lots)
- *Gutters and downspouts* - Round gutters are recommended because they are less likely to collect sediment in corners and edges. This sediment can then support bacteria growth
- *Screening of tanks or barrels and downspout openings* - Prevent leaves, dirt or sand from entering into the downpipe and rainwater tank
- *Screens and filters* - Install a cartridge filter or strainer (a net or screen mesh of 2-3 to 10mm is suitable) just before rainwater enters the storage tank. This makes removal of obstacles easier

- *First-flush diverter device* – The first rain of the year collects suspended particles, leaves and other debris that can contaminate water tanks and clog the system. The first rainfall should not enter the catchment tank for these reasons. The first rain event should only be used to flush the roof, gutter and downspouts
- *Water tanks* - There are various options including manufacturing on-site
- *Water tank vent and overflow pipe*- This should be equal to or larger in diameter than the inflow pipe to avoid backup, especially after large rain events.
- *Faucet and valve*
- *Water pump* (optional) - Water tanks and rain barrels can solely rely on gravity to deliver collected water to the desired areas, and be used without pumping devices. However, depending on the desired use for the water, a pump may be necessary for best performance

Maintenance

Rain barrels require regular draining after rainstorms and removal of leaves and debris collected on screens. Always check that the overflow is clear and directed to an appropriate location. Remove accumulated sediment and debris annually and inspect all components such as gutters and downspouts regularly. The inside of the tank must also be inspected. Look for system leaks and cracks. Check all connections and hoses for wear and all screens or mesh for debris accumulation and holes. Follow all manufacturers' recommended maintenance for any storage device.



References

County of Santa Cruz Planning Department, *Santa Cruz County Stream Care Guide*, co.santa-cruz.ca.us/Planning, 2003

Resource Conservation District of Santa Cruz County. *Slow it, Spread It, Sink It - A Homeowner's Guide to Greening Stormwater Runoff*, 2009

Texas Water Development Board. *The Texas Manual on Rainwater Harvesting*. Third Edition. 2005. Austin, Texas

Resources

Available at the MPWMD website: <http://www.mpwmd.dst.ca.us/wdd/conservation/conservation.htm>

[Central Coast Rainwater Harvesting](#)

[HarvestH2O.com](#) Water Resources & Related Links: Rain Barrels, Cisterns, Greywater, Water Quality, etc.

WATER-WISE LANDSCAPING

Description and Benefits

A water efficient landscape incorporates the use of drought tolerant plants with principles of irrigation scheduling to meet each landscape's specific requirements. Drought tolerant plants require very little water, or no water, once they are established. Water efficient landscaping lowers consumption of groundwater; allows more water to be available for other domestic and community uses and the environment; requires less time and work for maintenance; and when water restrictions are implemented, drought tolerant plants will tend to survive and thrive, while more thirsty ornamental plants may be unable to adapt.



When to use Water-Wise Landscaping

This is a great practice for any garden or landscape in California, regardless of soil conditions and topography.

Implementation

Drought tolerant plants can be planted any time of the year, although the winter and spring months are preferable for most plants. Be sure to have an irrigation or other watering system in place before installing new container plants. Some water-wise landscaping suggestions include:

Irrigation - Landscapes can be irrigated efficiently by hand or with an automatic irrigation system. Zone turf areas separately from other plants and use the irrigation method that waters the plants in each area most efficiently. For grass, use gear-driven rotors or rotary spray nozzles that have larger droplets and low angles to avoid wind drift. Microspray, drip line or bubbler emitters are most efficient for watering trees, shrubs, flowers and groundcovers.

For manual irrigation, avoid oscillating sprinklers and other sprinklers that throw water high in the air or release a fine mist. The most efficient sprinklers release big drops close to the ground. Water deeply and infrequently to develop deep roots. Water early in the morning to reduce water lost to evaporation. If you have an automatic sprinkling system, adjust your controller monthly to accommodate weather conditions. Most irrigation controllers now allow for the integration of soil moisture sensors that delay irrigation during wet periods.

Select appropriate plants and plant them in the correct zones of your landscape (Hydro-zoning) - Different areas in your yard receive different amounts of light, wind and moisture. To minimize water waste, group together plants with similar light and water requirements, and place them in an area that matches these requirements. Put moderate-water-use plants in low-lying drainage areas, near

downspouts, or in the shade of other plants. Your turf will require the most water and shrub/perennial beds will require approximately half the amount of water. Dry, sunny areas support low-water-use plants that grow well in our climate.

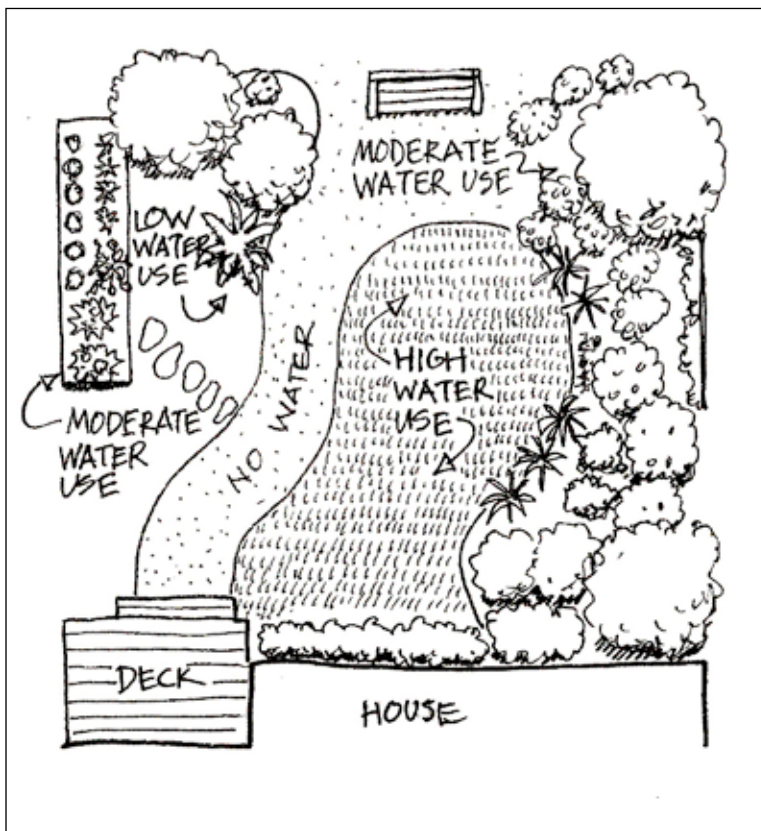
Mulch - Mulch keeps plant roots cool, prevents soil from crusting, minimizes evaporation and reduces weed growth. Organic mulches (like bark chips, pole peelings or wood grindings) should be applied 2 to 4 inches deep. (Deeper mulching provides more weed suppression, but also creates more of a fire hazard.) Inorganic mulches, such as rocks and gravel, should be applied 2 to 3 inches deep.

Use Turf Alternatives - Warm season native grasses like buffalo grass and blue grama that have been cultivated for turf lawns can survive with a quarter of the water that bluegrass varieties need. Warm-season grasses are greenest in June through September and straw-brown in winter.

Most cool season native grasses are greenest in the spring and fall and go dormant in the high heat of the summer. New cultivars can reduce typical bluegrass water requirements by at least 30 percent. Fine fescues, such as red fescue, can provide substantial water savings and are best used in areas that receive low traffic or are in shady locations. Use the appropriate grass and limit where you put it to reduce watering and maintenance requirements.

Maintenance

All landscapes require some degree of care during the year. Turf requires spring and fall aeration along with regular fertilization every 6 to 8 weeks. Keep your grass height at 3 inches and allow the clippings to fall. Trees, shrubs and perennials will need occasional pruning to remove dead stems, promote blooming or control height and spread. Much of the removed plant material can be shredded and used in composting piles.



Resources

Available at the MPWMD website (<http://www.mpwmd.dst.ca.us/wdd/conservation/conservation.htm>):

[WaterSense, and EPA Partnership “Wetter Yards are not better yards”](#)

[Water-Wise Landscaping Techniques](#)

[Local Certified Landscape Irrigation Auditors](#)

[A Drought-Tolerant Plant List for the Monterey Peninsula](#)

[Saving Water and Money by Finding and Fixing Leaks](#) by the Saving Water Partnership

[Weather-Based Irrigation Controllers and other Innovative Water Saving Products!](#)

References

County of Santa Cruz Planning Department, Santa Cruz County Stream Care Guide, co.santa-cruz.ca.us/Planning, 2003

Resource Conservation District of Santa Cruz County. Slow it, Spread It, Sink It - A Homeowner’s Guide to Greening Stormwater Runoff, 2009

RAIN GARDENS

Description and Benefits

A rain garden is a specialized landscape design that captures stormwater runoff from roofs, driveways, or other impervious surfaces and allows water to sink back into the ground, removing pollutants and improving infiltration.

When to use Rain Gardens

A rain garden design can be as simple as a shallow depression filled with plants that can grow in both moist and dry conditions. The required size, shape, and depth of the garden depend on how much water you are trying to capture. For large amounts of runoff or areas with insufficient infiltration, there are a full spectrum of engineered features, such as specialized soil mixtures, an aggregate base, and subsurface drains that can be added. These more complex designs are often referred to as bioretention cells.



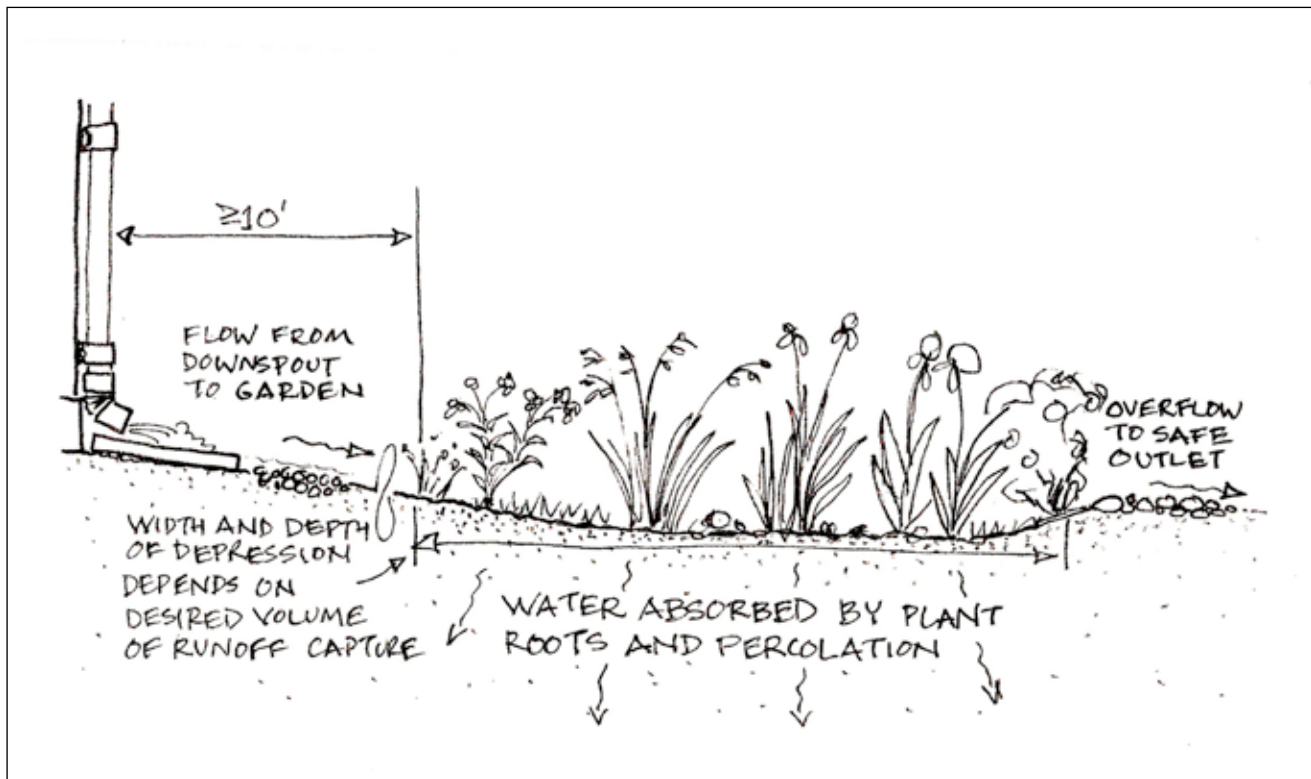
Implementation

Plant the center (lowest point) of the rain garden with species that tolerate wet conditions, such as native sedges and rushes. Around these, put plants suited to occasional standing water, like yellow monkeyflower (*Mimulus guttatus*) or California aster (*Aster chilensis*). At the furthest edges there are a variety of native evergreen and deciduous shrubs that prefer drier soil. For more suggestions, contact one of the local plant nurseries listed at the end of the Manual for suggestions and information about native and drought tolerant species.

Rain gardens should be located at least 10 feet from your house and at least 40 feet from a septic system or steep slope. They should also be designed to drain within 48 hours to reduce the risk of standing water and mosquito breeding. Rain gardens are a beautiful way to protect your property from erosion and protect the water quality of the Carmel River and its tributaries. They can enhance the aesthetic value of a site; be used on small parcels of land, easements, and right-of-ways; and are easily incorporated into existing landscapes or open space.

Maintenance

Routine maintenance is required and can be performed as part of the regular site landscaping program. Weeding and irrigation are essential in the first couple of months while plants become established. Annual pruning and mulching are recommended. Additional irrigation may be necessary during drought years. The use of native, site-appropriate vegetation reduces the need for fertilizers, pesticides, excessive water, and overall maintenance.



References

County of Santa Cruz Planning Department, *Santa Cruz County Stream Care Guide*, co.santa-cruz.ca.us/Planning, 2003

Resource Conservation District of Santa Cruz County. *Slow it, Spread It, Sink It - A Homeowner's Guide to Greening Stormwater Runoff*, 2009

PERMEABLE & PERVIOUS HARDSCAPES

Description and Benefits

Permeable pavers (like flag stone or traditional concrete) allow water to flow off the surface into surrounding gaps, which are filled with fine, crushed aggregate that permits water to flow into the soil below. The infiltration rate of permeable pavers depends on the gap size and aggregate used.

Pervious hardscapes allow water to pass through the surface material and sink back into the soil. The water seeps through to a rock base layer and is naturally filtered through the underlying soil where pollutants are removed.

Pervious materials increase infiltration of surface waters in landscapes and areas adjacent to buildings and structures. Popular choices include pervious paver stones, turf block and permeable asphalts and pavements, gravel, decomposed granite, or wood chips for walkways. The infiltration rate in a pervious hardscape can be 10 times greater than porous concrete, and more than 90 times greater than permeable pavers.



When to use Permeable or Pervious Hardscapes

Any hardscaped areas (such as driveways, paths, patios, and residential parking areas) located a minimum of 2 to 5 feet above the seasonal high groundwater table and at least 100 feet away from drinking water wells are candidates for replacement with pervious hardscape.

Implementation

Appropriate construction techniques are necessary to ensure the effective performance of pervious pavements. Hiring a licensed contractor experienced in these materials is highly recommended and might be required depending on the application. For specifics on installation and use, contact your local retailer or product manufacturer.

Step 1 - Planning

With a level measure, diagram the area you want to pave, noting existing structures (buildings, fences and other paved areas). Local companies can help you determine the best materials and the proper amount of supplies you need.

Step 2 - Preparing

Contact your local utility companies before excavation to be sure it is safe. Stake an area approximately 12" larger than the chosen work area. Plan to slope the paving away from buildings in the direction of normal drainage.

Step 3 - Excavating

A base of 4"-6" of processed gravel is recommended for pedestrian traffic. Excavate 7"-9" to allow for base material, sand and pavers. A base of 6"-8" of gravel is recommended for vehicular traffic, in which case excavate 9"-11" deep. Make sure to excavate 12" beyond the area you plan to pave.

Step 4 - Installing the Base

Compact the surface of the excavated soil with a plate compactor. Fill the area with 3/4" minus crushed stone or aggregate approximately 5" thick (decomposed granite is an inexpensive alternative). Compact with the plate compactor. Wet gravel lightly with water to help with compacting. Make sure to slope the surface 3/16" per foot for water drainage. Install a level line across the area.

Step 5 - Installing the Restraints

Always use edge restraints to prevent the pavers, bricks or stone from rolling or spreading. PVC, aluminum, concrete or pressure-treated wood will work, but precast concrete curbs are recommended for ease of installation, durability and esthetic appeal.

Step 6 - Screening the Bedding Sand

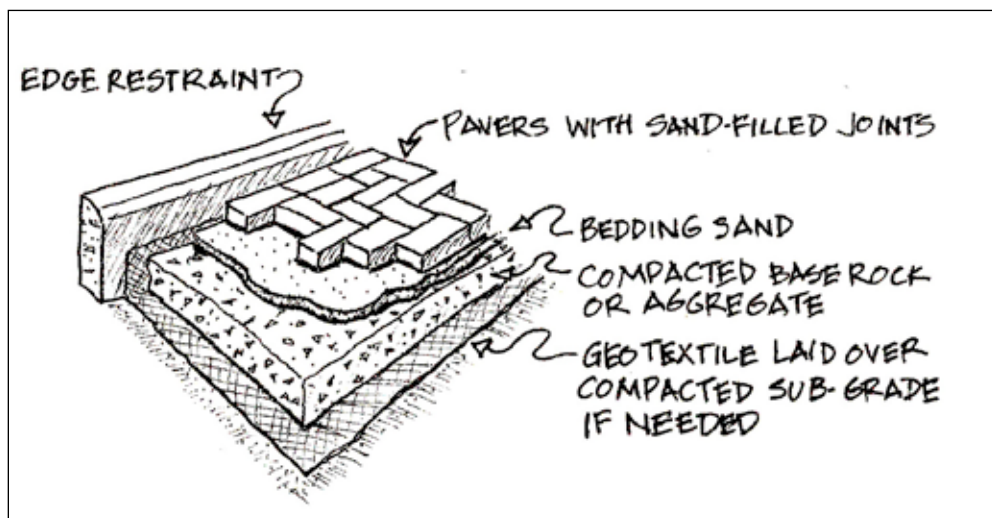
Spread 1" of sand over the compacted gravel, and then drag a 2" x 4" board across the top to smooth and level the surface. Fill in the low spots and repeat.

Step 7 - Installing Pervious Hardscape

Starting in a 90° corner, lay the hardscape material in your chosen pattern. Work outwards keeping all joint lines straight. Use string lines pulled along joint lines and parallel to the edge restraints or, chalk lines snapped on the surface of the sand bed to keep the joint lines straight. Leave a 1/8" space between pavers, bricks, or stone. If adjustment is needed use a screwdriver and hammer to move pavers into place. Cut pavers and brick if needed to fit along the edge restraints.

Maintenance

Permeable and pervious surfaces require varying amounts of maintenance. Surfaces constructed of pavers or stones will require sweeping or blowing to keep debris from clogging the pores water drains through. Poured pervious concrete surfaces genererally require annual sweeping to keep pores open, and will benefit from occasional power washing to remove any material clogging the pervious pores.



References

County of Santa Cruz Planning Department, *Santa Cruz County Stream Care Guide*, co.santa-cruz.ca.us/Planning, 2003

Resource Conservation District of Santa Cruz County. *Slow it, Spread It, Sink It - A Homeowner's Guide to Greening Stormwater Runoff*, 2009

GARDEN SWALES

Description and Benefits

Swales are shallow channels designed to reduce the velocity of water, and allow it to sink into the soil during low flows. Once saturated, swales function as conveyance structures carrying runoff to a rain garden, wetland, infiltration area, or other safe location. They can be formed to fit almost all site conditions and landowner objectives.

When to use Swales

Swales are useful in almost any garden or landscaped area where space is available and soil conditions are appropriate. Swales are not recommended for areas that receive large amounts of sediment, which can prematurely fill the swale and impede its functionality. A well-drained soil is best for swales; compacted soils and heavy clay soils may not drain runoff adequately.

Implementation

Depending on the existing landscape and available space, swales can have a meandering or nearly straight alignment.

An advantage to a meandering swale is that its geometry maximizes the time water spends in the swale, thus aiding infiltration and the trapping of pollutants and sediments. There are three types of swale systems:

1. **Vegetated Swales:** Grassed swales are vegetated with native perennial grass species along the bottom and sides of the channel. The vegetation in the channel slows runoff, allows sediments to filter out, and can help remove nutrients.
2. **Bioswales:** Vegetated swales that use engineered media (usually a designed soil mix consisting of sand, loam soil and hardwood mulch) beneath the swale to improve water quality, reduce runoff volume, and control peak runoff rates. Although their functions are similar to grassed swales, bioswales have a greater capacity for water retention, nutrient removal, and pollutant removal. Adding gravel or other permeable material below the soil mixture further enhances infiltration.
3. **Rock-Lined Swale:** A rock-lined swale uses rock instead of grass or other vegetation to safely infiltrate and convey runoff. Most are designed with rounded rock for an aesthetically pleasing landscape feature that mimics a creek bed.

When installing a swale use a minimum 2% slope from beginning to end (longitudinal slope) to ensure that water is conveyed away from any structures and to a desired destination. Nonwoven geotextile fabric can be used underneath the rock swales.

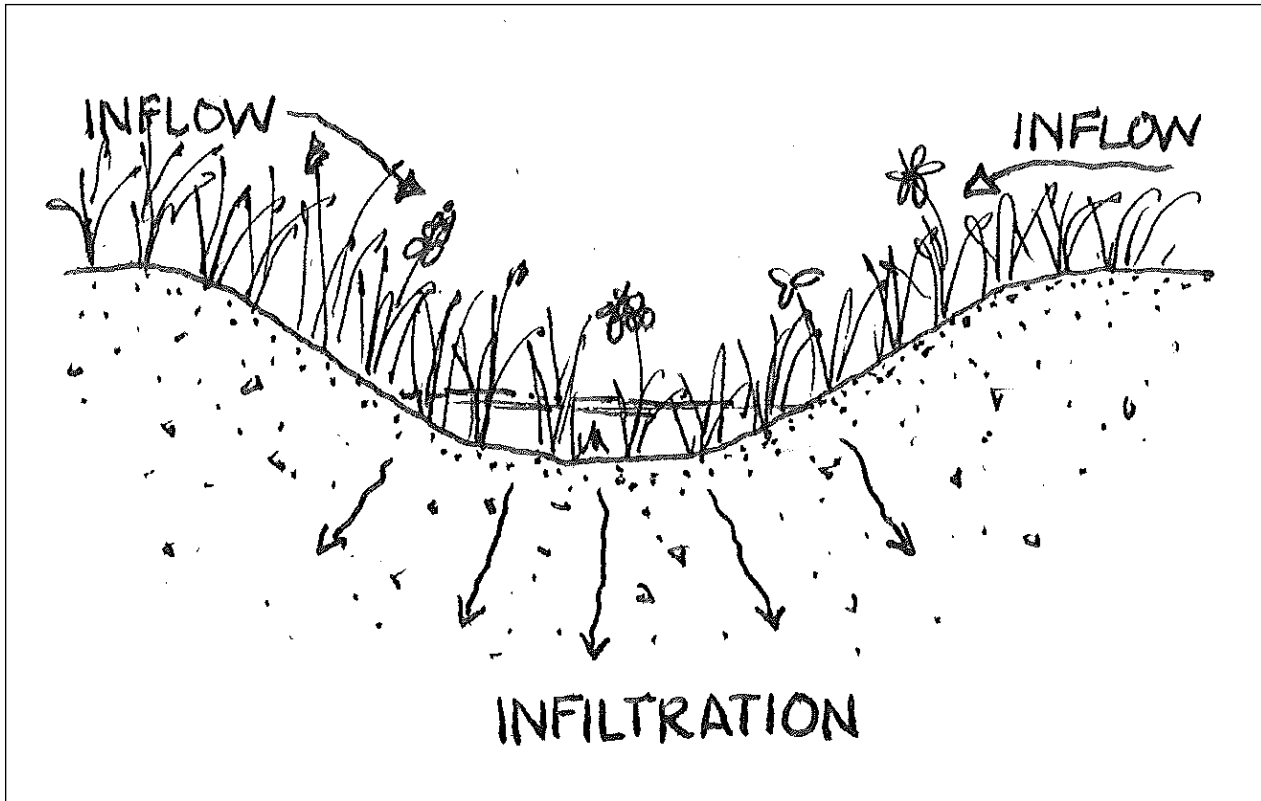
Maintenance

Routine maintenance is required to maintain efficacy of your swale. Before a planted swale is densely



vegetated, it is extremely vulnerable to erosion and must be protected with straw matting and other erosion control materials. Maintenance of a dense, healthy vegetated cover consists of periodic mowing (keep grass 2-4 inches high), weed control, reseeding of bare areas, and clearing of debris and accumulated sediment.

The swales should be regularly inspected for pools of water, formation of rills or gullies, and for uniformity in cross section width and longitudinal slope. When the uniformity is compromised it should be corrected quickly.



References

County of Santa Cruz Planning Department, *Santa Cruz County Stream Care Guide*, co.santa-cruz.ca.us/Planning, 2003

Resource Conservation District of Santa Cruz County. *Slow it, Spread It, Sink It - A Homeowner's Guide to Greening Stormwater Runoff*, 2009

HOME COMPOSTING

Description and Benefits

Composting is the way nature recycles organic materials and returns nutrients to the soil.

Over time, organic matter such as leaves, grass clippings, twigs, and fruit and vegetable food waste biologically decompose into a dark crumbly soil conditioner called compost. We can accelerate this process by creating and maintaining a home compost pile.

Organic materials such as yard and food waste account for 33% of the waste generated in a typical Monterey County household. Composting these materials reduces waste (preserving limited landfill space). When you use the finished compost in your garden and landscaping, you



- Return nutrients to the soil
- Improve water retention
- Help to improve soil structure and tilth

When Composting makes sense

Whether you have trees and shrubs, a garden or a few container plants, anything you grow will benefit from compost.

Implementation

Compost bins or enclosures are a good way to contain your organic materials during the composting process, although you can also pile your material up in a “heap” if you have the space. The ideal compost enclosure or space will accommodate one cubic yard of volume.

Enclosures can be as simple as a wire mesh hoop or more elaborately constructed with wooden slats or re-used pallets. Several commercially made bins may also be purchased and are available in a range of styles and sizes, including low cost compost bins at the Last Chance Mercantile at the Monterey Regional Waste Management District. Plans to build your own bin are available online at www.mrwmd.org.

Techniques

Composting can be done actively, requiring more effort but also yielding faster results, or more casually, with little to no effort and a longer wait for good usable compost. Both ways will have a positive effect on the environment and produce usable compost over the long run.

Active or “hot” compost piles have a 30:1 ratio of carbon to nitrogen, or a blend of equal parts nitrogen (green plant material) and carbon (brown plant material) with moisture and regular turning to promote a rapid decomposition. During the active compost process it is common for temperatures in the pile to range between 110 -150 degrees. A “hot” compost system can result in finished compost in 8 to 12 weeks.

“Casual” compost piles work too, since compost will “happen” even if you just pile on yard and food

waste, water sporadically and wait. The pile won't get as hot, so it won't decompose as quickly and it likely won't kill weed seeds, but you'll still get finished compost in 6-12 months.

When the compost is ready to use

Your compost is finished when the original material has been transformed into a uniform, dark brown, crumbly product with a pleasant, earthy aroma. You may want to stop adding to your compost pile after it gets to the optimal size of 1 cubic yard, and start a new pile so that your first pile can finish decomposing.

Composting is something you learn by doing. Through practice and observation, you'll find out what works best for your home situation, and learn to modify the process to suit your needs. There are a number of how-to books on backyard composting which you can find at your local library or bookstore. The www.mrwmd.org website has information about composting workshops and low cost compost bins for County residents.

Maintenance

A casual compost pile requires almost no maintenance. If you are trying to actively manage the pile, this table from the Monterey Regional Waste Management District is helpful:

Problem	Cause	Solution
Pile smells bad	Not enough air or... Too much moisture	Turn the pile Add dry materials
Pile won't heat up	Not enough moisture or... Pile size is too small or... Lack of nitrogen-rich material or... Particle size is too big	Water thoroughly Build pile to at least 3' x 3' x 3' Mix in manure, grass clippings or fruit/vegetable scraps Chip or grind materials
Pile attracts flies, rodents or pets	Pile contains bones, meat, fatty or starchy foods, or animal manure	Alter materials added to pile; bury fruit/vegetable scraps in the middle of the pile, or under 8"-10" of soil, or compost them in a worm bin.
Pile has slugs in it (and so does the garden)	Pile is easily accessible and provides daytime hiding place and breeding ground for slugs	Remove slugs and slug eggs from pile (eggs look like very small clusters of clear pearls). Locate compost pile far from vegetable gardens and/or create barriers or traps around pile/garden

Resources:

Online:

- www.mrwmd.org
- www.omexchange.org
- www.compostcss.cornell.edu/composting

Books:

- Pleasant, Barbara & Deb Martin.** *The Complete Compost Gardening Guide*, 2008.
- Campbell, Stu.** *Let it Rot!* 1998.
- Appelhof, Mary.** *Worms Eat My Garbage*, 1997.

References:

Monterey Regional Waste Management District. Home Composting Brochure, <http://www.mrwmd.org/composting.htm>

PRACTICES FOR YOUR PROPERTY



The larger your parcel, the more you have to manage, and the more risks you have to anticipate. This section builds on the concepts in the previous section but on an appropriately larger scale. The following are a sampling of means for balancing our needs for fire safety, animal husbandry and near-home recreation with those of a healthy watershed. For further information on any given practice, follow the references at the end of each article. For even more property management techniques, visit the RCDMC website at www.rcdmonterey.org or contact the RCD at 831-424-1036, ext. 3.

FIRE MANAGEMENT



Fire is a natural and integral part of the Central Coast landscape and the Carmel River watershed. The Monterey County Community Wildfire Protection Plan (MCCWPP) recognizes the overgrown state of hazardous fire fuel vegetation, and recommends fire resistant materials for construction, ‘defensible space’ around structures adjacent to wildlands, and preplanned strategic fire breaks and reduced fire fuel zones managed to reduce fire intensity.

The vegetation on our lands is critical to our quality of life and hosting attractive wildlife, while at the same time being a fire risk if managed improperly. Your best local resources for learning how to manage your property for fire safety in a sensible and environmentally-sound way are the Fire Safe Council (www.firesafemonterey.org) and your local fire district. The following practices are a summary of methods you can employ to reduce your risks from wildfire.

FIRE PROTECTION FOR YOUR HOME

Description and Benefits

Vegetation, landscape, and structure management practices can reduce the risk of wildfire to homes and other structures in rural areas such as Carmel Valley. Reducing the potential for wildfire movement to dwellings or through a property also reduces the overall risk and intensity of wildfire movement through the region.

When to use home Fire Protection Practices

Any property with structures or buildings within the wildland-urban interface (most of the Carmel River watershed) will benefit from these practices.

Implementation

Follow the following four steps to make you home and property as fire safe as possible.

1. Create and Maintain **Defensible Space**

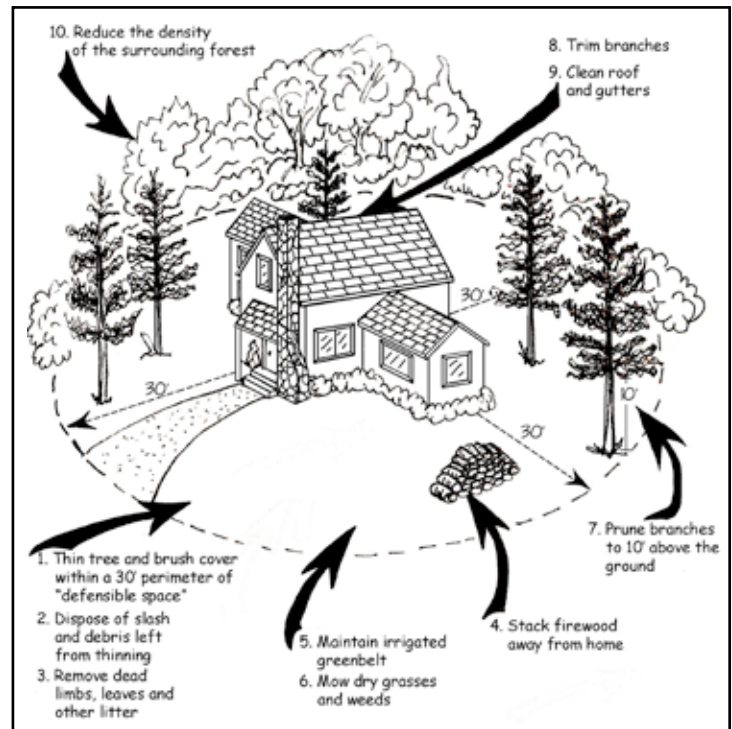
Your home's ability to survive wildfire is dependent on the buffer you create between the buildings on your property and the surrounding grass, trees, shrubs, or any wildland areas. These planned spaces can slow or stop the spread of wildfire and protects your home from catching fire – either from direct flame contact or radiant heat. Defensible space is also important for the protection of the firefighters defending your home. Two zones make up the required 100 feet of defensible space:

Zone 1 extends 30 feet out from buildings, structures, decks, etc. - 'Lean, Clean, Green'

- Remove all dead plants, grass and weeds (vegetation)
- Remove dead or dry leaves and pine needles from your yard, roof and rain gutters
- Trim trees regularly to keep branches a minimum of 10 feet from other trees
- Remove branches that hang over your roof and keep dead branches 10 feet away from your chimney
- Relocate wood piles into Zone 2 (below)
- Remove or prune flammable plants and shrubs near windows
- Remove vegetation and items that could catch fire from around and under decks
- Create a separation between trees, shrubs and items that could catch fire, such as patio furniture, wood piles, swing sets, etc

Zone 2 extends 30 feet to 100 feet from buildings, structures, decks, etc.

- Cut or mow annual grass down to a maximum height of 4 inches, and *do it before 10 a.m.* when the humidity is higher and temperatures are low to reduce the chance of igniting a fire.



- Create horizontal *and* vertical spacing between shrubs and trees
- Remove fallen leaves, needles, twigs, bark, cones, and small branches

2. Use Fire Safe **Structure Design & Construction** for new Wildland Urban Interface Construction or Remodels

- Use ignition resistant construction for roofs/roof assemblies, gutters, vents, decks, exterior walls, exterior windows
- Enclose the underside of eaves, balconies and above ground decks with fire resistant materials
- Show your 100 feet Defensible Space on plot plan
- Build your home away from ridge tops, canyons and areas between high points of a ridge
- Consider installing residential sprinklers
- Make sure that electric service lines, fuse boxes and circuit breaker panels are installed and maintained to code
- Contact qualified individuals to perform electrical maintenance and repairs
- Cover chimney outlets and stovepipes with a nonflammable screen of 1/2 inch or smaller mesh

3. Make sure there is **Access** to your Property

- Make sure that your street name sign is visibly posted at each street intersection
- Post your house address so it is easily visible from the street, especially at night
- Identify at least two exit routes from your neighborhood
- Clear flammable vegetation at least 10 feet from roads and five feet from driveways
- Cut back overhanging tree branches above access roads

4. Make sure that you have an **Emergency Water Supply**

- Maintain an emergency water supply that meets fire department standards through one of the following:
 1. a community water/hydrant system
 2. a cooperative emergency storage tank with neighbors
 3. a minimum storage supply of 2,500 gallon on your property (like a pond or pool)
- Clearly mark all emergency water sources
- Create easy firefighter access to your closest emergency water source
- If you use well water, an emergency generator to operate the pump during a power failure could save your home

More fire safety information and assistance:

- **Fire Safe Council for Monterey County:** <http://firesafemonterey.org/>
- **California Department of Forestry and Fire Protection (CAL FIRE):** http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_homeowners.php
- **Center for Fire Research and Outreach:** Be sure to take a look at the features of the fire “toolkit”. Fire Information Toolkit website: <http://firecenter.berkeley.edu/toolkit/>

References:

- Williams, G.W.** 2000. “Wildland Fire Management in the 20th Century.” *Fire Management Today*. Volume 60, No. 4. **University of California, Berkeley, Center for Fire Research & Outreach**, Fire Information Engine Toolkit <http://firecenter.berkeley.edu/toolkit/>
- CAL FIRE website.** http://www.fire.ca.gov/communications/downloads/fact_sheets/

BRUSH PILE REDUCTION

Description and Benefits

Dead brush and wood from heavy pruning and vegetation management projects needs to be safely reduced so as not to pose a fire risk. Burning and chipping of gathered or piled wood are common methods of reduction.

When to use Brush Pile Reduction

Large volumes of dry or otherwise combustible woody and vegetative debris should be piled and reduced if it could serve as fuel for wildfire, especially in areas naturally prone to fire such as Carmel Valley. This is often the case after understory clearing and extensive pruning work conducted for fuel load reduction projects.



Materials Needed

Chipping:

- Chipper appropriately sized for material to be reduced
- Saws and tools for reducing branches to fit into chipper as needed
- Tools and equipment to transport chipped material and/or spread it as mulch

Burning:

- Burn permit from the Monterey Bay Unified Air Pollution Control District
- Water supply close at hand; Backpack pump water-type fire extinguisher
- Shovels, MacLeods, etc. for managing the pile and perimeter
- Burn observer to remain on-site through entirety of burn

Implementation

Chippers are available at most rental stores. Check with your local fire district or the FireSafe Council for Monterey County for information about community “chipper” programs.

Safe Chipping:

Whenever possible, pile reduction by chipping is preferable to burning because it poses significantly less fire risk. Mobile wood chippers are frequently used to chop up branches and trunk pieces from tree and brush trimming operations. Chippers can cause serious or fatal injuries and amputations, so use them with extreme caution and attention to safe work practices.

Follow these Fire Safe Work Practices when operating chippers and other machinery in wildland areas:

- Wear close-fitting clothing, cuff-less trousers, and safety boots with non-skid soles. Tie back your hair, take off jewelry, and keep your clothing tucked in
- Use earplugs, safety glasses, hard hats and cuff-less gloves

- Protect yourself from contacting operating chipper components by guarding the infeed and discharge ports. Do not open the access covers or doors until the drum or disc completely stops
- Know what your coworkers are doing and where they are; working with a buddy ensures that help is nearby if an emergency occurs
- Always follow the manufacturer's guidelines and safety instructions
- Prevent detached trailer chippers from rolling or sliding on slopes by chocking the trailer wheels
- Maintain a safe distance (two tree or log lengths) between chipper operations and other work or workers
- Do all maintenance and clearing that requires a gas or electrical motor before 10 a.m., (NOT in the heat of the day), and in calm weather (NEVER when the wind is blowing)
- Keep the engine free of oil and dust, and keep the chipper free of flammable materials
- Know how to use the safety devices and controls, especially the emergency shutoff switch
- Learn how to open and close the hood, clear jams, and feed branches
- Perform safety checks before each use to ensure safety devices work properly

Safe Pile Burning:

Burn permits are only valid on "Permissive Burn Days" as determined by the Monterey Bay Unified Air Pollution Control District. You can learn the burn status each day by calling 1(800)225-BURN (2876) or visiting the Monterey Bay Unified Air Pollution Control District online at www.mbuapcd.org. To ensure that your proposed burn complies with local regulations, call the Monterey Bay Unified Air Pollution Control District, Enforcement Division, at 831-647-9411, or your local fire district.

- Pile size should be less than four feet in diameter. Material to be burned must be arranged in piles so as to minimize smoke production. Generally, this means small piles to allow for adequate air supply to prevent smoldering and poor combustion
- Material to be burned must be well dried
- Clear all flammable material and vegetation within ten feet of the outer edge of pile
- Keep a water supply close to the burning site
- Do not use oil, tires, lumber, paper, or other forms of non-vegetative material to ignite or sustain a fire
- An adult should be in attendance with a shovel until the fire is out
- Only undertake a burn under safe weather conditions. Do not include household trash or other debris in your burn pile, such as garbage, tires, plastics, paper, cardboard and lumber

References:

- Williams, G.W.** 2000. "Wildland Fire Management in the 20th Century." *Fire Management Today*. Vol. 60, No. 4.
- University of California, Berkeley, Center for Fire Research & Outreach**, Fire Information Engine Toolkit <http://firecenter.berkeley.edu/toolkit/>
- CAL FIRE website**, Equipment Use Safety brochure, http://www.fire.ca.gov/communications/downloads/fact_sheets/EquipmentUse.pdf

PRESCRIBED BURNS

Description and Benefits

Prescribed burning is used as a land management tool in California. This fact sheet is intended to introduce you to some basic information about the practice, but **IS NOT** a guide to conducting your own prescribed burn. Described below are the needed steps and agency contacts necessary to use prescribed burning. The practice is a complicated and risky activity involving careful planning, coordination, and experience, but it can provide multiple benefits to land owners and land managers, including:

- Reducing ground fuel loading in forests
- Preparing an area for replanting
- Improving wildlife habitat
- Controlling or eradicating unwanted weeds
- Improving the quality of rangeland forage
- Protecting people and property from catastrophic wildland fires
- Reducing thatch buildup in grasslands and improving conditions for reintroduction of native grasses and forbs



When Prescribed Burns make sense

Most ecosystem types in the watershed, including grasslands, oak woodlands, chaparral, and mixed conifer forests, evolved with occasional low (and sometimes high) intensity wildfires as part of the natural life cycle. Most land owners and land managers are interested in reintroducing fire on their land for the reasons listed above and to reduce the fuel load in oak woodland, chaparral, and mixed conifer forests to reduce the potential for catastrophic crown fires.

Necessary Preparation for a burn (depending on the size complexity of the burn)

- Burn plan and burn permit from CAL FIRE (only during fire season on CAL FIRE-responsibility lands), and a Monterey Bay Unified Air Pollution Control District permit
- Sufficient ground personnel to implement burn plan per prescription, including personnel with first aid training
- Fire Resistant Pants and Shirt or Coveralls, Hard Hat, Fire Resistant Shroud, Gloves, Goggles, Fire Shelter, Leather Boots, First Aid Kit
- Hand Tools: McCleod, Pulaski, Shovel, Backpack Sprayer, Flapper, Wire Cutter, Belt Weather Kit, Two-way Radio, Drip Torch, Fuel Mix, Fusees, Pen Flares
- Heavy Equipment: Bulldozer, Fire Engines

Implementation

Work with the California Department of Forestry and Fire Protection (CAL FIRE), your local fire department, and/or any local program that approaches fire management on a larger scale. CAL FIRE and local fire departments sometimes use prescribed burns for training personnel; contact them to see if such

an opportunity exists.

- Weigh the costs and benefits of fire as a management tool. Research how fire will impact both the treatment area, and the larger ecosystem. Compare these effects against the benefits you expect. Understand the frequency of burning needed to achieve those benefits, and the costs of time and resources prescribed burns require.
- Create a long-term fire management strategy with prescribed burning incorporated into overall long-term management activities. This is particularly important for large management areas, where burning can be an annual activity as different sites (i.e. burn units) are burned on different cycles. Components include:
 1. Site background information: the environmental attributes of the managed area, including wildfire history and the natural role of fire in the ecosystem
 2. Description of overall management goals for the site
 3. Justification for fire management at the site: describes the natural fire regime of the site and demonstrates how fire management will meet the management goals for the site
 4. Description of the fire management goals, proposed burn units, and a burn schedule. This critical, complicated step includes consideration of fuel vegetation types, topography, land use, natural and human made fire breaks, ideal weather conditions, burn timing, air quality, and the type of burn most appropriate for the site
 5. Creation of a map that incorporates the above information, such as fire breaks, ignition points, type of burn, wind direction, structures, etc.
- Collaborate with CAL FIRE, your fire protection district, or the FireSafe Council for Monterey County for perspective on regional fire management and information about available opportunities and resources.
- Develop a monitoring plan that outlines observations to be made before, during, and after every burn in order to evaluate whether the fire management goals were met.
- Create and submit a burn plan to Cal-Fire (if burning on “state responsibility areas”) or your local fire department and receive a burn permit. All burns need a Smoke Management Permit from the Monterey Bay Unified Air Pollution Control District (www.mbuapcd.org) AND clearance on the day of the burn. You also need to contact CAL FIRE on the day of the burn to let them know that you are implementing a prescribed burn.

Web resources about fire management and current programs in your area.

- CAL FIRE (www.fire.ca.gov)
- Monterey Bay Unified Air Pollution Control District (www.mbuapcd.org)
- Monterey San Benito Range Improvement Association/Wildland Fire Safe Council (www.wildlandfiresafecouncil.com)
- FireSafe Council for Monterey County: (www.firesafemonterey.org)

References

- Williams, G.W.** 2000. “Wildland Fire Management in the 20th Century.” *Fire Management Today*. Volume 60, No. 4.
- Wirka, Jeanne.** 1999. “The state of the art: prescribed burning in California grasslands.” *Grasslands*. Vol. IX, No. 3.
- California Native Grass Association.** 2002. “Techniques and Strategies for Using Grasses and Graminoids in Revegetation and Restoration.” May 7-8, 2002 training workshop binder.
- California Native Grass Association.** 1999. “Using Prescribed Fires as a Vegetation Management Tool.” October 20-21, 1999 training workshop binder.
- CAL FIRE,** Equipment Use Safety brochure, http://www.fire.ca.gov/communications/downloads/fact_sheets/EquipmentUse.pdf

PRACTICES FOR YOUR PROPERTY

EQUESTRIAN AND LIVESTOCK MANAGEMENT



Whether a source of income or recreation, the large and small animals we own and manage (some say it's the other way around) can have a productive role in the landscape as well as in our lives. Managing their feed, feeding patterns, access to water, and manure is a challenge for all landowners, especially those still becoming acquainted with a new parcel. To access the broad range of high-quality information available regarding livestock management, consult the references listed in the context of the brief selection of practices summarized in the following pages. Livestock & Land, University of California Cooperative Extension, and Oregon State University are just a few of those dedicated to this purpose.



HORSE MANURE MANAGEMENT

Description and Benefits

Horse facility owners should develop a waste management plan to ensure clean and safe facilities, protect creeks and ground water and reduce odors and insect breeding opportunities. The plan can be functional – not an elaborate creation. Document the manure use or disposal options you plan on using, such as utilizing composted manure as a soil amendment or hauling manure offsite.

Consider chore efficiency, visual impact, odor, health and safety implications, as well as economic costs and benefits in developing and implementing the waste management plan. Effective horse manure management helps improve the horse's living conditions as well as protect water quality.



A Horse Manure Management Plan will provide the following benefits:

- Healthier environment for horses
- Cleaner and safer work area
- Use of composted manure as a soil amendment
- Creek and stream protection
- Reduced waste volume through the compost process
- Reduced odors
- Reduced insect breeding opportunities
- Reduced neighbor complaints
- Turns a liability into an asset

Implementation

A sound manure management plan needs careful attention to detail. It uses principles from engineering, animal science, economics and crop and soil science to maximize the value of using animal waste and turning it into a soil amendment and to minimize the potential for environmental damage during the process. Also, anyone keeping a horse should be aware of zoning, health and water quality regulations. Resource Conservation Districts (RCDs), USDA Natural Resources Conservation Service (NRCS), University of California Cooperative Extension and private consultants offer assistance in the development of these plans. A successful manure management plan involves collection, storage, processing and disposal or utilization.

Collection:

- Clean-up manure from stalls and paddocks daily, scrape (or otherwise clean out) turnouts, paddocks and corrals regularly.
- Horses on pastures generally concentrate their manure. These areas will need to be picked up or dragged with a a harrow to disburse the solids in order to reduce breeding habitat for pests, reduce potential nutrient loading and leaching, and to allow beneficial organisms to process the materials adequately.

Storage:

Manure must be properly stored to maintain good conditions for processing and handling, be easy to handle and avoid leaching nutrients to ground or surface water. Management measures include:

- Locate the storage facility away from creeks, ponds and wells
- Storage facilities may be covered bins, dumpsters, sheds of concrete or wood, or piles on impervious surfaces covered with tarps. The type and size of the facility will depend on how much manure is stored, the method of disposal or utilization, and the volume of bedding used
- The storage facility will require a concrete base or other impermeable surface
- The area should be convenient with adequate space and surfacing for loading and unloading equipment
- Volume planning is essential, especially if you can only apply compost to pastures once a year

You must consider natural land features when developing a waste management plan. Evaluate slopes, soils, vegetation and proximity to creeks and drainages to avoid polluting water. To safe guard ground water, land characteristics below the soil surface must also be evaluated.

- Apply processed compost to pastures when your grasses can best utilize the nutrients (usually spring or fall, depending on species)
- Grading of the site may be necessary. Check regulations and required permits and avoid siting facilities near environmentally sensitive areas like wetlands or streambanks

Control Drainage

Use drainage improvements to protect stored manure from rainfall, surface runoff and flooding.

- Use a cover to prevent stored manure and liquid drainage from manure piles (leachate) from entering creeks and waterways
- Locate the storage facility on an impervious surface such as concrete, compacted clay or plastic to reduce the potential for seepage into groundwater
- Divert any runoff that does leave the storage site to a grass filter strip

Utilization

- Composted manure can be applied to land as a fertilizer and soil amendment. Composted horse manure decreases the risk of spreading internal parasites and weed seeds, and makes nutrients more readily available to growing grasses
- Composting manure and bedding materials reduces bulk, eliminates odor, improves handling qualities and produces a valuable product that can be given away, used on the property, or sold.
- Composting requires sufficient nearly level space, equipment, labor, a source of water and power, if an aerated system is to be installed
- Large horse facilities might want to hire a consultant to help plan a workable, environmentally safe manure management system

Disposal

- The OME (Organic Materials Exchange) is a local web-based service to list your raw, aged or composted manure. Interested gardeners and landscapers in the community can then contact you directly with their interest in your product
- Hauling off manure can be expensive, but may be the only alternative on many sites. Neighbors, landscapers, gardeners and nurseries may want your composted or aged manure

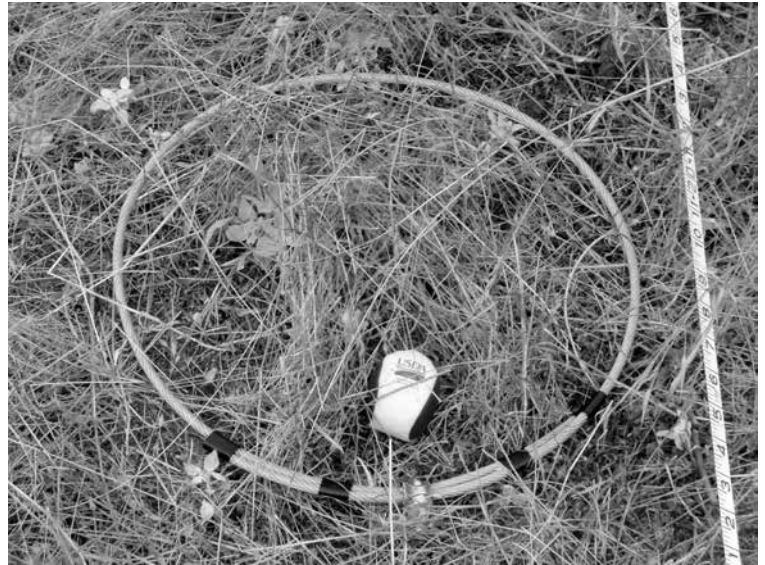
References

Organic Materials Exchange: www.omexchange.org/; livestockandland.org/; www.horsesforcleanwater.com/

TRACKING PASTURE HEALTH

Description and Benefits

Balancing the available forage with the timing and number of animals on a site is key to effective grazing management. To accomplish that, the land manager needs to know the proper amount of forage to graze that will maintain enough cover to protect soil and maintain or improve the quality and quantity of desired vegetation. Measuring Residual Dry Matter (RDM) on annual pastures and using visual assessments on perennial pastures are simple and valuable tools that enable the land manager to balance animal needs and the land's ability to produce feed. A field with a desirable blend of annuals and perennials will need a combination of these monitoring techniques in order to best maintain the viability of that blend.



California annual grassland forage plants have short life cycles and shallow root systems and should be managed to insure proper residual dry matter (RDM) for the next growing season. Annual forage responds to conditions that influence plant germination and establishment in the fall and early winter. Although fall weather has the greatest impact on most annual plant growth, the water holding capacity of the soil and RDM from the prior season also influences growth. (How to recognize RDM levels is described later in this article.) Managing RDM is the most effective way to improve the condition of the soil surface, increase its water holding capacity, and minimize the invasion of weedy or undesirable plants. Residual dry matter can minimize runoff and soil erosion as well as minimize the potential for manure to be transported to waterbodies. The amount of RDM required to protect the soil will vary according to forage species, soil type, slope and annual rainfall. For example, areas with heavy rainfall, erosive soils or steep hills require more RDM than flat, stable soil in drier climates.

Perennial Grasslands

California perennial grasses are found on many range sites and need to be managed differently than annuals if restoring perennial grasses to the ranch is a management objective. Native perennial grasses developed over millenia with natural wildlife herd movements. Herds tend to concentrate on a specific site and move frequently due to predator pressures. These types of high intensity, short duration grazing systems favor longer-lived, deeper-rooted perennial grass systems. Perennial grass systems tend to have higher infiltration rates, better soil quality characteristics, and longer “green” periods due to their extensive root systems that reach depths of over 3 feet.

Managing your ranch for both annual grasses and perennial grasses can benefit production in many ways. Annual grasses produce high amounts of digestible protein in a short amount of time. Perennial grasses tend to grow more slowly and stay green longer, and can thereby extend the high-value grazing period by a few months. Using proper management can best utilize these high-value forage periods while they occur, potentially reducing the need for supplemental inputs.

Materials Needed for Recognizing RDM Levels and Plant Density

For measuring RDM:

- 1-square-foot frame/quadrat (easy to construct with ½” pvc pipe and fittings)
- Grass clippers
- Ruler/yardstick
- Paper bags
- Gram scale
- Golf ball (or similarly-sized object)
- Tape measure or 20’ length of rope

For visual assessments:

- T-stake for marking photopoint
- camera
- notebook

Implementation

RDM measurements:

Management of annual grasses should focus on moderate levels of RDM. Landowners should consider the information below as guidelines and develop their own levels to meet their specific site and condition requirements. Taking measurements in the same locations each year will assist in evaluating if a field is responding to management as desired.

The amount of residual dry matter in a pasture should be estimated at the end of the growing season. This RDM information can be used to gauge utilization of the pasture before the minimum RDM level is reached. If animals continue to use the pasture after the growing season ends, RDM should be estimated again to determine when they should be removed. RDM can be estimated by either visual determination or, directly, by clipping and weighing samples.

Visual Determination

A quick, easy method to visually check RDM levels is to compare the site to a set of photos that illustrate various levels of RDM. When there is less than 400 lbs. of RDM per acre (‘low RDM’) objects the size of golf balls and areas of bare soil are visible at 20 feet. With 400 to 700 lbs. of RDM per acre (‘medium’) there will be little bare soil but the vegetation will appear patchy with an average of 2 inches of standing plant material. When 800 lbs. of RDM (high) is present, small objects are obscured from 20 feet away (a golf ball will not be visible), and an average of 3 inches of standing plant material will be present.

Weight determination

Ten samples should be made over a range site. Randomly pick a spot to measure and place the frame on the ground. Clip at approximately ½ inch off the ground. Put all clipped material and litter or shattered plant material into a sack and weigh with the gram scale (be sure to measure and subtract the weight of the sack). Grams per square foot multiplied by 96 gives you pounds per acre.

Example: 9 grams per square foot X 96 = 864 pounds per acre. Stocking rates can be figured from this data to reach guideline levels.

Perennial measurements

Photo Points – A photo point of the perennial stand you wish to manage should be taken each year in late spring when the annual grasses and forbs have gone dormant but the perennials are still green. This will allow you to see the perennials in the photo. A photo point can be a pole in a fence line, a tree, or other

permanent structure or marker that can be returned to each year. Taking the photo properly along with documenting date and direction of view (compass orientation) is important. More detailed information on photomonitoring is available from the resources below.

Plant Recognition – Using plant ID guides can help. However, if you cannot identify the key perennial plant you wish to manage contact your local Resource Conservation District or U.C. Extension Office.

Utilization – The concern here is the amount of photosynthetically active material (green blades) remaining for the plant to recover from grazing. Generally, less than 40 percent defoliation will not inhibit plant growth. However, one must give the plant time to re-grow before the dormant season. Also, depending on the species, grazing should be timed to allow the defoliated plants to grow and produce seed. Watch these areas over time to see the trend of the system.

An excellent resource on this topic is “Grass Growth and Regrowth for Improved Management”, available from Oregon State University’s Forage Information System: www.fsl.orst.edu/forages/projects/regrowth/default.cfm. For more information on annual or perennial rangeland and the monitoring aspects please contact your local Resource Conservation District or U.C. Livestock Advisor.

Websites to visit for more information

California Rangelands Research & Information Center: <http://agronomy.ucdavis.edu/calrng/range1.htm>

Grazing Lands Conservation Initiative: <http://www.glci.org/>

Society for Range Management: <http://srm.org/>

Grazing Lands Technology Institute: <http://www.ftw.nrcs.usda.gov/glti/homepage.html>

Central Coast Cattleman’s Grazing Lands NPS Approach: www.agwaterquality.org/grazing-doc.pdf



MATCHING STOCKING RATE TO CARRYING CAPACITY

Stocking rate refers to the amount of land area allocated to each animal for a specific period of time. The appropriate stocking rate is based on the carrying capacity of the pasture and will vary from year to year based on weather and prior use. Proper allocation of animals per unit of land maintains pasture/forage quality and protects the land from erosion. Pastures should be stocked at rates so that at least minimum RDM (Residual Dry Matter—see ‘Tracking Pasture Health’) levels are maintained. Animal and/or pasture managers should be prepared to move animals to a paddock or an alternative pasture once target RDM levels are reached or exceeded.



Carrying Capacity or the maximum number of animals a pasture will support without detrimental effects, is based on a variety of factors: the type of animals (i.e., cows, horses, sheep); age, working and breeding status; and the quality and productivity of the pasture’s plants and the level of utilization desired. Many publications and articles generalize the carrying capacity of irrigated pastures to be 1 to 2 acres per mature horse. Dryland pastures are substantially less productive and have much lower carrying capacities. Because productivity of dryland pastures varies greatly depending on soil type, rainfall and plant species composition, dryland carrying capacities also vary significantly. Carrying capacity on dryland pastures on the Central Coast may range from 10 to 60 acres per horse, and typically about 20% less for cattle.

As with soil, not all livestock were created equal nor do they use the pasture resource in the same way. One animal unit (AU) is equivalent to one mature cow weighing up to 1000 pounds. Other livestock equivalents are as follows: one horse = 1.2 AUs; one sheep or goat = 5 per AU (6 per AU if under the age of one year). Horses, sheep and goats can graze plant materials closer to the ground because of the nature of their mouths, tongues and/or teeth. Goats are mainly browsers, and although they do not tend to graze continuously, as cattle do, they can still overuse a pasture if not properly managed. In general, livestock will consume about 2-3 pounds of dry weight forage per day per 100 pounds of body weight after they are weaned.

To estimate carrying capacity, pasture managers should compare the amount of forage consumed and/or trampled by an animal versus the amount of forage available. Mature horses on all hay diets will consume 2 to 2.5% of their body weight in dry hay. Therefore, a 1200-pound animal can be expected to consume as much as 30 pounds of forage or hay per day to maintain body weight and condition. Producing dairy cows eat considerably more, and many animals will try to consume up to 4% of their body weight in feed to put on body fat for winter if they have 24-hour access to the pasture or field. Generally, the average intake of a horse grazing on pastures can be expected to resemble that of a horse fed hay. However, because some pasture plants are more palatable than others and horses may also trample or rub out plants, average intake estimates have only limited value when determining the carrying capacity of a

pasture. Instead it should be considered that a mature horse, whether or not its primary source of forage is the pasture, will eat or trample at least 1500 pounds of dry-weight of forage per month if left in a pasture all-day, all year-round.

Forage production for favorable and less favorable years has been estimated for range and pasture sites on the California Central Coast. These values ranging from 1000 to 4500 pounds per acre are reported by site in the USDA Soil Survey. Estimates represent the air-dry weight of forage from unfertilized pastures. Available forage to livestock during the grazing season would be approximately 3500 pounds on the best soil on flat ground because an average of 1000 pounds must be left for erosion control, seed source (if animal grass) and to prevent the invasion of undesirable plants. In addition, even in heavily utilized pastures, there is forage left virtually untouched (approximately 10%) because it is where manure has been or it's unpalatable for one reason or another. To estimate the forage available in your pasture create an exclusion area where forage can mature, be clipped and weighed to estimate production per acre.

The germination and growth of annual grasses coincide with the rainfall. Their major growing period on the Central Coast is usually in March and April. If adequate RDM was left from the previous year's growth, grazing may begin prior to the onset of fall rains and new growth. Animals grazing on range when the feed is dry may need protein supplementation. Grazing annual grass pastures during the winter or early green-feed period is not recommended until the new growth is at least 4-6 inches high, and it is best to visually confirm that pasture plants are at the right growth stage to be able to accommodate grazing with proper re-growth. Mechanical damage results if the plants are grazed when the soil is too moist. Likewise, livestock should be deferred from grazing pastures during irrigation. Typically, animals may return to graze 2-3 days after irrigation.

If sensitive wildlife areas or other important biotic communities exist within pasture areas or areas accessible to livestock then special provisions may be necessary to insure that these areas are properly managed. On some ranches, sensitive areas will need fencing so they can be managed separately from other pastures. Other sensitive areas of concern include unstable slopes, eroded gullies and ravines that present a hazard to livestock and a likelihood of getting worse if accessible to livestock. Other areas such as riparian areas and important water bodies, may also require fencing so that livestock access and pressure can be effectively managed to match the area's capacity.

Not all areas on a small ranch or horse facility should be expected to support vegetation. Some 'sacrifice' areas will appear as dry, bare lots because of heavy usage. These areas should not be referred to as pastures but rather as corrals or paddocks. 'Paddock' refers to a small, non-irrigated, nongrazable holding pen or exercise lot, often adjacent to a horse stall. (This definition of a paddock should not be confused with the division of a pasture into small grazing cells, which may be called paddocks.) Since it is not feasible to manage for vegetative cover in a paddock, the management considerations are different than those for a pasture and should have hardened footing surfaces to eliminate or reduce mud and erosion in these areas.

Resources

For best results, consult with specialists at UC Cooperative Extension, the USDA Natural Resources Conservation Service or the Resource Conservation District as listed in the resources section at the end of this document. The Forage Information System at Oregon State University provides access to a broad array of technical information and other professionals at www.fsl.orst.edu/forages/index.cfm.

SWINGING FLOOD GATE ON A FENCE

Description and Benefits

Where a fence crosses a gully or creek that occasionally floods, a swinging floodgate extending from the bottom line wire to a depth equal to the water level or the lowest point of the ditch can be installed to keep animals in while permitting driftwood and debris to pass through. A properly-installed swinging floodgate reduces obstructions to flow that can cause erosion and localized flooding.

When to use a Swinging Floodgate on a Fence

Any area where there is a threat of flooding or erosion from obstructions caused by a fence crossing a creek or narrow and shallow ditch or gully will likely benefit from installation of this practice

Implementation

A good fencing option for a narrow or very shallow ditch is to build a panel with pipe welded in the proper shape. Barbed wire can be strung across the panel, and hinge the panel to the stranded cable. Another option for spans less than 20 ft. is a panel made of pressure-treated 1" x 4" boards. Cut the boards to approximate the contour of the ditch, fasten the boards into a single panel with Class 3 merchant wire, stapling the wire to each board, leaving 4 - 6 inches between boards. Loop the merchant wire at the top to form a hinge, allowing the panel to swing on the stranded support cable.

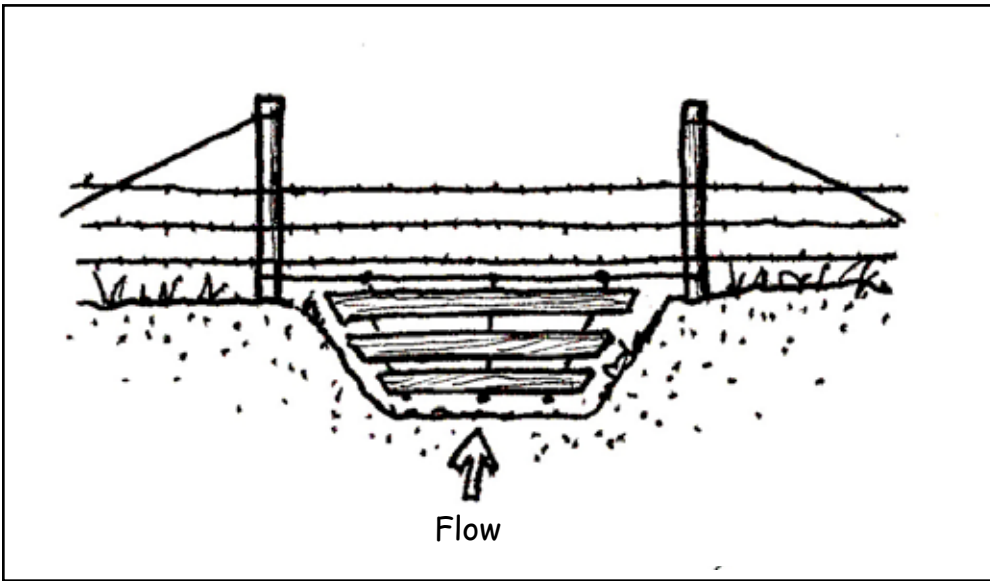


Maintenance

Always keep an eye out for the condition of your fence, especially at stress points where animals rub or push against it and where wildlife tend to pass through. On very large parcels, this may require a systematic effort to walk, ride or drive along your fence lines on a routine basis. During the rainy season particularly, check any stream or swale crossings before and after periods of flow to clear out existing or potential debris jams.

References

- Paige, C.** 2008. *A Landowner's Guide to Wildlife Friendly Fences*. Landowner/Wildlife Resource Program, Montana Fish, Wildlife, and Parks, Helena, MT. 44pp.
- Wyoming Game and Fish Dept.** 2004. "Fencing guidelines for wildlife." Revised version Habitat Extension Bulletin No.53. Wyoming Game and Fish Dept. 12 pp.



NRCS. 2008. Natural Resources Conservation Service General Standard and Specification Fence. Fence (Feet) Code 382. January 2008. NRCS Idaho. Online: <http://efotg.nrcs.usda.gov/toc.aspx?CatID=3958>

NRCS, OR, 2010. Wildlife Friendly Wire Fence, Job sheet

WILDLIFE-FRIENDLY RANGE FENCE

Description and Benefits

Fences can injure and/or create a barrier to wildlife if not designed and installed correctly. A wildlife friendly fence is a constructed barrier that controls the movement of domestic animals while allowing free passage for wild animals to jump over and crawl under, and is highly visible for hooved animals and birds.

When to use Wildlife Friendly Range Fence

This practice may be applied on any area where management of animal or people movement is needed.



Implementation

In most cases, a 40-inch tall fence on level ground with a minimum of 12-inch spacing between the top two wires will be sufficient to prevent adult deer injuries and mortalities. Additional accommodations will be needed to allow for passage under the fence for juvenile deer that prefer not to, or are incapable of, jumping over the fence. Whenever feasible, use smooth wire for the top and bottom wires to reduce injuries.

Fences should be low enough for adult animals to jump, preferably 40” or less, and the top two wires should be no less than 12” apart. Deer easily tangle their back legs if the top wires are closer together. The bottom wire or rail should be high enough for fawns to crawl under, at least 18” from the ground. Increasing visibility using a top rail, high-visibility wire, flagging or other visual markers can help ungulates and birds, such as hawks, and owls better navigate fences. Using smooth wire – barbless wire, high-visibility tape or braid, or high-tensile electric wire – for the top and bottom strands will prevent snagging and injuries. In areas where animals are temporarily confined, drop-down fence, lay-down fence or crossings can be used for safe wildlife passage.

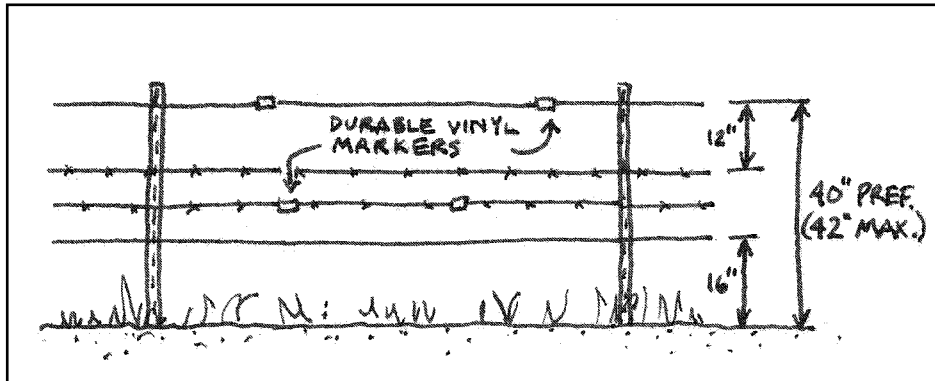
The following wildlife friendly guidelines will fit several types of fences:

- Top wire/rail preferred height 40” or a maximum of 42” above ground
- At least 12” between top two wires
- Bottom wire preferred height 18” above ground or a minimum of 16”
- Smooth wire on the bottom
- Posts at 20 foot maximum intervals
- Keep wire tight

- Make fence wire more visible by adding vinyl siding trim or small diameter PVC tubing to the top and middle wires. Flagging is not a first choice for making fencing more visible. Flagging needs to be replaced yearly and domestic and wildlife animals have been known to eat the flagging material

Maintenance

Always keep an eye out for the condition of your fence, especially at stress points where animals rub or push against it and where wildlife tend to pass through. On very large parcels, this may require a systematic effort to walk, ride or drive along your fence lines on a routine basis.



References

- Paige, C.** 2008. *A Landowner's Guide to Wildlife Friendly Fences*. Landowner/Wildlife Resource Program, Montana Fish, Wildlife, and Parks, Helena, MT. 44pp.
- Wyoming Game and Fish Dept.** 2004. "Fencing guidelines for wildlife." Revised version Habitat Extension Bulletin No.53. Wyoming Game and Fish Dept. 12 pp.
- NRCS.** 2008. Natural Resources Conservation Service General Standard and Specification Fence. Fence (Feet) Code 382. January 2008. NRCS Idaho. Online: <http://efotg.nrcs.usda.gov/toc.aspx?CatID=3958>
- NRCS, OR,** 2010. "Wildlife Friendly Wire Fence," Job sheet

STOCK POND HABITAT ENHANCEMENT

Description and Benefits

Stock ponds are ponds that have been constructed in rangeland settings to provide a water source for livestock and horses. Enhancing existing stock ponds can result in improved water quality for livestock and the creation of wildlife habitat. Ponds can be magnets for wildlife, large and small, and on the Central Coast, such ponds can provide important habitat for protected species such as California red-legged frogs and California tiger salamanders. Tree frogs (aka chorus frogs), birds, bats and other mammals also benefit greatly from the water availability and habitat provided by stock ponds.



Enhancing stock ponds to benefit livestock drinking water quality typically only involves fencing off the pond and providing a trough that draws water from the pond by the use of a pump or gravity (referred to as an “off pond watering system”). Enhancing stock ponds to benefit wildlife can also include fencing off the pond, but with a “wildlife friendly” fence. (See Wildlife Friendly Fencing) Vegetation in the fenced-off area provides food, nesting habitat, and cover for insects, birds, and other animals.

When deciding how to enhance an existing stock pond for native amphibians, you’ll need to consider several factors. For example, ponds that never go dry can give invasive species, such as bullfrogs, hybridized tiger salamanders and introduced fish (which all have insatiable appetites) a competitive advantage over native species. Alternatively, ponds that do not pond long enough can hinder native amphibians’ ability to reach metamorphosis. In response, Biologists typically recommend measures that allow ponds to be dry for 1 to 3 months each year, mimicking California’s seasonal water cycle. The hydro period is one of most important aspects of stock ponds for native amphibians in our area. You can meet these hydrologic recommendations by reshaping, re-excavating, repairing an embankment or installing a drain in your pond.

Planting trees, shrubs, grasses, forbs, rushes and sedges around a pond can improve both water quality, and wildlife habitat. Both California red-legged frog and California tiger salamanders benefit from the cover provided by some levels of submerged, emergent, and edge vegetation, especially when non-native predators are not controlled. California red-legged frogs need ponds with a mix of open surface water and vegetation for cover and for surfaces to attach eggs to. However, California tiger salamanders do not need this level of complexity and successfully breed in ponds with no emergent vegetation. Input from a local biologist, prior to fencing and vegetating a pond is important to help determine how best to proceed with enhancement efforts.

Any pond project proponent should communicate with the local vector control district for best management practices for minimizing mosquito production. Mosquito fish planted in a pond will harm any desired amphibians, as well as steelhead trout, if the mosquito fish escape through a pond outlet.

When to enhance a stock pond

Stock pond enhancement projects can be effective on ponds of any size and water holding capacity, although the scale of effort (i.e. fencing, off pond watering system, planting of trees, shrubs, grasses, forbs, rushes and sedges) of this practice should be adjusted to match the pond's water-holding capacity and duration. In general, fencing off the pond and providing for an off-pond watering system will give the landowner the most benefit to his/her operation. The extent of planting is determined by the conditions of the site, the ability to provide supplemental irrigation, and the desire of the rancher to devote some time to regular maintenance. Repairing or enhancing existing stock ponds can be expensive and may require several permits. The RCD of Monterey County, in Coordination with The Natural Resources Conservation Service and the US Fish and Wildlife Service can provide technical and financial assistance for eligible projects through their EQIP and Partners for Fish & Wildlife programs.

Implementation

The three main components to stock pond habitat enhancement are fencing, an off-pond watering system, and native plantings. Plan carefully, before you break ground. Work with your local NRCS and/or RCD office to determine the cost effectiveness of your plan and the additional benefits you can expect to see. NRCS and RCD staff can also provide technical assistance in planning your project and may be able to match your investment with a cost-share program that will make your project more affordable.

Fencing:

The size of the fenced area depends on the extent of the plantings you want to undertake as well as the location of other fences and the topographical limitations of the area. If keeping horses and cattle out of the pond and providing them with a watering trough is your primary goal, the fenced area need not be much larger than the pond. If you intend to improve the wildlife habitat around the pond, the fence should allow for at least a 20 foot buffer around the pond. Use a smooth wire, instead of the normal barbed wire, for the top and bottom wires of the fence to allow for safe movement of wildlife in and out of the pond area. A gate in the fence will simplify your maintenance and recreational access to the pond as well as allow for future "flash grazing" as a vegetation management tool.

If landowners want their animals to have direct use of the pond, another option is to fence off only a portion of the pond so that amphibians and livestock can both utilize the pond. California tiger salamanders are known to attach eggs to fencing located in ponds. The amphibian side of the pond should have vegetation to provide appropriate cover and refuge.

Off-Pond Watering System:

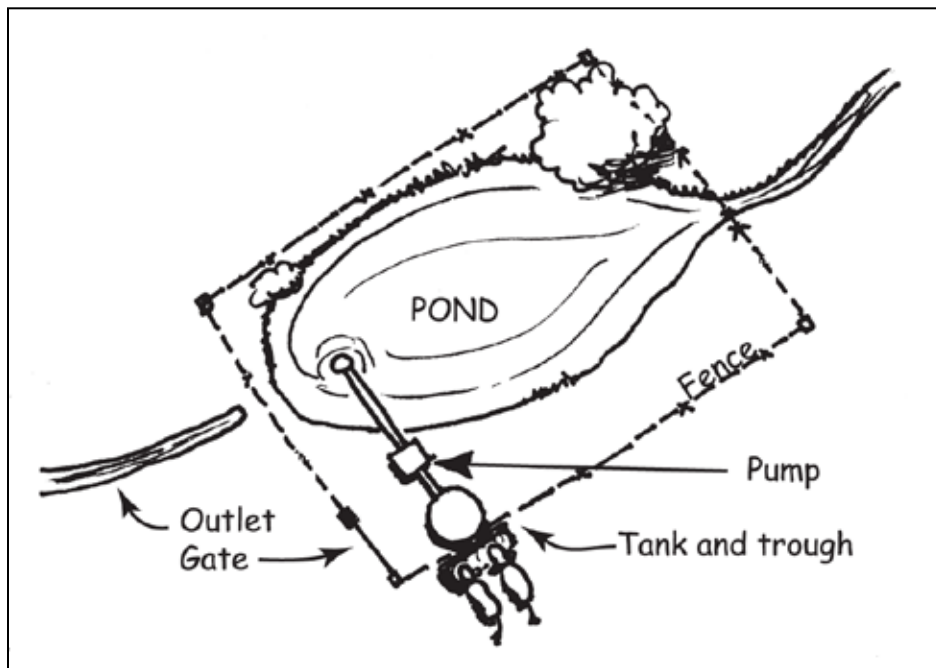
These systems can vary widely, depending on the site and the number of cattle or horses and the number of fields that will use the system. In fact, the systems are too varied and too complicated to adequately explain here. If you are unfamiliar with such systems, working with your local NRCS engineer can save you a lot of time and money. NRCS provides free technical assistance, and they may be able to match you with a cost-share program. Two general examples of off pond watering systems are:

- 1) Use of a solar pump to pump water to a storage tank on a small rise, which gravity feeds the water to one or more troughs in one or more fields
- 2) A more simple approach uses a siphon pump to pull water from the pond and gravity feed it directly to the trough

Native Plantings:

Planting native vegetation to provide habitat for wildlife will require several years of maintenance to the area while the plants become established. It will also require considerable work to prepare (i.e. weed

control) the site for planting. See *Hedgerows and Riparian Buffers* and *Native Grass Establishment* for details on establishing native plants. However, some simple and inexpensive planting options do exist. These low/no maintenance options may be preferable for busy landowners. Basically, consider planting just at the water's edge using sedges and rushes. These can be purchased as "plugs" and planted in the winter or early spring. If you have rushes or sedges growing along the streams on your land you can dig some of these up, separate them and plant them at the pond. Additionally, live cuttings of willow and cottonwood can be planted at the water's edge. See *Live Staking and Pole Planting* for details on how to harvest, handle and plant these live cuttings. None of these plantings will require supplemental watering or future maintenance (just keep the livestock from trampling or eating them), although you may need to install cages around the live cuttings to discourage browsing by herbivores.



Maintenance

During periods of heavy use, it's best to check the of your trough and pump as often as you visit your pond to ensure that you have a safe and adequate water supply for your animals and to avoid burning out your pump. Prior to rainy season, make sure that any pond spillways are adequately armored, and during the rainy season, keep an eye out for erosion and weak points. If your pond is fenced, periodically walk the fence perimeter to ascertain any damage to fence, posts,

and gates, and repair holes and replace posts as needed, especially at stress points where animals rub or push against it and where wildlife tend to pass through.

References

- Hayes, M.P. and M.R. Jennings.** 1988. "Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylei*): Implications for management." Proceedings of the Symposium on the Management of Amphibians, Reptiles, and Small Mammals in North America. R. Sarzo, KE Severson, and DR Patton (technical coordinators). USDA Forest Service General Technical Report RM-166:144-158.
- Bobzien, S. and J.E. DiDonato.** 2007. "The Status of the California Tiger Salamander (*Ambystoma californiense*), California Red-Legged Frog (*Rana draytonii*), Foothill Yellow-Legged Frog (*Rana boylei*), and other aquatic herpetofauna in the East Bay Regional Park District, California." Annual Report to USFWS.
- L.D. Ford, P. Van Hoorn, D.R. Rao, N.J. Scott, P.C. Trenham, and J.W. Bartolome,** in Review, "Managing Rangelands to Benefit the California Red-Legged Frog and California Tiger Salamander." Prepared for the Alameda County Resource Conservation District, Livermore, CA (IN REVIEW)
- USDA NRCS Grazing Lands Technology Institute.** 1997. *National Range and Pasture Handbook*.
- Vallentine, John R.** 1989. *Range Development and Improvements* 3rd edition. Academic Press.

PRACTICES FOR LARGE ACREAGES AND THE WATERSHED



Stewardship of larger acreages (typically over 10 acres) is never a matter of simply letting the land be, especially in the context of wildland fire risk, access road maintenance, invasive weeds, and production agriculture. While not addressed in this manual, a whole-property conservation plan is the ideal guidance document for planning resource management activities on your land. Conservation planning assistance is a free service of the USDA Natural Resources Conservation Service. They are co-located with the Resource Conservation District of Monterey County and can be reached at 831-424-1037, ext. 3.

VEGETATION MANAGEMENT



The vegetation management techniques described in the previous sections under fire and livestock management are equally relevant on any sized parcel. Additional vegetation management practices outlined in the following section relate more directly to native plant restoration and noxious weed control for both wildlife and water quality management.

Prescribed fire and grazing have been the traditional low cost tools used to manage rangelands and forest watersheds. The MCCWPP sets a goal of 20,000 acres of annual prescribed fire treatment for Monterey County.

HEDGEROWS

Description and Benefits

Hedgerows are rows or groups of trees, shrubs, perennial forbs, and grasses that are planted along field edges or other unused areas around a field. Hedgerows consisting of native plants require minimal maintenance once established and can provide many benefits to farmers and non-farmers alike. They can reduce wind erosion, improve the permeability of the soil, suppress weeds by direct competition, provide wildlife habitat, and provide habitat for beneficial insects. Hedgerows can also filter surface runoff and subsurface flows, preventing excess sediment, nutrients, and pesticides from entering waterways. They also provide an aesthetic benefit to the landscape.



Hedgerow along the edge of a cultivated field.

When to use Hedgerows

Hedgerows are appropriate for areas between fields, along fencelines and driveways, adjacent to roads and roadside ditches, and next to canals or streams. Because of the many benefits associated with hedgerows, they can be installed in agricultural and nonagricultural situations. They are ideal for landowners with small parcels who want to improve the aesthetics and wildlife habitat on their land. In either case, site selection is important and there are three main considerations to account for. First, there needs to be access to water for irrigating the hedgerow plantings for the first 2-3 years of establishment. Second, the site needs to be not subject to flooding, which will kill most of the native plants suited to dry conditions. Third, consider what equipment is used on the adjacent fields, roads, or canals, and be sure that the hedgerow will not hinder proper use of this equipment.

Materials Needed

- Small tractor or ATV: for discing, leveling, and mowing the site
- Hand tools: shovels, rakes, dibble sticks, 5 gal. bucket
- Lawn mower and/or weed whacker
- Drip irrigation system
- Native plants: trees, shrubs, perennial forbs and grasses
- Herbicide: backpack sprayer and/or wick applicator if not managing with organic methods
- Mulch: wood chips, crushed walnut shells, other suitable material
- “No Spray, No Disc” sign if site is maintained by others or along a county roadside

Implementation

Select a Site: The first step is to select a site. Possible sites include roadsides, fencelines, along streams or canals, and between fields. Some native plant species used in hedgerows are very water sensitive (i.e.

sensitive to overwatering), so good drainage is very important. The site should also have access to water and not conflict with normal equipment operations. Access and availability of water to a new hedgerow planting is the single most important factor affecting plant survival in the first year. Choose a site that will give the most benefits to your operation and that best fits your needs. The length and width of the site will vary. Greater widths will allow for more complex plantings (i.e. various species of native trees, shrubs, forbs and grasses).

Draw a Plan: It will be very helpful for you to draw a scale site plan for your hedgerow. Begin by drawing the existing site, including any features that will remain (e.g. trees, fences, canals, roads, buildings). After you have decided on the plant species to include in your hedgerow, overlay the existing site plan with a planting plan that indicates the species and spacing of the plantings. Overlay the planting plan with an irrigation system plan that shows the water source and indicates the sizes of the irrigation tubing/pipe and the flow rate of the emitters (typically expressed in gallons per hour, or gph) for the various species.

Site Preparation and Weed Control: It will be likely that your chosen hedgerow site will have weeds growing on it. If so, you will need to plan your weed control strategy to begin at least one year prior to planting your hedgerow. If you are fortunate and have a weed free site to work with, then disc the area in the late summer or early fall to make the soil workable. Then harrow the area to prepare an even, well-drained bed. A flush of weeds may appear after the first rains following the discing. These can be treated with a broad spectrum herbicide, light cultivation or flaming before the area is planted. Another approach can be to first establish a ground cover of native grasses and forbs during the first two years, followed by planting trees and shrubs the third year into cleared or unplanted spaces in the native grass and forb stand. Refer to Weed Control and Native Grass Establishment in this manual for details on site preparation.

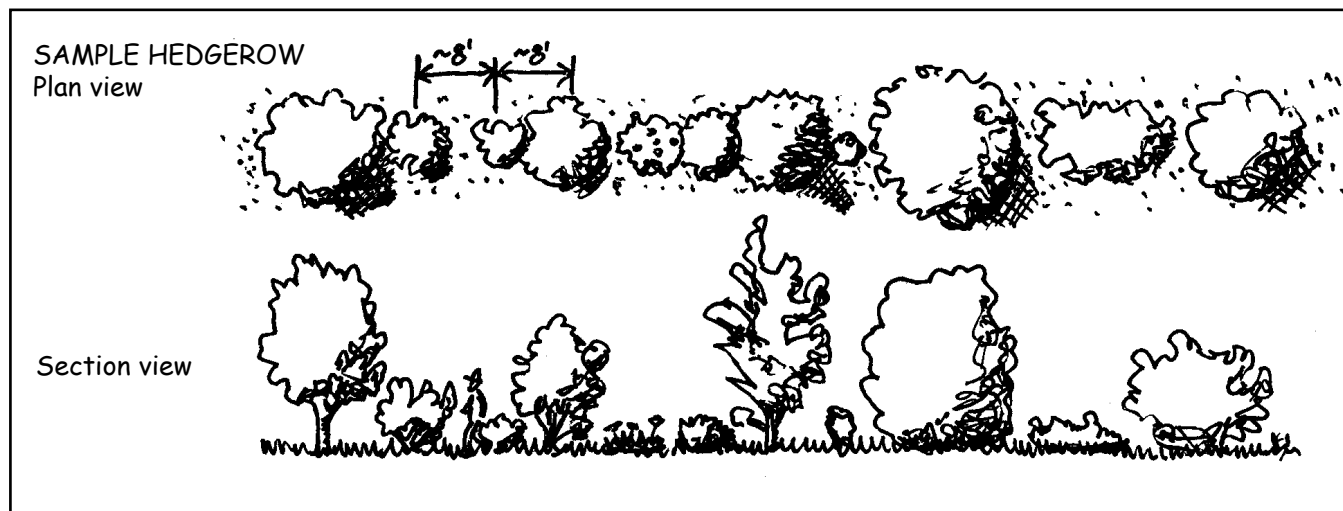
Native Plant Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Willow spp.												
Ceanothus spp.												
Coffeeberry												
Hollyleaf Cherry												
Yarrow												
Black Sage												
Toyon												
Golden Sticky Monkeyflower												
Elderberry												
California Buckwheat												
Deergrass												
Mugwort												
California Fuchsia												
Narrowleaf Milkweed												
Coyotebrush												
Manzanita												

Flowering periods of California Native Insectary Plants on the Central Coast.



Plant Selection: First identify any variability in the soil characteristics at your site. Work with your local nursery or plant expert to choose the plant species that are best suited to the soil, moisture, and other characteristics of your site. Remember, many native species such as toyon, varieties of ceanothus, and California buckwheat, are extremely drought tolerant. Too much soil moisture, whether it be from winter ponding, an irrigation system or tailwater from an adjacent field, will cause the plants to die. On the other hand, some native species, such as willow and cottonwood, are water-loving species that can tolerate frequent wet conditions. Further refine your plant selection based on the intended purpose of the hedgerow. Contact an IPM specialist (see the website www.ipm.ucdavis.edu for more information) to determine what plant species will attract insects that will most benefit your crops. If your primary goal is to use plants to attract beneficial insects (i.e. insects that prey on or parasitize crop pests), you should plant species with plentiful nectar and

pollen. Consider the time of year during which each species flowers, and try to use a good variety of plant species so that flowering will take place almost year-round. The figure on the previous page shows the flowering periods for several California native insectary plants. The most beneficial hedgerows are those with a combination of trees, shrubs, forbs and grasses. In some situations, the tree and shrub plantings may need protection from herbivores during establishment, such as metal wire ‘gopher’ cages. Be careful not to plant large trees under power lines. Planting should be done from late fall through spring to take advantage of cool, moist conditions ideal for establishment.



Irrigation: Identify your water source and assess water delivery capabilities. Design either a drip (preferred) or furrow irrigation system. Determine the watering needs of the plant species you chose and work with your local irrigation supplier to select needed materials. Installing a drip system with adjustable emitters will allow you to adjust the amount of water applied to each plant based on that species’ specific needs. The irrigation system will be used for the first 2-3 years to provide supplemental watering during the dry season until the plants have developed an adequate root system. Watering infrequently (i.e. every 2-4 weeks) but for a long duration (i.e. 2-8 hours) can help develop hardier plants with deeper root systems.

Maintenance

Hedgerows require regular maintenance during the 2-3 year establishment period. A major maintenance need is weed control. Spot spraying or wicking with herbicide in the spring and fall can be effective. A well-timed mowing in the spring to reduce the weed seed bank is another option. The most effective weed control for hedgerows without grass or forb plantings is a 6 inch layer of mulch (wood chips, crushed walnut shells, etc.) over the entire area. At the very least, placing a ring of wood chip mulch around each plant can be beneficial. Weed cloths around each plant are also very effective at suppressing weeds and maintaining adequate soil moisture. Some companies make specially-designed weed cloths for use around new plantings. Weed cloths will reduce the watering requirement. Monitor soil moisture regularly for the first month after planting to determine the proper watering frequency and duration. The irrigation system should be checked often during the period of use - emitters can become clogged and animals may chew on the irrigation lines. Cages may need to be installed around some tree and shrub plantings if you observe browsing by deer or livestock. Occasionally a plant may die and need to be replaced.

References

- Community Alliance with Family Farmers**, 2004. *Hedgerows for California Agriculture: a Resource Guide*.
- Robins, P., R. Bresnick Holmes, and K. Laddish, ed.** 2001. *Bring Farm Edges Back to Life!* 5th edition. Yolo County Resource Conservation District.

VEGETATED FILTER STRIPS

Description and Benefits

A filter strip is an area of grass or other permanent vegetation used to “filter” sediment, organics, nutrients, pesticides, and other contaminants from farm sheet flow runoff in order to maintain or improve water quality in local waterbodies, such as streams and ponds. Filter strips slow the velocity of water, allowing the settling out of suspended soil particles, infiltration of runoff and soluble pollutants, adsorption of pollutants on soil and plant surfaces, and plant uptake of soluble pollutants. Filter strips are typically no narrower than twelve feet, and increased width typically increases the filtering or water quality benefit. Filter strips can be an aesthetic means of stabilizing field border soil and can also serve as forage (on-farm use or cash crop), turnrows and headlands, and field access. Filter strips can enhance wildlife objectives depending on the vegetative species used and management practiced. When planted with native or adapted vegetative species they can provide food and cover for important wildlife.



When to use Vegetated Filter Strips

Filter strips are most effective and useful on land with less than 10% slope at the lower edge of crop fields, sacrifice areas, or hardened footing areas where there is sheet or uniform shallow flow, especially adjacent to streams, ponds, lakes, and drainageways. They can also serve as part of a riparian forest buffer system or as part of an agricultural waste management system.

Implementation

- The filter strip should be designed to accommodate anticipated flows, slope and soil type to maximize the potential benefit. To determine the optimum width of a filter strip, consult with an NRCS engineer who will evaluate the individual site.
- Before a filter strip is planted, a suitable seedbed should be prepared. On farmland, light disking or some other form of tillage is usually sufficient. Disking should be followed by some smoothing operation such as floating or planing so that larger clods are broken and the seedbed is smooth. This is particularly important for smaller seeded species such as clovers.
- For non-leguminous or grass-only plantings, additional fertilizer may be needed to aid establishment. Fertilize and amend the soil according to soil test results from the site and the needs of the species to be planted. Excess nitrogen fertilizer can be washed or leached out of the site (causing a water quality concern) or even give weedy species a competitive edge over the planted species.
- If legumes are to be included in the planting, make sure that they are either pre-inoculated or that you inoculate them with the appropriate rhizobial bacteria prior to planting at a rate of about 8 oz. of inoculum per 100 lb. of seed.
- For planting, the filter strip seed can be broadcast or drilled in. Drilling may require less ground preparation, and is the most desirable planting method. For single species or larger seeded types, an alfalfa or legume drill can be used. Broadcasting seed is faster and less expensive, but will require a light harrowing to incorporate the seed followed by a final floating or rolling to finish the seedbed.

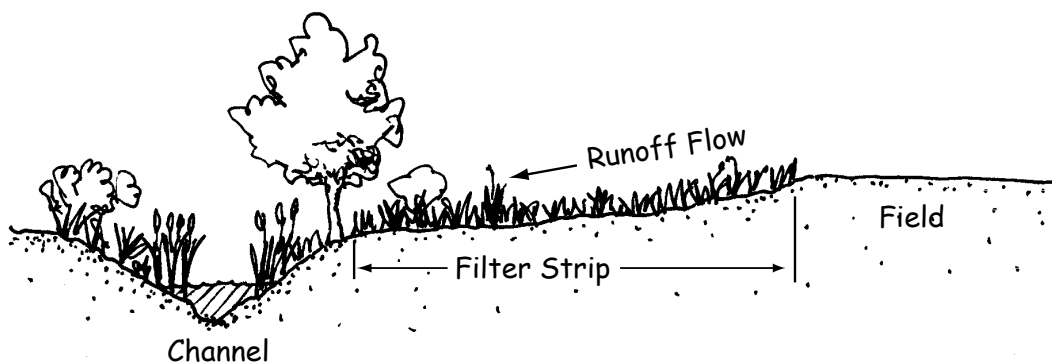
If necessary, mulch the newly-seeded area with straw for soil protection during germination. Supplemental seeding may be needed every 2-5 years.

- If fall rains are not expected immediately, a light irrigation will settle soil around the seed and hasten germination.
- Mow (and harvest if possible) filter strip grasses several times a year to encourage dense vegetative growth. For ground nesting wildlife, care should be taken to avoid mowing during nesting periods. If self-seeding is desired, mowing should be delayed until the desired filter strip species have matured seed. When mowing a planting that includes legumes, care should be taken to not cut below the growing point, or re-growth will be hindered.
- Be careful to maintain original width and depth of the planted area in order to maintain the intended benefits of the filter strip. Inspect and repair after storm events to fill in gullies, remove flow disrupting debris and sediment accumulation, reseed disturbed areas, and take other measures to prevent concentrated flow in the filter strip.
- Suppress weeds with well-timed mowings, which are preferable to herbicide in a filter strip. If herbicide is needed, it should be applied at low rates or in spot treatments and with adequate time for degradation before anticipated storms or irrigations (runoff events).
- Take care to exclude livestock and vehicular traffic from the filter strip during wet periods of the year since filter strips rely on infiltration for reducing contaminants. It is recommended that this type of traffic be excluded at all times to the extent that is practical.
- Restoration of the filter strip will be required once it has accumulated so much sediment that it is no longer effective.

References

USDA Natural Resources Conservation Service. Field Office Technical Guide, "Filter Strips".

Robins, P., R. Bresnick Holmes, and K. Laddish, ed. 2001. *Bring Farm Edges Back to Life!* 5th edition. Yolo County Resource Conservation District.



RIPARIAN BUFFERS

Description and Benefits

Riparian areas are lands adjacent to rivers, streams, sloughs, wetlands, and other waterways. The availability of water and flooding patterns (i.e. floodplains) define the extent of the riparian area. Both factors provide for a unique assemblage of vegetation. Some of the plant species commonly associated with riparian areas include willow, cottonwood, oak, sycamore, elderberry, mulefat, and many grasses and sedges. This vegetation provides protection from streambank erosion and influences, to a certain extent, the shape of the waterway it is adjacent to. Riparian areas and the associated floodplains are designed by nature to accommodate flood waters during high flow events. Riparian area restoration projects can vary in size and scope depending on the size of the waterway and adjacent land use activities. A project may be as simple as identifying the floodplain and extent of the riparian zone and planting a mixture of riparian plant species. In some cases the channel may have incised (downcut) and/or widened to the extent that a floodplain no longer exists. In such cases the channel may need to be reshaped, which is too complicated of a process to adequately describe in this text. Restoring riparian vegetation can provide numerous ecological and economic benefits. This practice of restoring riparian vegetation is also referred to as creating riparian buffers. Riparian buffers can be useful in agricultural settings, as the above ground vegetation intercepts sediment- and nutrient-rich surface runoff, and the roots take up nutrients from the subsurface runoff, in effect filtering the agricultural runoff before it reaches the stream.

When to Use Riparian Buffers

Riparian buffers can be planted along any waterway, from large rivers to small drainage swales, where riparian vegetation historically existed. The size and scope of the restoration project and the vegetation to be planted will depend on many factors. Size of the drainage, the existence and extent of its associated floodplain, and adjacent land use determine the boundaries of the project site. The timing and seasonality of water flow in the channel and the depth to the water table will determine the appropriate vegetation for the site.

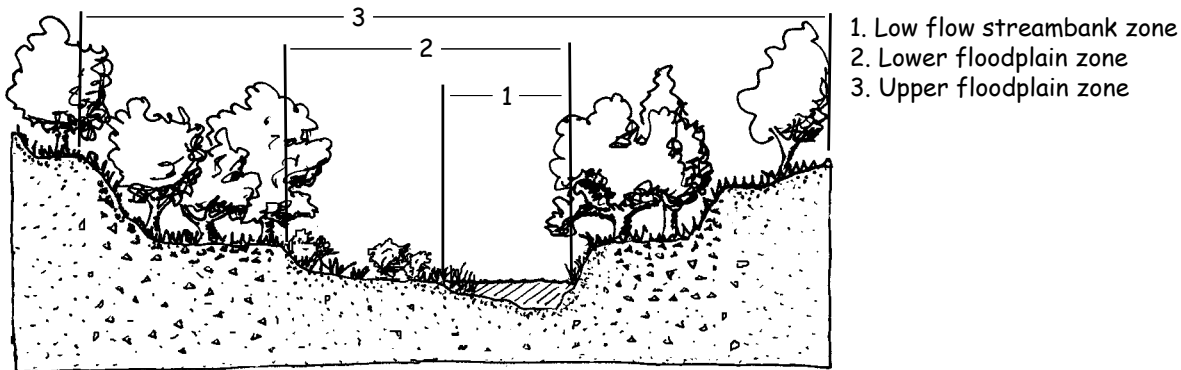
Implementation

Restoring riparian areas may require permits from the California Department of Fish and Wildlife, the Army Corps of Engineers, and the Regional Water Quality Control Board. Contact your RCD or NRCS for consultation during the site selection and planning phases of your project. Chances are if there are no special status species on the site and work is kept out of the channel, you won't need any permits.

Site selection is an important first step. Determine if your waterway exhibits a floodplain. Check the depth to the water table. Check soil types. Take note of existing vegetation. Is it native or non-native? Will the removal of non-native vegetation be a part of your project? Assess adjacent land use activities. Is supplemental irrigation available? Choose a site that will best be able to support the vegetation after an initial establishment period of 3-5 years. Access to and availability of water in the soil is your main concern.

Expect to spend as much time, if not more, planning your riparian buffer project as you do for actually doing the work. Drawing a map of your site will help. On your map you will want to identify the low flow channel, the hydrologic floodplain, and the topographic floodplain (See *Watershed Processes* for more information). Also note any existing vegetation, structures (e.g. bridge piers, irrigation pumps, etc.), roads, and erosion sites.

Once you have selected and mapped your site, decide what you want to plant and where you want to plant it. Referencing a nearby healthy riparian area can tell you a lot about what species grow and how they are distributed. If a healthy reference stream is not available, use your map and knowledge of the height and frequency of flows to determine planting zones. In general, you should delineate three zones: low-flow (or summer flow) streambank vegetation zone - mostly rushes, grasses and sedges; lower floodplain vegetation zone - mostly shrub-like plants able to withstand inundation; and upper floodplain zone - a mixture of grasses, shrubs, and trees. For riparian areas adjacent to agricultural fields a fourth zone of primarily grasses and forbs can be planted between the field and the riparian plantings (See *Vegetated Filter Strips*).



1. Low flow streambank zone
2. Lower floodplain zone
3. Upper floodplain zone

Refer to the *Native Plant List for Carmel Valley* in this manual for native plant species commonly found in the different zones in the watershed. You will also want to work with one of the local native plant nurseries to decide what plants are most appropriate for your site and to determine what plants are available. Whether you are planting in one zone or in all four, choose several species for each zone. Delineate on your site plan the extent of the plantings in each zone and what species will be planted there.

In general it is best to plant vegetation from late fall through early spring. Planting on the low-flow channel streambank and on the lower floodplain may not be possible during periods of high flow associated with winter storms. Planting these zones may need to occur in the spring. It is not necessary to plant the trees, shrubs, etc. in rows or at regular intervals, although this can make irrigation easier. It may be best to plant the riparian vegetation in clusters of 3-5 plants. The plants can be different species.

Maintenance

Protective cages may need to be built around the trees and shrubs to protect from herbivore browsing. Four to five foot wire fencing works best. Cut the fencing and wrap it around the planting to create a circular enclosure at least 3 feet in diameter. Stake the wire cage down using rebar or fence stakes. Mulching around the plantings with woodchips or other type of mulch will help control weeds. Irrigating the plantings during the summer (or when otherwise dry conditions exist) for the first two to five years is important to the success of the plantings. Create a wide, shallow watering basin for each plant. Provide the plants with a deep watering once a week initially, gradually reducing the frequency over time, using whatever irrigation system is most appropriate for your site

References

- Robins, P., R. Bresnick Holmes, and K. Laddish, ed.** 2001. *Bring Farm Edges Back to Life!* 5th edition. Yolo County Resource Conservation District.
- Barbour, M. et al.** 1994. *California's Changing Landscapes*. California Native Plant Society.

NATIVE PERENNIAL GRASS ESTABLISHMENT

Description and Benefits

Over the past 150 years California has seen a shift in its grassland vegetation from a mixture of perennial grasses and annual grasses/forbs to a system dominated by annual grasses/forbs (many of them introduced and invasive). Armed with rapid growth and prolific seed production, annual grasses effectively compete with slow-growing, long-lived native perennial grasses for light and soil water. For this reason reestablishing native perennial grasses requires careful human management of the land, as well as patience. This practice will cover the general guidelines to follow for reestablishing perennial grasses on Monterey County's grasslands and oak woodlands. Native perennial grasses provide many benefits, including deep rooting, which allows for deeper water penetration into the soil in the winter. This in turn can help reduce soil compaction and major runoff. Many perennial grasses remain green longer than annuals and can provide good forage for grazing animals.



Native perennial grasses are long-lived and develop deep roots.

When to use Native Perennial Grass

Native perennial grasses can be reestablished in any grassland, oak woodland or landscape, regardless of current land management. Actively grazed rangelands can provide an ideal opportunity for native perennial grass establishment, although changes will most likely need to be made in grazing management.

Materials Needed

Site preparation/weed control:

- Tractor or ATV equipped with a spray tank and boom
- Broad spectrum herbicide (e.g. glyphosate)
- Prescribed burn equipment: see *Prescribed Fire* later in this Manual

Seeding:

- Tractor equipped with a No-till seed drill; or a seed broadcaster and harrow

Implementation

Like other practices that involve native perennial grass establishment, it is best to think of this practice as having three phases: site preparation/weed control, seeding, and maintenance. Reestablishing native perennial grasses on your land is a long term commitment that will require careful planning and diligent management and maintenance to be successful. Timing is also critical during all phases.

Site preparation/weed control: The first step is selecting a site. Site attributes such as soil type and quality, existing vegetation, slope, aspect, average precipitation, accessibility, current/future use, and size should all be considered. The environmental attributes, from soil quality to precipitation, are key for determining

the various appropriate native perennial species for the site. Work with your seed supplier to determine the appropriate mix of species and application rates.

Once you have selected a site and determined that it can sustain native perennial grasses you must prepare the site for seeding. The emphasis on site preparation is thatch and weed seed reduction. For the purposes of establishing native perennial grasses, any non-native annual grass or herbaceous broadleaf plant is considered a weed. There are three primary techniques for weed control in grassland settings: grazing, prescribed burning, and herbicides. Existing vegetation will determine the preferred weed control management. If annual grasses dominate the site, the following strategy should be employed: heavy grazing in the spring just prior to setting of seed, a prescribed burn in late summer/early fall and an application of glyphosate to combat the first flush of weeds following the first rain (if necessary).



Melica californica (Onion Grass)

Seeding: October and November are typically the optimal months for planting. Keep track of the weather patterns and plan to plant so that the seed will not sit on the ground too long before a good, germinating rain. Ideally, a small rain event in September or early October will promote the germination of remaining weed seeds and glyphosate can be applied prior to or shortly after the native perennials have been seeded. Seeding should be done using a no-till range drill designed to handle fluffy seeds, such as a Truax drill, which was designed for prairie restoration. Native perennial grass seeds germinate slower than annuals, typically 2-4 weeks (depending on temperature) following the first germinating rain.



Maintenance

Maintenance intensity will diminish as the native perennials become established, but the first 2-5 years are critical. As with site preparation, maintenance focuses on weed control with the goal of reducing competition. Now that the native grasses have been planted, herbicide use must be more selective. Once again, grazing or mowing the site in the spring following planting can reduce seed production of annuals. If broadleaf annuals, such as yellow starthistle, are the dominant weeds found emerging in the spring, a selective broadleaf herbicide can be applied. A wick application of glyphosate using an ATV

or tractor mounted wick applicator in the spring is another option. A pre-emergence herbicide can be applied in the fall prior to the first rain event. Burning the site the first spring following planting is not recommended, but prescribed burns can be one of the most cost effective methods for weed control. Burning, along with grazing and mowing are the preferred techniques for long term maintenance. Burns should be conducted in the late spring (in general) and not more than once every two to three years. The Nature Conservancy and CAL FIRE are good resources for more specific prescribed burn information (See *Prescribed Burns* for more information)

References

Robins, P., R. Bresnick Holmes, and K. Laddish, ed. 2001. *Bring Farm Edges Back to Life!* 5th edition. Yolo County Resource Conservation District.

COVER CROPS

Description and Benefits

Cover crops have been grown in agricultural situations in California since the early part of the last century. They have been used in perennial crops and in a variety of field and row crops, either as an integral part of the annual cropping system or as a rotational crop. Cover crops are associated with soil benefits such as improved tilth and fertility, reduced erosion and crusting, and increased water-holding capacity. Field margins, roadsides, banks, levees and slopes can also be planted with cover crops for weed suppression.



Cover crops also provide valuable cover, nesting and foraging habitat for a variety of wildlife and can support beneficial insects, which aid in pest control.

A variety of perennial and annual grasses and forbs (broadleafed plants) can be used for cover crops as either single- species or multi-species mixes depending on the farmer's needs. Fast-growing grass species provide high biomass for boosting organic matter in the soil, while some species of legumes can provide high volumes of nitrogen for the following cash crop. Mixed cover crops can be used to provide a combination of biomass and crop nutrient production. "Green manure" cover crops are typically incorporated into the soil before a cash crop is planted. In an orchard or vineyard setting, many annual cover crops can be managed to self-seed, minimizing needs for replanting and soil disturbance. Perennial grass cover crops can provide basic soil cover, and are typically selected to minimize water and sunlight competition with adjacent trees and vines.

When to use Cover Crops

Cover cropping is useful in a variety of agronomic situations where either rainfall or adequate irrigation are available. In an annual cropping system, the cover crop can be planted after harvest of one crop and before planting of the next to provide soil management and fertility benefits. In a perennial cropping system, a cover crop can be managed between plant rows for similar benefits.

Implementation

Before a cover crop is planted, a suitable seedbed should be prepared. This is usually started after the post-harvest irrigation for perennial crops or after seedbed preparation for annual crops. On farmland, light disking or some other form of tillage is usually sufficient for most cover crops. Disking should be followed by some smoothing operation such as floating or planing so that larger clods are broken and the seedbed is smooth. This is particularly important for smaller seeded cover crops such as clovers. In non-tillage orchards, or with shallow-rooted citrus trees, care should be taken not to till too deeply where a large percentage of tree roots may have grown near the surface.

Unless non-leguminous or grass-only cover crops are used, additional fertilizer is not usually required

for cover crops. Otherwise, follow your seed company representative's recommendation for fertilizer type and rate. Excess nitrogen fertilizer may actually reduce overall nitrogen fixation and give weedy species a competitive edge.

Prior to planting, mixes including large-seeded legumes should be inoculated with the appropriate rhizobial bacteria. Host-specific bacteria work in combination with special root structures to bind or 'fix' nitrogen into plant tissues. Some seed is sold pre-inoculated, but large-seeded legumes such as vetch, peas and beans should be inoculated immediately before planting at a rate of about 8 oz. of inoculum per 100 lb. of seed and layering it into the planter hopper. If the seed is broadcast rather than drilled, it should be wet-inoculated to provide better adhesion of the inoculum to the seed.

For planting, the cover crop seed can be broadcast or drilled in. Drilling may require less ground preparation, and is the method of choice for first-time plantings. For single species or larger seeded types, an alfalfa drill can be used. Broadcasting seed is faster and less expensive, but will require a light harrowing to incorporate the seed followed by a final floating or rolling to finish the seedbed. In established perennial cover crops, supplemental seeding may be needed every 2-5 years.

If fall rains are not expected immediately, a light irrigation will settle soil around the seed and hasten germination. Summer annual cover crops will require regular irrigations just as any other warm season crop.

Maintenance

In orchards or vineyards, two to six mowings, beginning in February or March, may be needed from cover crop planting until the cash crop is harvested. If self-seeding is desired, mowing should be delayed until the cover crop has matured seed. When mowing a cover crop mix that includes legumes, care should be taken to not cut below the growing point, or re-growth will be hindered. Mowing, spot-spraying or hand-hoeing may be needed to keep sprinkler or drip emitters clear, but using low-growing cover crops or extending sprinkler risers could reduce the need for such maintenance.

Incorporation of the cover crop (if necessary) should be timed to allow at least two weeks of decomposition in the soil before planting. Timing of incorporation should also be made in consideration of adequate soil moisture for decomposition, otherwise additional irrigation may be necessary to adequately break down the organic matter for proper seedbed preparation for the following crop. In spring, care must also be taken not to enter a field with excessive soil moisture, which would obviously hinder equipment access and also damage the soil with excessive compaction and clodding. The simplest scenario for cover crop incorporation involves "knocking down" the cover crop with either mowing or herbicide, followed by disking the plant material into the soil. After a period of decomposition, the soil surface would then be reshaped and smoothed, as needed.

References

Wrynski, Jeanette. "Cover Crops for Agriculture and Wildlife." *Valley Habitats*, Number 15. Ducks Unlimited, Inc. 1996.

University of California Sustainable Agriculture Research and Education Program (UC SAREP)

INVASIVE WEED CONTROL

Description and Benefits

Weed control involves the containment, reduction, and/or elimination of certain plant species that are invasive and problematic in a rangeland system. Weed control methods include mechanical removal, chemical applications, cultural practices, grazing, prescribed burning, biological control, revegetation with native species, and integrating various combinations of these methods. Weed control can lead to increases in native plant species, forage quality for wildlife and livestock, wildlife populations, plant diversity, and soil water availability. It can also decrease allergens, restore more natural fire regimes into an area, and help prevent degradation of rivers and streams. Due to the variability among control methods and their effectiveness on different weed species, any weed control program should include consultation with the County Agricultural Commissioner, University of California Cooperative Extension Specialist, and/or a Pest Control Advisor.



Thistle removal

Methods

Although not all weed control techniques are practical at all locations, most methods can be applied in woodland and grassland systems.

- Hand-pulling (and hand cutting), grubbing, and hoeing can be applied anywhere a person can access and are good options for controlling new (incipient), small infestations, or previously treated weed infestations where plant density is low
- Grazing (if the weed is palatable) can be done just about anywhere safe animal access can be managed.
- Mowing is effective in areas accessible by mowing machinery, typically flat or gently sloping areas, and where soil erosion (i.e. stream banks) and desirable plant species vulnerable to soil compaction/large equipment are NOT a concern
- Chemical herbicides can be applied anywhere authorized by the specific herbicide label and is one of the most efficient weed control methods. Many herbicides are registered for rangelands, and even some for use near water. Herbicides are a good tool to utilize on large weed infestations and/or with particularly problematic species. Once a weed infestation is reduced, other methods can be integrated without significant loss of efficiency
- Prescribed burning can be done in most situations depending on the slope of the terrain and experience of the burn crew

Develop a Weed Management Plan

Generally there are multiple ways to control a particular weed species. Often integrating several different control methods is more effective than just using one tool repeatedly. This makes careful planning of your weed control activities very important. The following steps are typically a part of any effective weed control plan:

1. Develop vegetation management goals and priorities for your site such as the long-term desired vegetation composition of different areas (native, pasture, garden, etc.)
2. Identify and prioritize weeds on the property
3. Identify and prioritize control methods for each priority weed species
4. Develop a control plan or timeline for implementation of those methods
5. Implement control plan and monitor results to ascertain effectiveness towards achieving your goals
6. Make changes to the control plan and try again modifying goals if necessary

An excellent all-around on-line weed identification, management and mapping resource is available through the California Invasive Plant Council (Cal-IPC) website at www.cal-ipc.org. Reference texts such as *Weeds of the West* by the Western Society of Weed Science or *The Grower's Weed Identification Handbook* by UC Cooperative Extension are available in hard copy. You can also take a sample to the Monterey County Agricultural Commissioner's office or UC Cooperative Extension (UCCE, in the same building) in Salinas, both of which have weed management experts available in office and free on-site consultation.

How to prioritize weed species to control

Prevention is the key to good weed control. If a weed is on your neighbor's property and is a known problem – keep it off of yours. If a weed is just starting to invade your property, and is a known problem-control it first. This will save you time and money later. Focus weed control techniques initially on the perimeter of source populations and progress toward the heart or center of the weed population. This will contain the spread of the weed while control measures are being taken. The more impact a weed can have on the overall ecological functioning of an area the more important it is to remove it early. Thus, species that are known to alter water flow, sedimentation, and other processes are high priorities. Do not waste time on species that you don't have the tools to control; especially if there are other problem species you could focus your control efforts on more successfully.

Chemical control

Always follow the directions and precautions required on the label of any material or equipment you use for your personal safety, environmental considerations, and to maximize the effectiveness of your application. Personnel at the Ag Commissioner's Office can provide guidance regarding herbicide applications and alternatives. Find them (and UCCE) at 1428 Abbott Street Salinas, CA 93901.

DRAINAGE/EROSION MANAGEMENT AND BANK STABILIZATION



While storm runoff and erosion are natural processes, they are often concentrated or exacerbated by the changes we make to the land to accommodate production, access, structures, or other purposes. The following techniques are a brief introduction to the practices available for keeping our land, streams and roads productive and safe.



RURAL ROAD MANAGEMENT

Description and Benefits

Maintenance of residential and ranch roads is an important and complex subject, and we strongly recommend that you consult the roads handbooks referenced at the end of this article if you intend to do any major road work. Many forest and ranch roads were designed and built to capture runoff and transport it in ditches and culverts. When these structures fail, they cause damage to the road, ranging from minor problems (a few ruts) to major hazards (washouts, stream diversions, large ruts) that make the road impassable. Annual maintenance can be time-consuming and costly. This article covers three techniques (outsloping, rolling dips, and proper culvert installation) that, when properly implemented, result in multiple benefits, including: reduced annual maintenance, reduced erosion, reduced sedimentation of water courses, improved natural drainage, improved reliability, and overall reduced maintenance costs.



Conditions Where Outsloping, Rolling Dips and Culverts are Useful

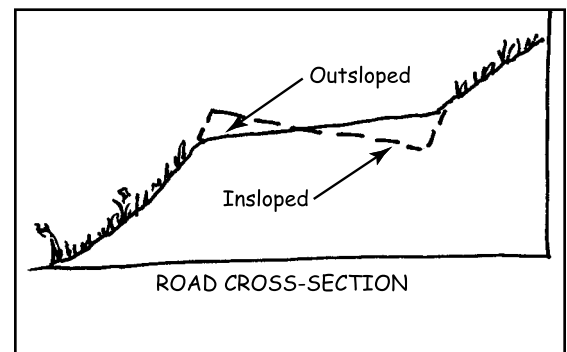
Existing or planned forest and ranch roads that do not have an overly steep grade and that are built on stable fillslopes are typically well suited to outsloping. On outsloped roads, rolling dips are best installed on grades under 12 percent. Culverts work for ephemeral runoff (flow during and after storm events only) and intermittent (seasonal) stream crossings. Many of the concepts outlined in this article can also be applied to the construction and maintenance of trails; the only difference is the scale.

Implementation

Unless you're proficient with the use of the various types of heavy equipment needed, we recommend you research and contract with a licensed engineer and a road construction company or heavy equipment operator for any road work. For many, road construction and maintenance is not a "do-it-yourself" practice, and you'll save time and money by researching and selecting a contractor who fits your needs.

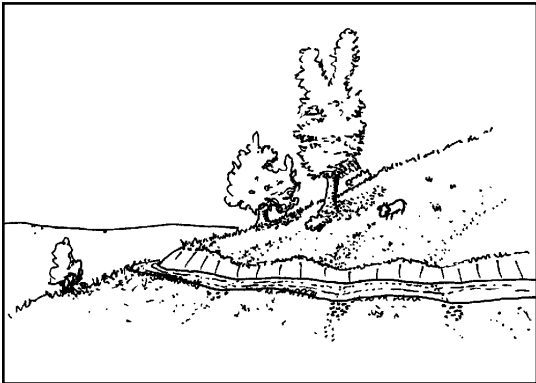
Following is basic information to make it easier for you to assess and discuss your road maintenance needs with your road maintenance contractor. Again, if you plan to do the work yourself, purchase a copy of the *Handbook for Forest and Ranch Roads* and consult the BMP Toolbox in Appendix A of the *Fishnet 4C Roads Manual* (available for free download on the internet).

Outsloping: The goal of outsloping is to disperse (not concentrate) and drain runoff from the road surface along its entire outer edge (not in an inboard ditch). Most insloped roads have an inboard ditch and a berm on the outer edge of the road surface. Changing an insloped road into an outsloped road requires removing the berm and placing the spoils in the inboard ditch, which becomes part of the road surface. The road surface is then graded with an outsloped pitch with a drop of 3/8" to 1" per foot



Outsloping eliminates the need for an inboard ditch.

depending on the road grade (4% = 3/8" / ft.; 5% = 1/2" / ft.; 6% = 5/8" / ft.; 7% = 3/4" / ft.; 8% or more = 1" / ft.). The outer edge of the road should be planted with a mix of grasses (native, if possible) and covered with straw mulch (1 bale per 700-1,000 sq. ft.) for erosion control.



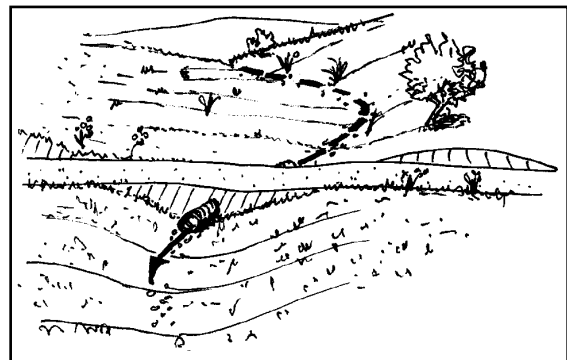
Rolling dips are located at natural swales in the landscape.

Rolling Dips: smooth angled depressions in the road surface; they should have a long, shallow approach on the up-road side and a more abrupt rise on the down-road side. Rolling dips are generally built at a 30 to 45 degree angle to the road, and with a grade of at least 1% greater than the road. Two situations require rolling dips on an outsloped road: swale crossings and steep road grades. A rolling dip needs to be installed at every swale that intersects the road to ensure that runoff will flow across the road and continue down the natural swale. It is critical not to concentrate runoff or allow it to divert down the road surface along the direction of travel. As road grade steepens, rolling dips are needed

at regular intervals to prevent the tendency of runoff to divert along the road surface before it can drain across the road. Guidelines for the spacing of rolling dips are included in the reference documents listed below; they are generally based on the road's grade, surface material, and anticipated rainfall. Look at other roads with a similar grade and surface in your area to see when runoff begins to create rills. In some cases rills can form in less than 10 feet, and the road would need to be a series of rolling dips to prevent erosion.

Culverts: Culverts should be installed at most ephemeral and intermittent stream crossings. In some cases low water crossings and bridges are more practical applications. A non-scientific rule of thumb for deciding when to install a culvert as opposed to a rolling dip is to look for exposed rocks, roots or bare soil in the swale uphill of the road. These indicate the swale receives sufficient flow to cause erosion, and that a culvert would be a good choice.

Culverts should be sized to pass the anticipated 100-year storm flow and should be set with a 'trash rack' such as a t-post placed two culvert diameters upstream of the inlet to prevent clogging. Culverts should be aligned with and placed in the natural swale bottom so that flow enters and exits the culvert without having to turn. A rolling dip should be built at **all** such crossings, whether a culvert is installed



or not, to insure that if the culvert fails water can flow over the road and continue down the natural channel instead of diverting down the road. This simple practice, also called a 'critical dip', can mean the difference between the loss of a crossing (worst case) and the loss of hundreds of feet of road.

Even in the case of ephemeral streams, a landowner needs to consult with the Department of Fish and Game (see Permits section, pg 108) prior to culvert installation. Any grading that affects more than 100 cubic yards of soil requires a Grading Permit from the County of Monterey.

References

Weaver, W.E. and D.K. Hagans. 1994. *Handbook for Forest and Ranch Roads*. Mendocino County Resource Conservation District.

RCDs of Monterey, Santa Cruz and San Mateo Counties, *Central Coast Rural Roads Handbook*. 2013.

Fishnet 4C Roads Manual www.fishnet4C.org/roads-manual.html

EROSION CONTROL BLANKETS

Description and Benefits

Erosion control blankets provide immediate protection from surface erosion for steep slopes (typically greater than 3:1). They also create an ideal environment for native grass seed germination. Erosion control blankets can also be used to temporarily stabilize soil in grass lined channels, although this practice will focus on their use for stabilizing steep slopes. The main purpose of erosion control blankets is to provide initial erosion protection until the desired permanent vegetation (such as perennial grasses) becomes established and can provide long-term protection. Erosion control blankets are a combination of natural fibers sandwiched between, or otherwise attached to a synthetic netting. Erosion control blankets come in rolls. They vary in thickness, durability and life expectancy. Erosion control blankets are biodegradable and last from 1-5 years.



Erosion Control Blankets installed at a construction site.

When to Use Erosion Control Blankets

Erosion control blankets can be installed on any slope where the soil has been disturbed and when the slope is too steep (3:1 or greater) for straw mulch to provide adequate erosion protection. The site also needs to be free of rock outcroppings or other obstructions. Erosion control blankets need thorough contact with the soil. Typical uses are on stream banks, road cuts, and construction sites.

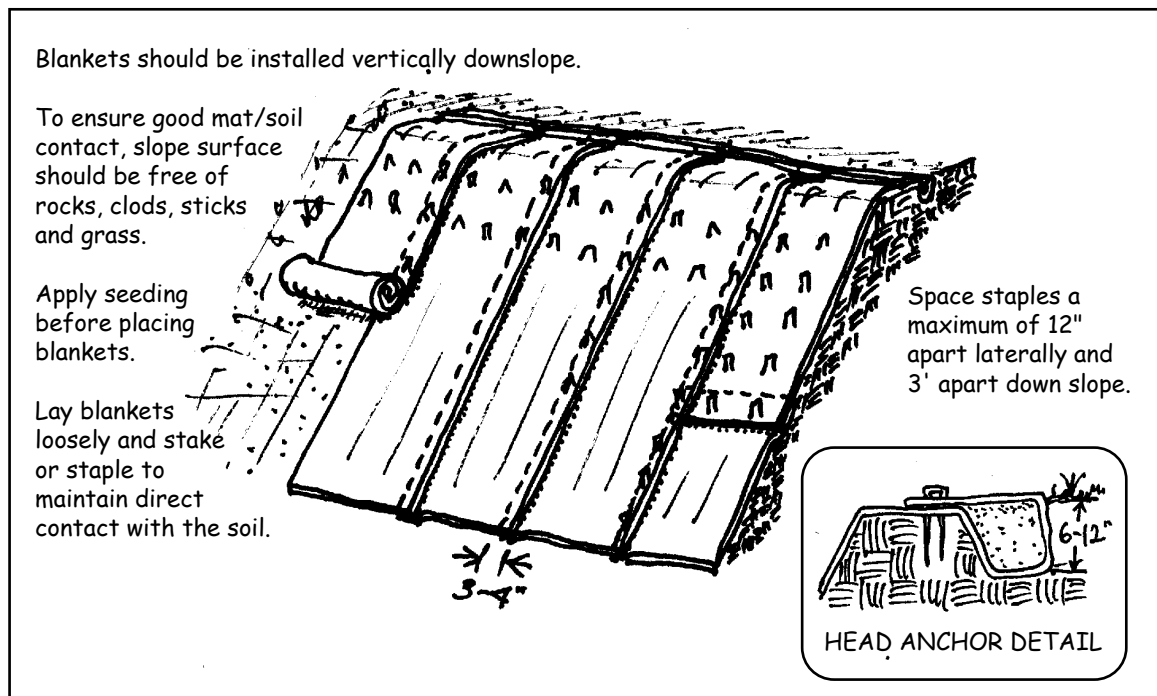
Implementation

Site Preparation: It is important that the soil surface is graded and smoothed so that the erosion control blankets have complete contact with the soil. Remove all rocks, logs/sticks, and clumps of dirt from the area. Loosen the top 2-3 inches of soil in preparation for seeding.

Installation: Installing erosion control blankets is fairly straight forward, but this practice will fail if you do not properly key in the top of the erosion control blanket.

- Begin by digging an anchor trench (6" deep and 6" wide) across the top of the slope, preferably 3-4 feet from the edge. Place the spoils on the upslope side of the trench
- Seed the area from the trench to the bottom of the slope with native grass seed. Try not to walk on the seeded area. If an area is disturbed, smooth the area and re-seed
- Secure the end of the erosion control blanket in the anchor trench using staples or pins at 1' intervals (see Figure 14). Backfill the trench and compact the soil. Seed the trench and fold over and secure the end flap of the roll, again using staples or pins at 1' intervals
- Overlap adjacent rolls 3 inches. Start at one end of the slope and work across. If installing on a stream bank, start at the downstream end of the site

- Roll the erosion control blankets down the slope. Secure with staples or pins every 3 feet starting at the top of the slope and working down. Be sure not to stretch the erosion control blanket. Remember you want complete contact with the soil
- When splicing together rolls mid-slope, slip the end of the new roll under the end of the roll that just ran out. Be sure there is at least 1-foot of overlap. Staple or pin the overlap area at 1' staggered intervals
- Simply cut the erosion control blanket at the bottom of the slope using heavy-duty scissors



Maintenance

Until your site is stabilized with vegetation, inspect the blanket installation prior to and following large storm events, and secure any loose anchors or sections of blanket. Failing sections may need replacement or other, more substantial erosion protection in the form of more rigid materials or strategically placed quarried rock. If your work is conducted under a permit, make sure that you review any maintenance or changes to the site with the conditions of your permit or the permitting agency.

References

- McCullah, J.A.** 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.
- McCullah, J.A.** 1999. *Erosion Draw 3.0 CD-ROM*. Salix Applied Earthcare.

MULCHING

Description and Benefits

Mulching is the spreading of a layer of straw, woodchips, or other suitable “loose” material over the soil surface. Mulching is intended to provide temporary protection while permanent vegetation becomes established. Mulching has multiple applications and benefits. Applications are listed in the next section. Benefits include weed suppression, erosion protection, and soil moisture retention. Both non-native and native straw mulch is available, although native straw bales are typically more expensive. Native straw tends to spread easier and often contains residual native grass seeds which can bolster native grass establishment on the site. “Dirty” straw that contains weed seeds can be a new source of weeds on your property if used.



When to Mulch

Apply straw mulch to recently disturbed soil surfaces for protection from raindrop impact erosion and sheet erosion. Application of straw mulch to recently disturbed slopes is highly recommended, although the straw mulch may need to be secured using a tackifier or netting, or by crimping with tracked heavy equipment (for large areas) or a shovel (small areas). Straw mulch is suitable for large or small areas that have been seeded for grass establishment following the completion of construction. Using seed-rich native straw can be an alternative to seeding and mulching separately. Apply straw mulch to bare soil in anticipation of a rain event on construction sites, restoration sites or stockpiles of soil near waterways. Use straw mulch, woodchips or crushed walnut shells around recently planted trees and shrubs for weed suppression. Use mulch sparingly around trees and shrubs planted in clay or otherwise poorly draining soils.

Implementation

Spreading straw mulch is a simple, yet time consuming practice. A work crew will make spreading straw mulch over large areas a more manageable task. If the area is extremely large or on a steep slope, you may want to consider using a hydroseeding contractor. They can spray the area with seed, straw mulch and a tackifier that will hold it in place. Straw mulch can be sprayed without seed as well for large areas.

Seeded Areas:

- Remember that mulch is intended to provide temporary protection. Seed disturbed soil with the appropriate mix of native grasses and forbes for the site prior to mulching. See *Native Perennial Grass Establishment* for details on preparing the seedbed and seed application rates
- Apply straw mulch at a rate of roughly one bale (65 lbs.) per 500-750 ft². Cover the area with no

more than 2-3 inches of straw mulch. Too much mulch will inhibit grass seed germination and establishment

- Anchor the straw on steep slopes by one of the following methods:
 - Use a dull shovel to punch the straw in every 1-2 feet
 - Use a dozer (or other tracked equipment) to track over the area. Be sure to run the equipment up and down the slope to create small shelves with the tracks that are perpendicular to the fall-line
 - Quickly herd goats or sheep through the area (trample method)

Around Trees and Shrubs:

- Hoe, pull or apply herbicide to the weeds around the plant. Be careful not to damage the plant's roots, which may be near the soil surface
- Apply a 4-6 inch mulch layer of straw, woodchips, etc. in a 4 foot diameter area around each plant
- Plants will not need to be watered as often as without mulch. Check plants occasionally to see if too much water is being applied

As a Seeding Method:

- Many native grass seed suppliers also have seed-rich native grass straw available. Seed-rich straw is cut and baled with the mature seeds still intact
- Using seed-rich native grass straw provides a less expensive alternative to seeding and mulching separately, although the amount of seed applied to the area that comes in contact with the soil will also be less
- Spread the seed-rich native grass straw in the same manner as described above in "Seeded Areas"

Maintenance

Until your site is stabilized with vegetation, inspect the site prior to and following large storm events to make sure your mulch is remaining in place and serving its purpose. Replace mulch and reseed in patches if needed. Ultimately, failing sections may need more substantial erosion protection in the form of more rigid materials or strategically placed quarried rock. If your work is conducted under a permit, make sure that you review any maintenance or changes to the site with the conditions of your permit or the permitting agency.

References

McCullah, J.A. 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.

McCullah, J.A. 1999. *Erosion Draw 3.0 CD-ROM*. Salix Applied Earthcare.

State of California, California Department of Fish and Game. 1998. *California Salmonid Stream Habitat Restoration Manual*. Third edition.

STRAW WATTLES

Description and Benefits

Straw wattles are tubes of straw netting that are used for erosion control, sediment control and stormwater runoff control. They are an excellent short term solution to controlling erosion, reducing sedimentation and reestablishing natural vegetation on slopes and hillsides.

Straw wattles help to stabilize slopes by shortening the slope length and slowing, spreading and filtering overland water flow. This helps to prevent sheet erosion as well as rill and gully development, which occur when runoff flows uninterrupted down a slope. Straw wattles capture sediment and hold it on-site, enabling seeds to settle and germinate, thus aiding the revegetation process.

By filtering overland runoff and holding sediment on the slope, straw wattles help to protect ponds, rivers and streams from sediment pollution. Straw wattles may be placed across channel bottoms, but their primary use is on slopes.

Straw wattles come in different diameters and are made of different materials. They are usually 25 feet in length, with diameters that can range from 8 -12". The outside tube can be made of jute, nylon, or photo-degradable materials. Wattles are generally stuffed with rice or wheat straw. Wattles made with the plastic netting will last approximately 3 - 5 years, with the straw bio-degrading and the netting breaking down to small pieces from sunlight. Biodegradable wattles will last only a season to a year due to the fairly rapid break-down of the burlap covering.

When to use Straw Wattles

Straw wattles will provide temporary erosion protection on slopes and hillsides after construction, fire or other vegetation disturbance. Straw wattles can also be used on flat ground projects such as urban development construction sites. They can also be snaked around storm drains to prevent sediment from washing into gutters.

Some common applications for straw wattles include:

- Erosion control on slopes and hillsides
- Fire rehabilitation and reforestation
- Streambank restoration and revegetation
- Construction sites

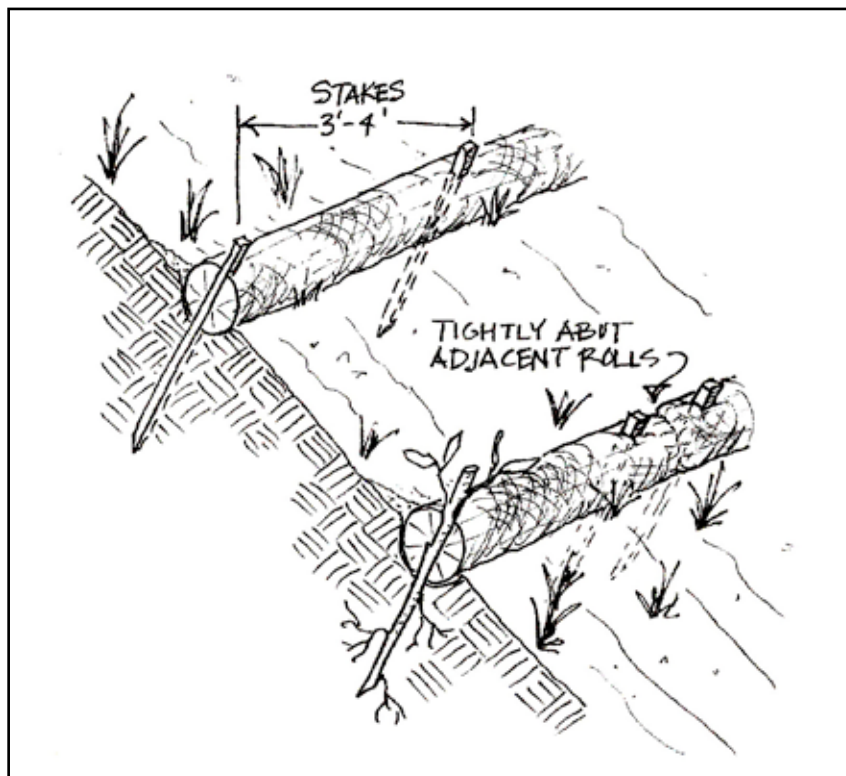
Implementation

Straw wattles are installed by staking in place, and can be used individually or tied together to achieve any desired length. Correct installation of straw wattles is crucial to their effectiveness. They are labor intensive because they need to have good ground contact and anchoring. Wattles should be anchored to



the ground by trenching, backfilling and staking.

Installation of the wattles: First, smooth out a shallow depression for the wattle to lay into. Second, using wood stakes, drive a stake through the wattle and into the ground, so the stake is at least 6 inches in the ground and about two inches above the wattle. The wattle will flatten out over time, so you don't need it any higher. Put 5 stakes in each 20 foot long wattle. Wattles should be placed in a checkerboard pattern with a 15' horizontal spacing and a 30' vertical spacing (see manufacturer's specifications). These recommendations can be altered.



Maintenance

The maintenance requirements of straw wattles and other fiber rolls are minimal, but short-term inspection is recommended to ensure that the rolls remain firmly anchored in place and are not crushed or damaged by animals or equipment traffic. Monitor the installation daily during prolonged rain events. Repair or replace split, torn, unraveled, or slumping wattles. Straw wattles are typically left in place on slopes. If they are removed, collect and dispose of the accumulated sediment. Fill and compact holes, trenches, depressions, or any other ground disturbance to blend with the surrounding landscape.

References

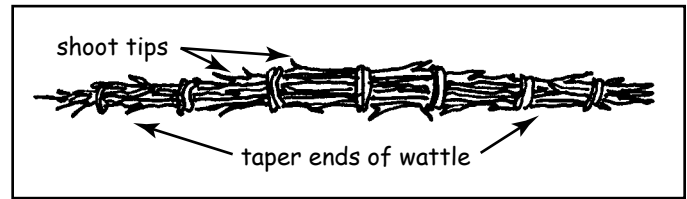
EPA Stormwater Menu of BMPs: cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

WILLOW WATTLES

Description and Benefits

Willow wattles are long cylindrical bundles of live cuttings that can be used for both streambank protection and to reduce erosion, aid drainage, and improve infiltration on dry upland slopes.

Willow wattles are similar to fascines, with the exception that for wattles the cuttings are arranged in alternating directions throughout the length of the wattle. Wattles are typically installed in combination with other streambank protection practices (e.g. brush mattresses and reinforced brush layering), but they also have useful application as a stand alone practice. In streamside situations, wattles placed at the toe of the streambank can help protect against the stream cutting into the bank as well as capture sediment that sloughs from the upper bank. Wattles can also be installed in shallow staggered trenches on upland slopes. The trenches are dug on contour. The staggered series of wattles breaks the slope length into several short slopes. This regulates the energy of the runoff flowing down the surface of the slope providing for improved infiltration and reduced erosion. As the cuttings in the wattles become established, they serve to further stabilize the slope and provide habitat for wildlife.



Willow Wattle construction detail.

When to Use Willow Wattles

Willow wattles are well suited for streamside use as well as on upland slopes. Wattles are used in streamside situations where immediate as well as long-term stabilization is needed. Wattles can be installed at the toe of the streambank (similar to coir rolls), but will require sustained flows through the dry season to ensure establishment. Wattles are often used as toe protection in combination with other practices. They can also be installed in several rows up an eroding slope or high streambank in cases where the rills are forming on the slope or sloughing is occurring due to the affects of overland flow.

Implementation

Willow wattle construction:

- First harvest the cuttings according to the guidelines for Pole Planting and soak the cuttings for at least 24 hours. Willow can be used for most applications, even on dry upland slopes. Other locally available material may also be used provided that it will root from cuttings
- Tie together the live cuttings into bundles of 10 to 30 feet in length and 6 to 16 inches in diameter. Be sure that the cuttings alternate in orientation and that the tips of the cuttings are staggered throughout the length of the wattle. Tie the wattle together with twine every 2 feet. Taper the ends of the wattle in case it will be joined to another one during installation (see figure above)

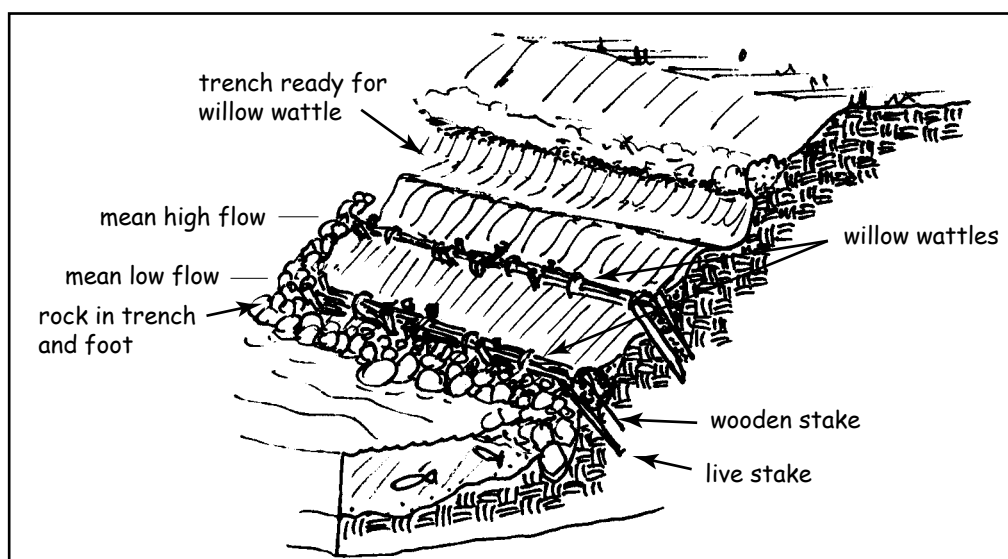
Installation for streambank stabilization:

- Perform any slope repairs or regrading prior to wattle installation
- Dig a shallow trench on the contour at the mean low water level (i.e. summer flows) at the toe of the streambank along the length of the site. The trench should be as wide as the wattle and half as deep. If the streambank has a long slope with a sloughing vertical bank at the top, a second or third wattle can be installed at intervals up the slope
- Lay the wattle in the trench along the length of the site. If more than one wattle is needed, be sure to tie together the ends of the adjoining wattles with rope. Also be sure that a stake is aligned at the joint
- Drive a wooden stake every 2 to 3 feet into the center of the wattle. Additionally drive live stakes on the

downslope side of the wattle in the intervals between the wooden stakes. In some cases (particularly at joints) you may need to drive parallel wooden stakes upslope and downslope of the wattle and secure the wattle to the ground with a wire that runs between the two wooden stakes

- Tie wire or rope between the parallel wooden stakes at the notch and pound into the ground until the wattle is held secure. If the ground is too rocky for wooden stakes, use rebar or metal concrete form stakes.
- Backfill the area behind the wattle forming a small bench
- Dig a trench approximately 2 feet wide by 2 feet deep perpendicular to the contour, from the mean low water level to above the mean high water level at the upstream and downstream ends of the wattle (this is a trench that is running up and down the slope)
- Install rock riprap or rootwads into the trench. This ‘keys in’ the installation and keeps the stream from cutting behind the wattle

For dry upland slope situations, install the wattles on contour (not at an angle). For dry slopes the goal is to improve infiltration of runoff into the soil.



Using Willow Wattles as part of a streambank stabilization project.

Maintenance

To maximize the benefit of growth from the wattles and stakes, protect sprouting plants from grazing and herbicide. Sprouting willows may need to be pruned or trained in order to minimize potential for flow obstruction and maximize bank protection benefits. Depending on the site that could involve ‘coppicing’, which maximizes the number of thin, flexible stems, and limbing up, which trains the plant to one or a few large stems. The willows are often just pioneer species that may eventually be replaced with other plants that grow on the shoreline. Periodically inspect the site to look for damage from animals, weather or other sources. Check for sprouting success and replant areas that need attention.

References

- McCullah, J.A.** 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.
- Schiechl, H.M. and R. Stern,** 1997. *Water Bioengineering Techniques for Watercourse Bank and Shoreline Protection*. English Translation with additions. Blackwell Science, Ltd.
- United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS).** 1998. *The Practical Streambank Bioengineering Guide*.
- United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS).** 1992. “Soil Bioengineering for upland slope protection and erosion protection.” In *National Engineering Handbook (NEH)*, Part 650, Chapter 18.

LIVE STAKING AND POLE PLANTING

Description and Benefits

Both live staking and pole planting involve the insertion of live, rootable vegetative cuttings into the ground. If correctly prepared and placed, the live stakes and poles will develop a root system and vegetated shoots. Live stakes are typically 1/2" to 2" in diameter and 3' to 4' in length. Pole cuttings are typically 1" to 3" in diameter and 4' to 10' in length. Willow and cottonwood are most commonly used for live staking and pole planting. The root system serves to stabilize the soil, protecting it from erosion. When planted near a stream or in the floodplain, the shoots reduce the velocity of the water during high flows, resulting in sediment accumulation. When planted in a regular pattern on a streambank or slope, live stakes serve to anchor the soil.



When to use Live Staking and Pole Planting

Live stakes can be added to hard structures like riprap and gabions to provide added soil stabilization and improved wildlife habitat. Live stakes need to be planted in an area where the roots will have year-round access to water or where irrigation can be provided during the dry season for the first 3-5 years of establishment. Though they can be used alone, live stakes are often combined with other biotechnical practices, and are useful in upland areas to stabilize eroding gullies and small slumps, and can anchor and enhance the habitat benefits of erosion control blankets and turf reinforcement mats, willow wattles, straw wattles, and other erosion control products.

Pole plantings are ideal for project sites with widely fluctuating water tables and areas where supplemental irrigation is not feasible. Pole plantings can be used alone, but they also work well with other biotechnical practices, including hard structures like riprap and gabions. Pole planting usually requires the use of heavy equipment (typically a backhoe), in which case a project site needs to be appropriately accessible.

Implementation

Harvest:

Stakes and poles should be harvested during the plant's dormant season (typically November through April). Live stakes and pole cuttings should be cut from straight, healthy two- to five-year-old branches. Do not "clear cut" your harvest stand, rather choose and cut select branches that will make the best live stakes while leaving a healthy stand. Try to harvest from plants growing near to where you will be planting. If there is not a suitable harvest stand in the immediate area, harvest from a stand that is growing in similar conditions to your planting site. Branches that have already begun flowering (i.e. bud swell) will not root as well because rooting hormones are translocating to support flowering.

Suitable stakes are 1/2" to 2" in diameter and should be cut into 3' to 4' lengths. Suitable poles are 1" to 3" in diameter and should be cut into 4' to 10' lengths. Make clean cuts and avoid splitting ends. Large

anvil style loppers work best. If the loppers can't cut the branch, then it is too big to be a stake or pole. The butt ends of the stakes and poles need to be trimmed to a 45-degree angle and the tops need to be cut flat. This allows for easy identification of which end goes in the ground during planting. If you are unsure which end is up, look at the leaf bud scars. They always point up. Trim all lateral stems from the stakes and poles as flush as possible.

Storage:

The key to successful live staking and pole planting is keeping the stakes and poles wet. You'll get the best results if you soak the cuttings in water for about a week. At a minimum, soak cuttings for 24 hours. Tie stakes or poles together into easy to manage bundles. Completely submerge the bundles in water (pond, creek, etc). You can also soak the bundles in a large garbage can filled with water or cover the bundles with burlap and keep them wet using a sprinkler. The sooner you get the cuttings in the water the better.

Planting:

Stakes - Create a pilot hole using a small sledge hammer to drive a 3' - 4' concrete stake into the ground. You may have to hit the side of the stake to loosen up the soil so you can remove the stake. Insert the butt end of the live stake (with 45-degree cut) into the pilot hole using a dead blow hammer if necessary to pound in the stake. Insert the stake so that 80% of its length is below the ground. Trim the top if it becomes smashed or split during planting. Tamp the soil around the stake and water heavily soon after planting. Plant stakes every 1 - 3 feet.

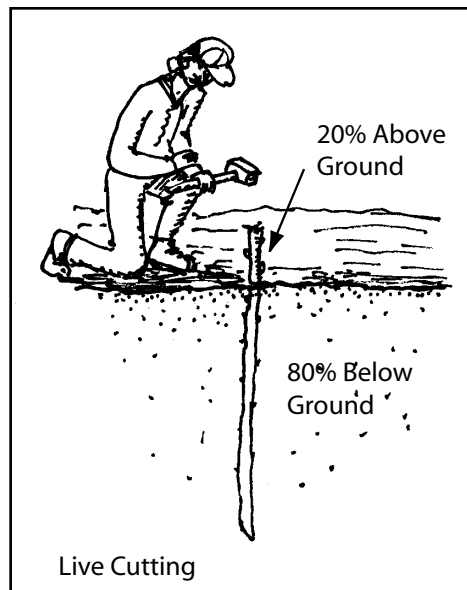
Poles - Use a backhoe with a "Stinger" or an auger to create a planting hole that reaches into the water table. Insert the butt end of the stake (with 45-degree cut) into the planting hole. Insert 1 - 2 poles so that 80% of the pole is below the ground. Trim the top if more than 1 foot remains above ground. Tamp the soil around the stake and water heavily soon after planting so as to eliminate air pockets in the soil around it.

Maintenance

Protect new growth from grazing and herbicide. Sprouting willows may need to be pruned or trained in order to minimize potential for flow obstruction and maximize bank protection benefits. Depending on the site that could involve 'coppicing', which maximizes the number of thin, flexible stems, and limbing up, which trains the plant to one or a few large stems. The willows are often just pioneer species that may eventually be replaced with other plants that grow on the shoreline. Periodically inspect the site to look for damage from animals, weather or other sources. Check for sprouting success and replant areas that need attention.

References

- McCullah, J.A.** 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.
- State of California, California Department of Fish and Game.** 1998. *California Salmonid Stream Habitat Restoration Manual*. Third edition.
- United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS).** 1998. *The Practical Streambank Bioengineering Guide*.



Plant live cuttings with no more than 1 foot above ground.

BRUSH LAYERING

Description and Benefits

Brush layering is a simple practice that can be applied to many different situations. This fact sheet discusses the use of brush layering in upland slope situations, although brush layering is also appropriate for streambank situations. Brush layering is the placement of layers of live vegetated cuttings (willow, mule fat, coyotebrush, etc.) in between layers of soil. The layers are created in benches, which can require significant soil movement depending on the scale of the project. For the purpose of this manual, we'll discuss practice applications for small to medium sized projects that can be installed using a backhoe and/or handtools.



Brush layering can provide multiple benefits to failing or unstable slopes: the cuttings reinforce the soil structure and root growth provides additional soil stability; the tips of the cuttings protruding from the soil slow and/or stop runoff and other debris as it travels down the slope; and new shoot growth provides raindrop erosion protection and wildlife habitat in addition to slowing (and improving infiltration) of runoff. To further reduce soil erosion and improve slope stability, the soil layers can be wrapped in geotextile fabric during construction.

When to use Brush Layering

Brush layering is a good way to stabilize slopes (often associated with roads) and streambanks. Cut slopes and fill slopes created during road construction often require permanent stabilization. Ideally, brush layering is implemented during the construction of the road at points where soil stability is questionable. Brush layering can also be implemented to stabilize existing fill slopes (downhill side of roads) that chronically fail and jeopardize the road.

Implementation

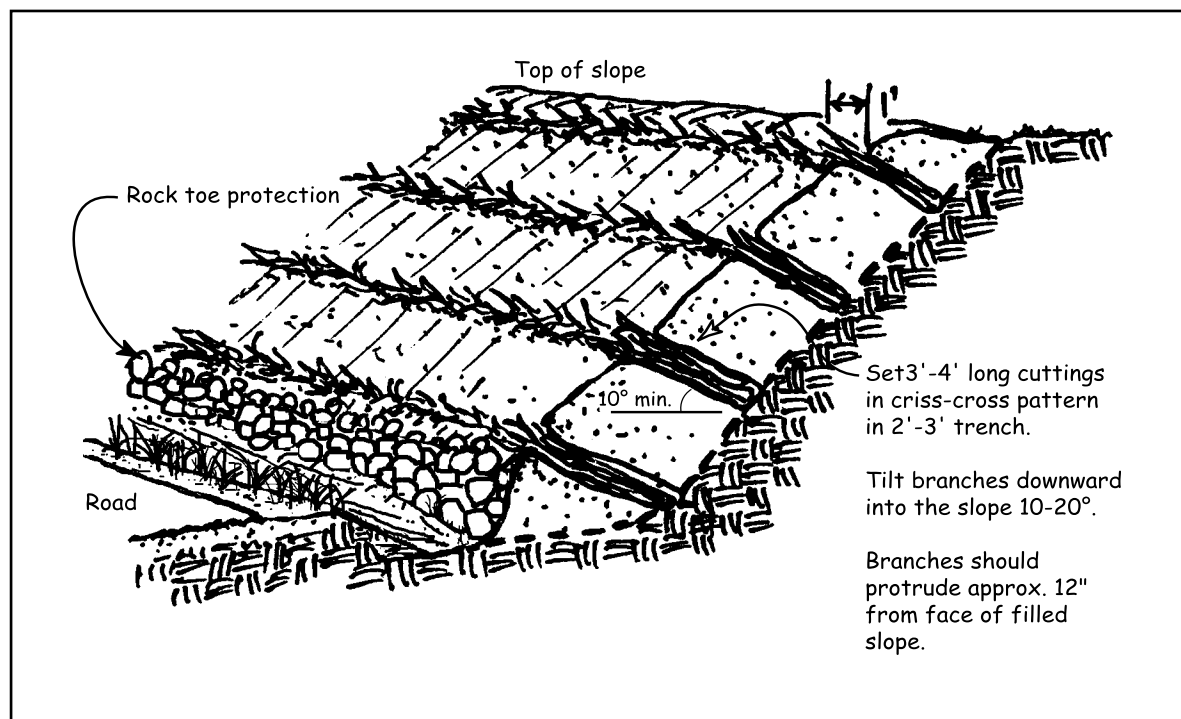
This practice focuses on the implementation of brush layering on upland slopes. This practice is recommended for slopes up to 2:1 in steepness. Slope length should not exceed 20 feet. Harvest and manage live cuttings following the guidelines described in Live Staking and Pole Planting, except that some side branches can be left on, and those side branches that are trimmed off can be saved and used as part of the brush layer matrix. Live cuttings should be soaked for at least 24 hours prior to installation. For best results, install brush layers as soon as the species selected for live cuttings goes dormant.

Installation:

- Begin by excavating a bench along the contour at the base of the slope. Make the bench 2 to 3 feet wide and angled back into the slope 10-20 degrees so that the outside edge is higher than the inside
- Place 3 to 5 layers of live cuttings on the bench so that the bases of the cuttings are at the inside edge of the bench and the growing tips extend from the outer edge about 1 foot
- Backfill the bench and live cuttings with the soil excavated from the next bench. Be sure to compact

the backfilled soil to ensure maximum contact between the soil and the live cuttings

- Space benches 3 to 5 feet apart depending on the slope. The steeper the slope the closer the spacing
- Seed and mulch the bare soil between the benches after all of the brush layers have been installed
- If possible, install a drip hose with inline emitters every 1 foot along the top of each brush layer. Irrigate once a week until winter rains moisten the soil. Additional irrigation the following summer will result in better plant establishment. If a drip system is not feasible, any supplemental irrigation will be helpful



Brush Layering construction detail.

Maintenance

Beyond any irrigation needed to aid plant establishment if installed during the dry season, the primary maintenance needed for this practice is to replace failures as needed, especially during the first rainy season after installation.

References

- McCullah, J.A.** 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.
- Schiechtel, H.M. and R. Stern,** 1997. *Water Bioengineering Techniques for Watercourse Bank and Shoreline Protection*. English Translation with additions. Blackwell Science, Ltd.
- United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS).** 1992. "Soil Bioengineering for upland slope protection and erosion protection." In *National Engineering Handbook (NEH)*, Part 650, Chapter 18.

BRUSH MATTRESS

Description and Benefits

A brush mattress involves placing a dense mat of live cuttings along the slope of an eroding streambank. The brush mattress provides immediate erosion protection, as well as long-term protection once the cuttings become established and begin to grow. The roots stabilize the soil while the shoots slow water flow, making the brush mattress effective at capturing sediment during high flows - instead of the streambank eroding, it actually rebuilds. Brush mattresses are a technically simple practice, but they are labor intensive and require large numbers of live cuttings.



Volunteers install a brush mattress.

When to use Brush Mattresses

Brush mattresses are ideal for stabilizing (and rebuilding) streambanks that erode during high flows. The streambank should be smooth and graded back to a slope no steeper than 2:1. The base of the mattress should be permanently in water or in contact with the water table if live cutting establishment is desired. The size/length of the brush mattress can vary depending on the needs of the site.

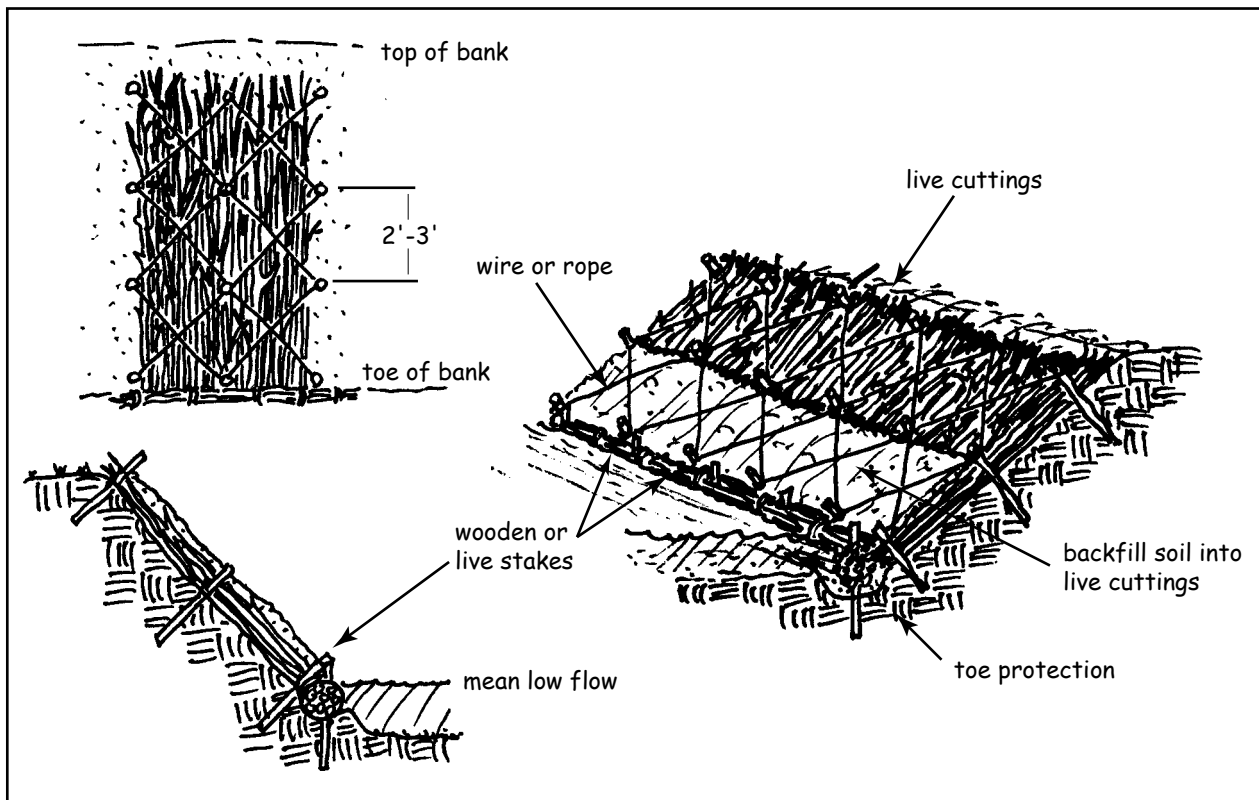
Implementation

Collect live cuttings following the guidelines described in *Pole Planting*. Install brush mattresses during the dormant season for the live cuttings (November through March). This practice may require permits. Contact your local California Department of Fish and Wildlife warden for consultation.

Installation:

- Reshape the slope of the streambank so that it is an even grade. This may require “pulling back” the top of the bank to ensure the slope is not steeper than 2:1. Pulling back the bank is preferable to filling as the latter is inherently less stable. Additionally, while reshaping the slope, excavate to a depth of about 6 inches the entire area to be covered with the brush mattress
- Excavate a trench on contour at the toe of the slope. This should be at the mean low water level. The trench should be large enough to accommodate the base of the brush mattress and the selected toe protection (rock riprap, rootwads, coir rolls)
- Beginning at the toe of the slope in the trench, pound in wooden stakes (or live stakes) at 3 to 5 foot centers along the length of the site and up the slope. Only partially pound in the wooden stakes at this time (to a depth of about 1 foot)
- Place live cuttings on the slope with the base ends in the trench. Slightly crisscross the cuttings until they form a mat 6 to 12 inches thick
- Tie wire or rope horizontally and in a crisscross pattern from stake to stake. Tie off each segment so that if one section breaks, the others remain intact. An alternative is to lay live pole cuttings horizontally atop the brush mattress and tie them to the wooden stakes
- Pound the stakes into the ground until the brush mattress is secure against the slope

- Backfill soil around and into the brush mattress. Use a bucket to throw water over the mattress. This will work the soil into the spaces between the live cuttings and will provide some moisture to help with initial root establishment. The top layer of the live cuttings should still be visible after backfilling
- Place selected toe protection (i.e. rock, rootwads, coir roll) in the trench and in an additional trench dug perpendicular to the contour at the upstream end of the mattress. This is to prevent the stream from cutting under or behind the brush mattress



Brush Mattress installation detail.

Maintenance

Beyond any irrigation that might be needed to aid plant establishment if installed during the dry season, the primary maintenance needed for this practice is to replace slips or failures as needed, especially during the first rainy season after installation.

References

- McCullah, J.A. 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.
- Schiechtel, H.M. and R. Stern, 1997. *Water Bioengineering Techniques for Watercourse Bank and Shoreline Protection*. English Translation with additions. Blackwell Science, Ltd.
- State of California, California Department of Fish and Game. 1998. *California Salmonid Stream Habitat Restoration Manual*. Third edition.
- United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 1998. *The Practical Streambank Bioengineering Guide*.

GULLY REPAIR

Description and Benefits

Gullies are common nuisances, causing road damage, sedimentation of streams, and other hazards to humans and livestock. Traditionally, gullies were repaired with check dams—grade control structures typically built with rocks or logs. Most traditional check dams eventually fail, widening the gully. People have tried to fix gullies by filling them up with slash, trash, straw bales, refrigerators, cars, or anything handy. We now know this usually makes a gully bigger and uglier. A gully is typically a symptom of another problem, such as a poorly placed culvert or other factor that has concentrated and increased water flow over the land. Gullies also form in response to stream downcutting. This article should give you a better insight into why gullies form and offer some suggestions of practices you can use to repair them. These practices include woven willow “check dams,” turf reinforcement mats, and various bank stabilization techniques.



When to Repair Gullies

Gullies should be repaired only after the source of the problem has been identified and treated. In cases where the source of the problem cannot be treated, treatment of the gully is most likely a temporary fix. In the case that the source of the problem no longer exists or has “run its course,” repairing the gully will help accelerate the return of the natural landform and ecological functions of the area affected. This practice applies only to ephemeral and intermittent streams and swales.

Implementation

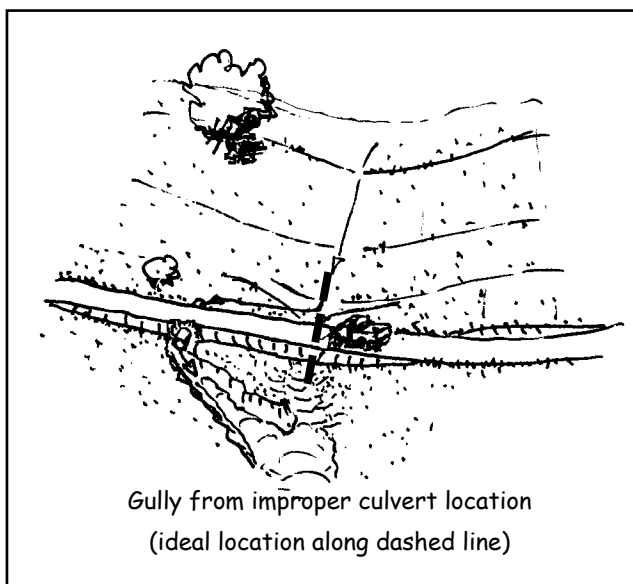
Usually, gullies form for two different reasons, and the way you repair the gully will depend on how and why it formed.

“Top-down” gullies form when runoff is concentrated and/or flow increases to a point (the “nickpoint”) where the bottom of the channel can not withstand the erosiveness of the water. The gully will continue to downcut and widen below the nickpoint and the headcut will migrate upstream creating new nickpoints. Stabilizing the headcut can help slow or stop the upstream migration of the gully.

“Bottom-up” gullies form from large stream downcuts, or when the stream becomes incised. Associated tributary streams will respond by also downcutting. This downcutting will originate at the confluence with the large stream and travel up the tributaries until they reach equilibrium. This process can reach up into the small swales that feed the tributary. When the downcutting happens rapidly, the tributary and the swales that feed it take on a gully-like appearance.

Top-down Gully Repair: ‘Top-down’ gullies are typically associated with roads. On many roads the runoff is concentrated into an inboard ditch and is transported under the road through a culvert, which discharges the water onto the land below. Installing these culverts without regard to the natural topography directs a large amount of water where it never flowed before, resulting in a gully that will eventually affect the stability of the road. See *Road Construction and Maintenance* for proper culvert

placement and outsloping information.



Locate culverts in natural drainages to avoid gully formation.

Bottom-up Gully Repair: Recognize and understand that stream adjustment is a natural process. Don't pour truckloads of money and time into trying to stop it; do what you can do stabilize the newly formed and most likely steep stream banks that result from downcutting. Please refer to the following practices for stream bank stabilization techniques: *Live Staking & Pole Planting*, *Willow Wattles*, *Straw Wattles*, and *Brush Layering*. Protect road crossings by stabilizing the headcut before it reaches the road.

Once the source of the runoff that caused the gully is identified and treated, the task of repairing the gully remains. If the gully formed in a previously existing stream channel or swale (i.e. someplace water naturally flows), your task is to stabilize the headcut and the banks of the gully. Refer to the practices mentioned above for specific techniques.

This may require a Streambed Alteration Agreement from the California Department of Fish and Wildlife (See *Permits and Regulations*). If the gully formed where water wouldn't naturally flow and you have redirected the runoff discharging into the gully to a more appropriate location, the most complete repair would be to fill in and restore the natural landform. The ground work should be followed by seeding native perennial grasses, legumes, and wildflowers and covering the disturbed soil with straw mulch. If the landform is not completely restored and a swale exists where the gully was, runoff may collect in the swale and eventually cut a new gully.

If filling in the gully is not feasible, stabilizing the headcut and the banks of the gully is the best solution. (See Headcut Repair, next topic) In situations where the gully is dry most of the year, the banks should be pulled back to at least a 2:1 slope, smoothed, seeded with native perennial grasses, legumes, and wildflowers and covered with straw mulch. If adequate soil moisture exists in the gully throughout the year, willow wattles can be installed across the channel at regular intervals along the length of the gully. The willow wattles capture sediment as it is transported down the gully and slowly build up the elevation of the bottom of the gully.

Maintenance

Inspect gully repair projects after each major storm to catch failures before they expand. Repair any weak spots with the same methods used for the practice, while modifying it as you see how the land and runoff responds to your efforts.

References

- McCullah, J.A. 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.
- State of California, California Department of Fish and Game. 1998. *California Salmonid Stream Habitat Restoration Manual*. Third edition.
- Weaver, W.E. and D.K. Hagans. 1994. *Handbook for Forest and Ranch Roads*. Mendicino County Resource Conservation District.

HEADCUT REPAIR

Description and Benefits

A headcut is typically found at the upstream end of a gully, although some cases several headcuts may be observed in a single gully. Each headcut, with the exception of the uppermost headcut, represents a former nickpoint and can continue to cause downcutting of the channel. Water pours over the headcut like a small waterfall, causing bank erosion and undercutting the base of the headcut, causing it to “migrate” upstream. To slow or stop this migration and continued erosion, the headcut must be stabilized. This practice will outline several techniques for stabilizing headcuts.



A log headcut repair site near Cambria, CA.

In general the headcut is regraded to a more stable angle and the soil is covered by a variety of materials, from soil and concrete filled sandbags to rock riprap. If the area has year-round moisture, vegetation can be planted to further stabilize the banks. Keep in mind that gullies (and headcuts) are typically symptoms of a larger problem. First identify and treat the larger problem (see *Gully Repair*).

When to repair Headcuts

The techniques described for headcut repair apply to ephemeral and intermittent streams and drainages. Headcuts should be repaired only after the cause of the gully has been identified and treated. The headcut can be caused by overland or subsurface flows. There must be enough space upstream of the headcut to pull back the bank to at least a 2:1 slope. Work should be done when the stream or drainage is dry.

Implementation

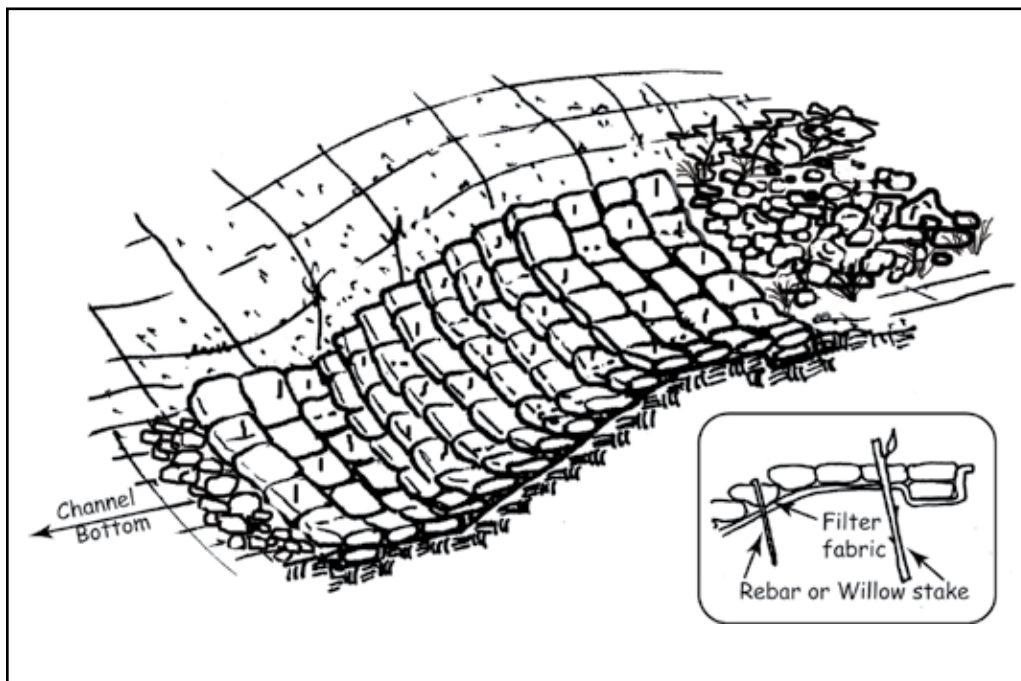
Repairing headcuts can be a simple, straight-forward operation. Access to the site can determine the suitability and cost effectiveness of the various techniques used to repair headcuts. Topography and vegetation can limit the equipment that can reach the site. Minimal disturbance to the existing landscape should be a primary goal for any technique.

All Sites and Techniques: Pull back the headcut and adjacent banks to at least a 2:1 slope using a backhoe or hand tools. Further excavate the channel bed where surface-hardening materials (such as sandbags, logs, or rock riprap) will be placed so that they will be level with the adjacent banks (see figure next page). Dig a small trench at the base of the slope of the channel to key in the surface hardening materials. Dig another small trench at least four feet upstream from the top of the slope of the channel and at least one foot uphill from the top of the banks to key in the filter fabric needed between the native soil and surface materials. Smooth the surface of the new channel and banks and lay the filter fabric over the area. Begin by laying the filter fabric in the channel, from trench to trench. Use a single piece if the filter fabric is wide enough to extend up the banks. If more than one piece is used, lay additional pieces similar to the first piece (from downstream to upstream) being sure to overlap at least one foot with the previous

piece. Staple the filter fabric in place using landscape staples every 1-2 feet and starting in the channel and working your way upstream and upslope. It is very important to key in the top of the filter fabric (see *Erosion Control Blankets* for details). Once the area has been reshaped and the filter fabric secured, you can choose the surface hardening option that best fits the location and the project budget. Two such options are described below.

Rock Riprap: This is the least labor intensive technique. Delivery and ability to place rock is the limiting factor. Place rock riprap in the channel section of the reshaped slope. Begin by placing the largest rocks in the trench at the base of the slope and work your way to the upstream trench. In most cases one layer of rock will suffice. Choose quarried (angular) rock that with diameters that averages 1/4 to 1/3 of the width of the channel bed. For example, if the channel bed is two feet wide, choose rock with a 6" to 8" average diameter. Willow stakes can be installed in the adjacent banks using the concrete stake and sledge hammer to create a pilot hole.

Soil and Concrete Filled Sandbags: Fill sandbags with a 50-50 mix of soil and concrete. Another option is to sew your own filter fabric 'sandbags' and fill them with only soil. Securely staple the open end of each sandbag closed. Place the sandbags in the channel section of the reshaped slope. Lay the first row



of sand bags in the trench at the base of the slope with the stapled end upstream. Stagger the next row so that each sand bag is centered on the seam between the two under it. Continue to the upstream trench. Secure every third sandbag by first creating a pilot hole with a concrete stake and driving a wooden stake into the pilot hole through the sandbag.

Maintenance

Inspect headcut repair projects after each major storm to catch failures before they expand. Repair any weak spots with the same methods used for the practice, while modifying it as you see how the land and runoff responds to your efforts.

References

McCullah, J.A. 1999. *Erosion Draw 3.0 CD-ROM*. Salix Applied Earthcare.

NATIVE PLANT LIST FOR CARMEL VALLEY

The following is a list of possible native plants that should grow well in Carmel Valley and vicinity. All the plants need full sun exposure and are perennial in growth habit unless otherwise stated in the Notes column. Several of the plants are horticultural cultivars of native plants and may be more readily available at local nurseries. Most of these plants will require summer irrigation during their establishment period (first 2-5 years after planting).

Native Plants Common to Wetland Areas and Springs

<u>Common name</u>	<u>Scientific name</u>	<u>Notes</u>
<i>Grasses, Sedges, Rushes</i>		
Tufted hairgrass	<i>Deschampsia caespitosa</i>	To 3' tall, 1' wide, cool season. Full sun/part shade.
Creeping wildrye	<i>Leymus triticoides</i>	2'-3' tall, cool season, spreads by rhizomes.
Santa Barbara sedge	<i>Carex barbarae</i>	1'-3' tall, full sun/part shade, clumping.
Clustered field sedge	<i>Carex praegracilis</i>	0.5'-2.5' tall, full sun to partial shade.
Spike rush	<i>Eleocharis macrostachya</i>	1'-3' tall, full sun to partial shade. Flowers May-Aug.
Blue rush	<i>Juncus patens</i>	1'-3' tall, full sun to partial shade. Flowers May-Aug.
Flat-bladed rush	<i>Juncus xiphioides</i>	1.5'-3' tall, full sun to partial shade. Flowers May-Oct. Spreads by rhizomes.
Tules	<i>Scirpus californicus</i>	3'-5' tall. Flowers May-Aug.
<i>Forbs & Shrubs</i>		
Goldenrod	<i>Solidago</i> spp.	2-4' tall/wide, part shade. Flowers July-Sept.
Mugwort	<i>Artemisia douglasiana</i>	3'-7' tall, full sun to partial shade. Flowers June-Oct.
Dogwood	<i>Cornus sericea, ssp. occidentalis</i>	4'-15' tall, partial shade. Flowers May-July, deciduous.
Currant and Gooseberries	<i>Ribes species</i>	3'-6' tall, varying growth habits, trailing or upright, shade to part sun. Flowers Jan-April. Currants have no spines, gooseberries have thorns.
California blackberry	<i>Rubus ursinus</i>	To 20' tall and wide, full sun to partial shade. Flowers Jan-May. Evergreen w/ spines.
Mulefat	<i>Baccharis salicifolia</i>	6'-10' tall, 4'-6' wide, full sun to partial shade, occasional summer water. Flowers Mar-May. Easily propagated from cuttings.

<u>Common name</u>	<u>Scientific name</u>	<u>Notes</u>
Trees		
Box elder	<i>Acer negundo</i> 'Californicum'	40'-60' tall and wide, full sun to partial shade. Flowers Mar-Apr. Deciduous. Propagation by seedling volunteers.
White alder	<i>Alnus rhombifolia</i>	60'-80' tall, 20" wide, deciduous. Flowers Mar-May. Propagation from seed.
California sycamore	<i>Platanus racemosa</i>	30'-80' tall, 20'-50' wide. Flowers Feb-Apr. Deciduous.
Black cottonwood	<i>Populus balsamifera</i>	80'-100' tall, 30' wide. Flowers Feb-Apr. Deciduous. Easy propagation from seed and cuttings.
Willow	<i>Salix spp. species</i>	20'-30' tall. Flowers Mar-Apr. Deciduous. Easy propagation from seeds and cuttings.

Native Plants Common to Upland Areas

Mountains and Valley: Plants in this list are suited for growth in the valley floor and both foothill and mountain environments.

<u>Common name</u>	<u>Scientific name</u>	<u>Notes</u>
Grasses		
California brome	<i>Bromus carinatus</i>	1.5'-3' tall, cool season bunchgrass, deep soils.
Blue wildrye	<i>Elymus glaucus</i>	2'-3' tall, cool season bunchgrass, deep, good soils. Establishes rapidly and re-seeds well.
Idaho fescue	<i>Festuca idahoensis</i>	1'-2' tall, cool season, tufted, drought tolerant. Tolerates partial shade.
Meadow barley	<i>Hordeum brachyantherum</i>	1' tall, cool season, tufted bunchgrass. Prefers wet conditions and tolerates flooding. Can take partial shade.
California barley	<i>Hordeum californicum</i>	2'-4' tall, cool season, tufted. Adapted to upland dry meadows and tolerates short duration floods. Tolerates partial shade.
Creeping wildrye	<i>Leymus triticoides</i>	2'-3' tall, cool season, spreads by rhizomes.
California oniongrass	<i>Melica californica</i>	1'-2' tall, cool season, tufted, well-drained soils. Tolerates partial shade.
Deergrass	<i>Muhlenbergia rigens</i>	1.5'-5' tall, warm season bunchgrass, tolerates extreme conditions.
Nodding needlegrass	<i>Stipa cernua</i>	1'-2' tall, cool season bunchgrass. Well-drained soils, drought tolerant.
Foothill needlegrass	<i>Stipa lepida</i>	1' to 3.5' tall, tufted, cool season bunchgrass. Dry and disturbed sites, full sun to partial shade.

<u>Common name</u>	<u>Scientific name</u>	<u>Notes</u>
Purple needlegrass	<i>Stipa pulchra</i>	1'-2' tall, cool season bunchgrass. Drought tolerant, widely adapted.
Pine bluegrass	<i>Poa secunda</i>	2.5' tall, cool season, tufted bunchgrass. Adapted to shallow soils. Full sun to partial shade.
<i>Forbs & Shrubs</i>		
Common yarrow	<i>Achillea millefolium</i>	1' tall and spreading, drought tolerant. Flowers Apr-Jul.
Chamise	<i>Adenostoma fasciculatum</i>	2'-8' tall and nearly as wide, drought tolerant. Flowers Feb-July. Evergreen.
Coyotebrush	<i>Baccharis pilularis</i>	4'-8' tall and wide, infrequent summer water. Males flowers Oct-Nov, female flowers Oct-Jan. Evergreen.
Buckbrush	<i>Ceanothus cuneatus</i>	8' tall and wide, very drought tolerant, flowers Feb-Apr. Evergreen.
Wild lilac	<i>Ceanothus 'Concha'</i>	6'-8' tall and wide, infrequent summer water. Flowers Mar-Apr. Evergreen.
Yankee Point Carmel creeper	<i>Ceanothus griseus horizontalis</i>	(var. 'Yankee Point') 3'-5' tall, 6'-8' wide, occasional summer water. Flowers Mar-May. Evergreen.
Blue blossom	<i>Ceanothus thyrsiflorus</i>	6'-20' tall and wide, infrequent summer water, flowers Mar-May. Evergreen.
Goldenbush	<i>Ericameria ericoides</i>	To 3' tall, dry, well-drained soils. Coastal. Flowers in spring.
California buckwheat	<i>Eriogonum fasciculatum</i>	1'-3' tall, 3' wide, drought tolerant. Flowers May-Dec.
California flannelbush	<i>Fremontodendron californicum</i>	6'-15' tall, dry, well-drained soils. Flowers May-Jun. Evergreen
Fremont silk tassel	<i>Garrya fremontii</i>	4'-10' tall, well-drained soils. Flowers Jan-Apr. Evergreen.
Deerweed	<i>Lotus scoparius</i>	1.5'-3' tall, full sun, drought tolerant. Flowers Feb-Oct. Deciduous.
Bush lupine	<i>Lupinus albifrons</i>	2'-6' tall, drought tolerant. Flowers Mar-July. Deciduous.
Sticky monkeyflower	<i>Mimulus aurantiacus</i>	To 4' tall and wide, full sun to partial shade. Occasional summer water, flowers Mar-Aug. Evergreen.
Coffeeberry	<i>Rhamnus californica</i>	4'-8' tall, 4'-6' wide, Sun to part shade, Flowers Apr-Jun. Evergreen
California wild rose	<i>Rosa californica</i>	To 6' tall and wide, full sun to shade, infrequent summer water. Flowers May-Nov. Deciduous.

<u>Common name</u>	<u>Scientific name</u>	<u>Notes</u>
California blackberry	<i>Rubus ursinus</i>	To 10' tall and wide, full sun to partial shade. Flowers Jan-May, evergreen.
Sage	<i>Salvia</i> spp.	Most spp. to 3' tall and wide, infrequent summer water. Flowers early summer.
Elderberry	<i>Sambucus mexicana</i>	15'-20' tall and wide, full sun to partial shade, tolerates some drought, flowers Apr-Nov. Deciduous.
Snowberry	<i>Symphoricarpos albus</i>	To 3' tall, partial to full shade. Flowers May-Jul. Deciduous. Toxic to humans.
Poison oak	<i>Toxicodendron diversilobum</i>	Shrub to 6.5', vines to 100', small tree to 15'. Full sun to partial shade, drought tolerant. Flowers Apr-May. Deciduous. Causes mild to severe rash on most humans.

Trees

Bigleaf maple	<i>Acer macrophyllum</i>	30'-75' tall, 30'-50' wide, full sun to partial shade. Prefers moist soils. Flowers Apr-May. Deciduous.
California buckeye	<i>Aesculus californica</i>	10'-20' tall, 30' wide, summer deciduous. Flowers May-Jul. Toxic to humans, wildlife and livestock.
Toyon	<i>Heteromeles arbutifolia</i>	15'-20' high and wide, occasional summer water, flowers May-Jun. Evergreen. Easy propagation from seed.
Black walnut	<i>Juglans californica</i> var. <i>hindsii</i>	45'-75' tall and wide, drought tolerant. Flowers Apr-May. Deciduous.
Hollyleaf cherry	<i>Prunus ilicifolia</i>	10'-25' tall and wide, infrequent summer water. Flowers Apr-May. Evergreen. Easy propagation from seed.
Coast live oak	<i>Quercus agrifolia</i>	30'-60' tall and wide, full sun to partial shade, infrequent summer water. Flowers Mar-Apr. Evergreen. Easy propagation from seed.
Blue oak	<i>Quercus douglasii</i>	30'-50' tall, 40'-70' wide, drought tolerant. Flowers Apr-May. Deciduous.
California black oak	<i>Quercus kelloggii</i>	30'-80' tall and wide, shade tolerant when young. Occasional summer water, flowers Apr-May. Deciduous.
Valley oak	<i>Quercus lobata</i>	60'-80' tall and wide, infrequent summer water. Flowers Mar-Apr. Deciduous. Can be propagated from seed.

References

- Hickman, James C.** 1993. *The Jepson Manual*. University of California Press.
- Matthews, Mary Ann.** 1997. *An Illustrated Field Guide to the Flowering Plants of Monterey County and Ferns, Fern Allies, and Conifers*. California Native Plant Society.

INVASIVE WEED CONTROL IN MONTEREY CO.

Carmel Valley's topography, geology, and climate provide suitable habitat and conditions for a large variety of non-native plant species to thrive. Non-native plants alter ecosystem functions such as nutrient cycles, hydrological cycles, and wildfire frequency, and outcompete native plants and animals. Effective control requires awareness and active participation of the public as well as natural resource managers.

The most effective and efficient weed control strategies are preventing invasions by new plant species, and quickly detecting invasions that occur so weeds can be eradicated or contained before they spread.

In recognition of the enormous problems that these invasive weeds can cause, and the coordinated effort that is required to effectively control them, the Monterey County Weed Management Area (WMA) was formed with the objective of identifying and mapping the county's worst weeds, implementing projects designed to prevent, eradicate, or manage these invasive plants, and educating local residents about weeds. More information about County weed control activities - as well as images of the weeds listed below - can be found on the Monterey County Commissioner of Agriculture's website invasive weed page (<http://ag.co.monterey.ca.us/pages/invasive-weeds>).

Ten common invasive plants of Carmel Valley and recommended control methods

1. **Acacia or Wattle**, *Acacia dealbata* & *A. decurrens*

Both trees are found throughout Monterey County. They favor disturbed places in coastal prairies, riparian areas and coniferous forests. Silver wattle is often confused with green wattle (*Acacia decurrens*), but is distinguishable by the small, silvery hairs that grow on its twigs. They can spread via rhizomes and seeds, and easily resprout after being cut. Both trees change soil chemistry by fixing nitrogen and the plants' fallen leaves may have allelopathic effects that prevent the growth of native understory plants. Like many acacias, these two wattles are commonly planted as ornamentals.

Control methods: Physical management techniques include felling, felling followed by herbicide application on stumps, ring barking and prescribed burning. As resprouting can occur after felling (although not always), a combination of these techniques may be required.

2. **Field mustard and wild radish**, *Brassica rapa* & *Raphanus sativus*

Several introduced mustard and wild radish species from Europe have naturalized in Monterey County. They are winter annuals in the Brassicaceae family resistant to frost and mild freeze. Buried seeds can survive 50 years or more. Like other Brassicas, they grow profusely and produce allelopathic chemicals that prevent germination of native plants. The spread of these plants can increase the frequency of fires in grasslands, chaparral and coastal sage scrub, changing these habitats to nonnative annual grasslands. Recurring fires can promote establishment of infestations. The foliage, roots, and especially seeds of Brassica and many related species have sulfur-containing compounds that can cause toxicity problems in livestock when large quantities of seeds are ingested or when animals are confined to pastures that consist primarily of mustard family species.

Control methods: Mowing, hand-pulling and chemical controls are all effective. Long-term maintenance of infested sites is required.

3. **Italian thistle**, *Carduus pycnocephalus*

Italian thistle is an aggressive annual that ranges in height from twelve inches to three feet. Its leaves are white-wooly below and green-hairless above. Thimble-sized rose to purple flowers are clustered in groups of two to five. Italian thistle occurs in meadows, pastures and roadsides, and it commonly

colonizes disturbed areas throughout Carmel Valley.

Control methods: Hand pulling is effective for small patches if done before seed is set. The root must be severed below the ground so plant does not regrow. Mowing and slashing is not reliable because plants can regrow and produce seed. The seed bank takes up to ten years to be depleted. Herbicide applications of glyphosate are effective. See manufacturer's recommendations for effectiveness.

4. Yellow starthistle, *Centaurea solstitialis*

Found throughout the upper areas of the watershed, this annual plant has become one of the most prominent noxious weeds in California. Native to Eurasia, it is extremely competitive, invading cropland, pastures, and rangeland, increasing farming costs and reducing productivity. Yellow starthistle has degraded thousands of wildland acres, crowding out native plants and reducing the habitat value for wildlife. It is also toxic to horses.

Control methods: It is critical that all control measures be conducted prior to seed production and dispersal, which occurs from late May through July, depending on your location and the recent weather. In established stands, any successful control strategy will require multiple years of management, and follow-up treatment or restoration to prevent rapid reestablishment. Weedeaters or mowing can be effective at managing starthistle. However, mowing too early will allow increased light penetration and more vigorous plant growth and high seed production. Mowing is best when conducted at a stage where 2 to 5 percent of the seed heads are flowering (Benefeld et al. 1999). Mowing after this period will not prevent seed production, as many flower heads will already have produced viable seed. In addition, mowing is successful only when the lowest branches of plants are above the height of the mower blades. Results should be repeatedly monitored, as a second or perhaps a third mowing may be necessary to ensure reduced recovery and seed production (Thomsen et al. 1996a, 1996b).

Combinations of techniques can be more effective than any single technique: prescribed burning followed by spot application of post-emergence herbicides to surviving plants can prevent the rapid reinfestation of the treated area. Similarly, combining mowing and grazing, revegetation and mowing (Thomsen et al. 1996a, Thomsen et al. 1996b), or herbicides and biological control may provide better control than any of these strategies used alone. Effective combinations may depend on location or on the objectives and restrictions imposed on land managers.

5. Poison hemlock, *Conium maculatum*

Poison hemlock is a biennial that can grow from two to ten feet tall. Poison hemlock is abundant and common in the Carmel River watershed, and is commonly found in disturbed areas where it forms dense patches along roadsides, fields and riparian forests and floodplains. Plants disperse seed in September through January. Seed can remain viable in the soil for up to three years. It has the potential for prolific seed production, and does so by asexual means

Poison hemlock is best known for its toxicity to vertebrates, causing death primarily by respiratory paralysis after ingestion. It is toxic to livestock, wildlife and humans.

Control methods: Hand-pulling the plant is effective, especially prior to seed set. Because of the biennial nature of the plant, the entire root system does not need to be removed. Spring mowing is effective at killing mature plants, yet regrowth will most likely occur and will require maintenance. A second mowing in the late summer is recommended to eliminate subsequent regrowth. A third year of mowing may be required to exhaust the seedbed. Prescribed burns do not appear to be a good control method. Effective post-emergence herbicides including glyphosate appear to be effective when applied in the late spring, especially in the rosette stage (second year).

6. **Jubata grass/Pampas grass, *Cortaderia Jubata/Cortaderia selloana***

Jubata grass and purple Pampas grass are perennial grasses that form large clumps of tough wiry and sharp-edged long leaves. Plants can range from six to ten feet in height and are difficult to remove once established. These two closely-related plants were introduced from South America for use as ornamentals, and were also planted for erosion control. These grasses have escaped cultivation and infested thousands of acres along the California coast, crowding out native species. Both grasses have showy, characteristic flower plumes, sharp leaf blades, and can form large clumps over five feet tall. Although both grasses occur locally and are often difficult to tell apart, jubatagrass is the bigger problem in this region. Jubatagrass does not require pollination to form viable seed, and a large plant is capable of producing a million tiny seeds that are easily dispersed by wind. Jubatagrass is perennial and individual plants can live 10 years or more.

Control methods: For large plants, a pick, shovel and strong back are required to remove the entire crown and top section of the roots. A chainsaw or machete is effective at exposing the base of the plant, facilitating removal. Smaller plants can be pulled and removed by hand. Burning is not effective because plants will resprout. Control can also be achieved by spot treatment with a post-emergence herbicide application such as glyphosate (follow manufacturers' recommendations and guidelines). For most effective control, apply herbicides in late summer or early fall, and monitor the area for reestablishment for several seasons. Further spot applications on resprouts will most likely be required to prevent reestablishment.

7. **Cape ivy, *Delairia odorata***

Formerly known as German ivy, this South African plant invades riparian areas along the entire Pacific Coast. It is a fast growing vine, with long trailing stems that easily stretch over twenty feet from the rooted base, and smother other plant life. Although Cape ivy rarely reproduces by seed in this area, it can resprout from any portion of the plant, including each node on the stem, which enables the plant to spread rapidly and makes control efforts difficult. In recent years populations of ivy have appeared in grasslands, open oak forests, coastal plant communities, Monterey pine forest, seasonal wetlands, and riparian zones. It is rapidly becoming established in most of the riparian or stream-side areas of Monterey County, especially along the coast.

Control methods: Cape ivy is very difficult to control without destroying any and all associated plants along with it. Manual removal has been attempted with mixed success. Manual removal requires clearing all vegetation and carefully removing any small root fragments that are capable of regrowth. Removed Cape ivy should be placed in plastic bags or removed off-site. A mixture of foliar-sprayed glyphosate and triclopyr are affective at killing long-established and extensive infestations of Cape ivy. Applications must be done in late spring when the plant is photosynthesizing actively but is past flowering.

8. **Blue gum eucalyptus, *Eucalyptus globulus***

Eucalyptus is a very large genus that consists of over 600 species, which are native to Australia, Tasmania, and some surrounding islands, in a range of soil conditions and temperatures. Blue gum is a tall (150-180 foot), aromatic, straight-growing tree, with bark that sheds in long strips, leaving contrasting smooth surface areas. Adult leaves are waxy blue, sickle-shaped, and hang vertically. Juvenile leaves are oval, bluish green, and have square stems. Fruits are blue-gray, woody, and ribbed. Trees produce abundant fruit drop and leaf and bark litter. Blue gum is distinguished by its tall growth habit, smooth bark, long leaves, and large, solitary, waxy buds and fruits.

Eucalyptus is found throughout California, but has primarily escaped to become invasive along the coast from northern to southern California. Native plants are unable to grow underneath groves of eucalyptus. This has been attributed to either the thick litter layer that can develop, or perhaps

an allelopathic effect. Existing stands of *E. globulus* can aggressively invade neighboring plant communities if sufficient moisture is available. *Eucalyptus globulus* also contributes to the spread of fire because of its characteristic long, stringy bark.

Control methods: Removing trees is a difficult task and can be expensive if individual trees are felled. An effective method to control stump resprouting is necessary. The most effective control of sprouting is achieved through applications of triclopyr or glyphosate directly to the outer portion of the stump's cut surface at the time of tree felling.

9. **French broom, *Genista monspessulana***

Brooms were originally introduced into North America from the Mediterranean region as ornamental shrubs. Since then, the attractive landscape plants have escaped cultivation to become a destructive weed pest all along the Pacific Coast. Brooms easily colonize open and disturbed areas, but can also invade undisturbed grassland and forest habitats. The flowers and seeds of brooms contain compounds that can be toxic to humans and cattle, and the foliage is unpalatable and avoided by livestock. In forests, these large, aggressive shrubs out-compete native plants and can form dense thickets, causing fire hazards due to heavy fuel loads.

French broom is an upright, evergreen shrub that commonly grows to nine feet in height. It is common on the coast, mountain slopes, and in disturbed places such as river banks, road cuts and forest cuts, but can colonize grassland and open canopy forest. French broom is a prolific seeder, and in some areas, seedlings will appear to carpet the ground.

Control methods: Relatively easy control can be achieved with flaming or herbicide treatments of seedlings. When the ground is moist, entire large plants can be pulled up by their roots using a weed wrench. All control methods require appropriate timing and follow-up monitoring. Once a treatment program is started, it is important to maintain control efforts, as the French broom seeds germinate for several years.

10. **Cheeseweed, *Malva parviflora***

Cheeseweed is a common annual weed in California. Cheeseweed begins growing with the first rains in the fall and quickly develops a deep taproot that becomes woody and makes the plant very difficult to remove by hand or even with tools. Cheeseweed only reproduces by seed, which have a very long viability. Plants tend to have an upright growth habit and can grow up to 5 feet tall. This species flowers from March to September in central California.

Control methods: Best control is achieved by hand-pulling young plants. The long tap root develops rapidly, so this must be done when the plant has four or fewer true leaves. Removing plants before they can produce seed helps reduce future impact. Young plants can also be killed by cutting them off at the crown, but older plants may resprout from the crown. Shallow mechanical cultivation may be used on large numbers of young plants. The cultivator should be set so that the blades or tines will pull the plants from the ground or cut the tap root below the soil level. Mowing is not an effective method of control because the plants have viable buds on the stems below the height of the mower blade. Mulches can also be effective. At least 3 inches of organic mulch, such as bark or wood chips, will make it physically difficult for the seedling to emerge and will screen out the amount of light that mallow requires to effectively sprout. Mulch must be maintained to maintain needed depth, or seedlings can push through to become established.

References: Additional informational about nonnative plants can be found at the following websites:

Agricultural Commissioner of Monterey County: <http://www.ag.co.monterey.ca.us/>

California Invasive Plant Council: <http://www.cal-ipc.org/>

California Native plant Society: <http://www.cnps.org/>

PLANT MATERIALS SOURCES

Local Nurseries

Central Coast Wilds

114 Liberty Street
Santa Cruz, CA 95060
phone: (831) 459-0655

website:

www.centralcoastwilds.com

State registered organic nursery provides quality native plants, seeds, and services to landscapers and designers.

Elkhorn Native Plant Nursery

1957B Highway 1
Moss Landing, CA 95039
phone: (831) 763-1207

website:

www.elkhornnursery.com

Seed, container & bareroot plants, contract collect & grow, demonstration garden.

MEarth's Native Plant Nursery

4380 Carmel Valley Road
Carmel, CA 93922
phone: (831) 624-1032

website:

www.MEarthCarmel.org

Open by appointment only; Organically-grown native plants, shrubs, grasses, trees, wildflowers wholesale/retail, contract collect & grow, demonstration gardens.

Native Revival Nursery

8022 Soquel Drive
Aptos, CA 95003
phone: (831) 684-1811

website:

www.nativerivival.com

Wholesale & retail seed & plants, contract collect & grow, revegetation & restoration.

Rana Creek Nursery

35351 East Carmel Valley Road
Carmel Valley, CA 93924
phone: (831) 659-2830

website:

www.ranacreeknursery.com

Wholesale seed, wildflowers, shrubs, grasses, trees; retail container plants by appointment; sustainable landscaping, revegetation & restoration natives; contract collect & grow.

Sierra Azul Nursery & Gardens

2660 East Lake Avenue
Watsonville, CA 95076
Phone: (831) 763-0939

Website:

www.sierraazul.com

Mediterranean & water-conserving plants, many natives.

Seed Suppliers

ConservaSeed

P.O. Box 1069
Walnut Grove, CA 95690
phone: (916) 776-1200
fax: (916) 776-1112
email: info@conservaseed.com
website: www.conservaseed.com

Hedgerow Farms

21740 County Road 88
Winters, CA 95694
phone: (530) 662-4570
fax: (530) 668-8369
email: info@hedgerowfarms.com
website: www.hedgerowfarms.com

LA Hearne Company

King City, CA
phone: (831) 663-1572
phone: (800) 253-7346
email: seedsales@hearneco.com
website: www.hearneseed.com

Pacific Coast Seed

6144 Industrial Way, Building A
Livermore, CA 94550
phone: (800) 733-3462
fax: (925) 373-6855
email: pcseed@attglobal.net
website: none

S & S Seeds

P.O. Box 1275
Carpenteria, CA 93014
phone: (805) 684-0436
fax: (805) 684-2798
email: info@ssseeds.com
website: www.ssseeds.com

Snow Seed Company

21855 Rosehart Way
Salinas, California 93908
phone: (831) 758-9869
fax: (831) 757-4550
email: info@snowseedco.com
website: www.snowseedco.com

VENDORS & SUPPLIERS

Erosion Control & Planting Products

Ewing Irrigation

225 Dela Vina Ave.
Monterey, CA 93940-3717
phone: (831) 656-9530
fax: (831) 656-9503
website: www.ewing1.com

Irrigation and erosion control
supplies

Graniterock

1755 Del Monte Boulevard
Seaside, CA 93955-3603
phone: (831) 392-3700
fax: (831) 392-3701
website: www.graniterock.com
Concrete & Building Materials

Martins' Irrigation Supply

420 Olympia Avenue
P.O. Box 854
Seaside, CA 93955
phone: (831) 394-4106
fax: (831) 394-2011

website:
www.martinsirrigation.com

Irrigation and erosion control
supplies

Reed & Graham, Inc.

690 Sunol Street
San Jose, CA 95126
phone: (408) 287-1400
website: www.rginc.com

Irrigation Supplies

Ewing Irrigation

225 Dela Vina Ave.
Monterey, CA 93940-3717
phone: (831) 656-9530
fax: (831) 656-9503
website: www.ewing1.com

Hydro Turf Inc

750 Work St.
Salinas, CA 93901
phone: (831) 754-2020
website:
www.hydroturfonline.com

Martins' Irrigation Supply

420 Olympia Avenue
P.O. Box 854
Seaside, CA 93955
phone: (831) 394-4106
fax: (831) 394-2011

website:
www.martinsirrigation.com

Rain For Rent

469 El Camino Real
Salinas, CA 93908
phone: (831) 422-7813
website: www.rainforrent.com

COST-SHARE PROGRAMS

The following list of cost-share programs are available to landowners, farmers and ranchers to help them plan and implement watershed appropriate practices to manage their resource concerns.

U.S.D.A Farm Service Agency (FSA) & Natural Resources Conservation Service (NRCS)

ENVIRONMENTAL QUALITY INCENTIVES PROGRAM (EQIP)

The purpose of the Environmental Quality Incentives Program (EQIP) is to promote environmental quality and agricultural production. Cost share payment incentives of up to 75% are offered to farmers and ranchers to install conservation practices on their land. Some of the practices available for cost share are fencing, irrigation water management, tree and shrub planting, pond establishment, nutrient management, and hedgerow establishment. EQIP is a competitive program based on environmental points earned from the planned practices.

WILDLIFE HABITAT INCENTIVES PROGRAM (WHIP)

Under the Wildlife Habitat Incentives Program (WHIP) wildlife habitat is developed or improved on the private land of cooperating owners. This voluntary program cost shares up to 75% for landowners wanting to establish upland, wetland, riparian, or aquatic habitats on their property.

EMERGENCY WATERSHED PROGRAM (EWP)

The objective of EWP is to assist sponsors and individuals in implementing emergency measures to relieve urgent hazards to life and property, caused by natural disasters. Aid provided through EWP may include financial and technical assistance in installing post-fire debris flow protection, removing debris from streams, protecting destabilized streambanks, establishing cover on critically eroded lands, and purchasing floodplain easements. For this program NRCS provides up to 75% of the funds needed, the community or a local sponsor pays the remaining 25%.

For more information on the above USDA programs, contact your local NRCS field office at (831) 424-1036 ext. 3.

US Fish and Wildlife Service (USFWS)

PARTNERS FOR FISH & WILDLIFE (PFW)

This program provides technical and financial support to the landowner interested in *restoring* wildlife habitat on his or her property. USFWS will guide an interested landowner through the process of determining the possibilities of the piece of land and developing a plan for developing habitat. Depending on the project, landowners can apply for cost share on up to 50% of the cost for implementing the plan. The Fish & Wildlife Service's emphasis in this program is on restoring habitats that protect special status species and that will be self-sustaining in the long run. Candidate projects include creating shallow water areas, enhancing uplands and stockponds on rangeland, revegetating with native plants, and erecting fence along riparian areas to manage livestock. Interested landowners can contact program coordinator **Shawn Milar at (831) 648-0623 and shawn_milar@fws.gov** or visit the USFWS informational website at www.ceres.ca.gov/wetlands/introduction/partners.

California Department of Fish & Wildlife (DFW)

PRIVATE LANDS WILDLIFE HABITAT ENHANCEMENT & MANAGEMENT PROGRAM (PLM)

The PLM seeks to enhance and safeguard much needed habitat for California wildlife and, at the same time, improve profits for ranchers and farmers, forestland owners, and managers. Through this program, a landowner is enabled to offer fishing and hunting opportunities that start before or extend beyond traditional seasons; modify regulated bag limits; issue tags or permits directly to individuals he lets on his land; set and collect whatever access and service fees desired; and eliminate payment of additional fees normally required for hunting. The program also helps develop non-hunting activities like bird watching, photography, camping, and hiking. To participate, a landowner must complete a habitat assessment; develop and receive approval for a management plan and pay the license fee; and must also make a five-year commitment to the program and maintain records of progress in improving habitat. For more information, visit www.dfg.ca.gov/wildlife/hunting/plm.html.

FISHERIES RESTORATION GRANT PROGRAM (FRGP)

The Fisheries Restoration Grant Program (FRGP) was established in 1981 in response to rapidly declining populations of wild salmon and steelhead trout and deteriorating fish habitat in California. Every year, this competitive grant program funds millions of dollars of projects from sediment reduction to watershed education throughout coastal California. Interested landowners wanting assistance with planning and implementation of projects that benefit steelhead habitat directly or indirectly must have a private or public non-profit organizational sponsor such as an RCD or watershed council. For more information, contact **Margaret Paul at 831-649-2882** or see the webpage at <http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/>.

DFW Wildlife Conservation Board (WCB):

INLAND WETLAND CONSERVATION PROGRAM (IWCP)

The objectives of the IWCP include the enhancement of wetlands and other wildlife habitat on private land. The WCB has set this program up so that the interested landowner works together with a “local sponsor” (a local agency or non-profit organization—an RCD is one example) to develop and maintain a wetland project. The WCB can offer up to 50% cost share through the local sponsor for the project implementation. The WCB can also buy conservation easements on property that landowners would like to maintain as wetland wildlife habitat. The program is funded by the State Habitat Conservation Fund, which is established for availability through 2020. For more information, call the WCB Wetlands Program Manager, **Chad Fien at (916) 323-8979**.

CALIFORNIA RIPARIAN HABITAT CONSERVATION PROGRAM (CRHCP)

This is a statewide program created in 1991 to support efforts towards protection and restoration of riparian habitat. Landowners interested in receiving program support must work with a local non-profit organization or agency such as the RCD. The WCB will support a project with the requirement that the applicant and other partners provide at least 25% matching contribution, whether in funds or in-kind. Criteria for project selection include: 1) inclusion in a larger watershed planning effort; 2) benefit to many species, especially “listed” species; 3) physical link to other habitat in good condition. The WCB requests that landowners sign an agreement to maintain a project for at least ten years after construction. For more information, contact program coordinator **Terry Roscoe at (916) 445-1113**.

CAL FIRE

VEGETATION MANAGEMENT PROGRAM (VMP)

The goal of this program is to provide incentives for using fire as a tool to control unwanted brush and other vegetation that create wildfire hazards. Benefits include minimizing future wildfire suppression, maximizing watershed values, and improving the grazing and hunting capacity of the land. CDF will cover the liability, plan for, and conduct a prescribed burn on private land. The landowner pays 10% or more of the estimated cost, depending on land management objectives. Participants develop a management plan for the property with consideration of follow-up treatments to enhance the effects of the burn. Joint projects with neighboring landowners are encouraged. For more information, contact **Jonathan Pangburn at (831) 233-9475** or jonathan.pangburn@fire.ca.gov.

Monterey Peninsula Water Management District and Cal-Am Water

Historically, the Monterey Peninsula Water Management District (MPWMD), in a joint-effort program with California American Water (CAW), has offered rebates for various pre-qualified water conserving appliances. The Rebate Program was updated on January 1, 2010 by MPWMD Ordinance No. 140. The rebate application and information websites below have the most up-to-date information about the program: <http://www.mpwmd.dst.ca.us/wdd/Rebates/rebates.htm>, and <http://www.montereywaterinfo.com/rebates.html>

Cal-Am also has a learning center with helpful information on wise water use, green solutions, and leak detection kits at <http://www.amwater.com/caaw/learning-center/index.html>

For more information, contact **Joe Dimaggio at (831) 646-3228** or joe.dimaggio@amwater.com.

Resource Conservation District of Monterey County (RCDMC)

RCDMC, in partnership with the USDA Natural Resources Conservation Service, provides technical assistance to landowners, farmers, ranchers and other land managers in Monterey County. The two entities can provide confidential, on-site visits that include planning and design services for a range of resource protection and conservation practices such as erosion control, water quality protection, habitat enhancement, flood management, irrigation efficiency, and nutrient management. For eligible projects, the RCDMC can provide access to and/or facilitate applications for grant or cost-share assistance through various local, state and federal funding programs. For certain projects the RCDMC may also be able to apply for other grant funds on behalf of a cooperating landowner, grower or rancher. For more information, contact the **RCD/NRCS office at (831) 424-1036, ext. 3**.

Big Sur Land Trust

The Big Sur Land Trust works with landowners to develop voluntary conservation easement agreements and trail easement agreements in order to secure vital lands and waters for the benefit of the community and future generations, conserve wildlife through protection of habitats, sustain working lands, restore watersheds and ecological systems, facilitate scientific research and increase community access to land. In a conservation easement agreement the Big Sur Land Trust works with a willing landowner to identify conservation values on their property and negotiate land-use restrictions that are consistent with the goals of the landowner and Land Trust. The Big Sur Land Trust acquires conservation easements through both purchase and donation. Donated conservation easements may qualify as tax-deductible charitable contributions and may result in property tax savings. For more information, call **(831) 625-5523**.

PERMITS AND REGULATIONS

Several of the practices in this manual, when implemented, will require you to adhere to federal and state laws and regulations, even if the work is being done on private land. Many of these laws and regulations were developed in response to public demand that natural resources and wildlife be protected from industries, agencies, and individuals who, through their actions, either intentionally or unintentionally damage or degrade those natural resources and wildlife. The evolution and drafting of these laws, often referred to as “environmental” laws, took many years and in some cases decades to complete.

Permit applicants may be individuals, watershed groups, special districts (such as RCDs), or local, state, or federal agencies. Because the permitting process can be complicated and time consuming and there are often fees associated with permit applications, it is recommended that individuals work with their local watershed group to combine restoration projects and permit applications into a larger effort.

Given the variety of laws and their associated forms, requirements and fees, it is no wonder that well-meaning individuals and citizen’s groups are frustrated when they have to go through the multi-agency permitting process. The RCD of Monterey County has sponsored ‘permit coordination’ programs in the past to simplify the process for conservation projects and is supporting an effort to create a state-wide program to reduce unnecessarily burdensome costs and delays associated with the variety of permits needed for conservation projects.

Below is an introduction to the range of permits applicable to conservation and restoration projects undertaken by individuals and watershed groups in Monterey County, followed by a list of recommendations for how best to navigate the process. Contact the RCD for further assistance or guidance with any of these.

Local Agencies

County of Monterey Building Department Grading Ordinance: The County Building Department requires a permit for non-agricultural earth-moving or excavation that exceeds 100 cubic yards or is more than two feet in depth, or which creates a cut slope greater than five feet in height and steeper than a 1.5:1 (run:rise) slope. They also require permits for fills deeper than one foot, or that are placed on natural terrain with a slope steeper than five horizontal to one vertical, or which exceed 100 cubic yards on any one site. A fill or excavation which is to be used only for agricultural purposes such as cultivation or leveling for crops or orchards which does not adversely affect any drainage course is exempt from these permitting requirements. However, construction of reservoirs is not exempt from permitting.

Cultivation on Slopes: Open Space Policy 3.5.2. a. & b. of the 2010 Monterey County General Plan requires a discretionary permit for the conversion of uncultivated land on slopes in excess of 25%. A ministerial permit is required for the conversion of land, not cultivated for 30 years prior, for agricultural operations if the natural slope is 15 to 25 percent, and no development conversion is permitted if the slope is greater than 25 percent. There are new slope grading ordinances forthcoming as part of the General Plan Implementation. More information on these permits is available at www.co.monterey.ca.us/building/ or 831-755-5027.

County of Monterey Planning Department Tree Ordinance: A permit is needed for any oak removal if the tree is greater than six inches in diameter at two feet above ground level. Department of Planning and Building Inspection will not approve removal of more than three such trees per lot in a single year. Areas outside of the North County Area Plan, Toro Area Plan, Cachagua Area Plan, and Carmel Valley Master Plan designated as farmlands, rural grazing or permanent grazing are exempt from permits to

remove oak trees if the removal is for rangeland improvement, wildlife habitat promotion, watershed area enhancement, hazards to life or property, or firewood for owners and on-site residents. More information on these permits and associated standards is available at www.co.monterey.ca.us/planning/ or (831) 755-5025.

County of Monterey Public Works Department requires Encroachment Permits for any work within a county road right-of-way such as grading, vegetation pruning, placement or removal. More information is available at <http://www.co.monterey.ca.us/publicworks/randb.htm> or (831) 755-4800.

Monterey Bay Unified Air Pollution Control District enforces the Agricultural Burning Ordinance. In Monterey County, the burning of agricultural wastes requires a permit that can be acquired from the agencies designated by the California Air Resources Board. Individual fire departments may also require a burn permit. For more information, contact them at (831) 647-9411.

The Monterey Peninsula Water Management District has regulatory oversight over vegetation management grading, motorized vehicle access, and trail and road modification within the Carmel River riparian corridor in the lower 15.5 miles. Rules governing all of these activities can be found on the District's website at http://www.mpwmd.dst.ca.us/programs/river/erosion_potential/erosion_potential.html. A River Work Permit may be required. Permits for any of these activities must be acquired by contacting the District Engineer. More information about MPWMD requirements can be found at the District's website noted above. **Contact: Larry Hampson, District Engineer, MPWMD at (831) 658-5620 or Larry@mpwmd.net**

MPWMD also issues "Water Permits", required within their jurisdiction for those who want to obtain a building permit and a set a water meter or intensify water use on an existing connection. More information about Water Permits is available at (831) 658-5601.

State Agencies

California Coastal Commission: Development activities in the Coastal Zone, which are broadly defined by the Coastal Act to include (among others) construction of buildings, divisions of land, and activities that change the intensity of use of land or public access to coastal waters, generally require a Coastal Permit from either the Coastal Commission or the local government. The Coastal Zone is strictly defined on maps available through the County Planning Department, which is the local agency responsible for carrying out the Coastal Act requirements. In much of Monterey and Santa Cruz Counties, the Coastal Zone lies on the ocean-side of Highway 1 with notable exceptions around Elkhorn Slough and on the Monterey Peninsula. More information on permits required in the Coastal Zone is available through the County Planning Department at (831) 755-5025.

California Environmental Quality Review: The local or state government with the most jurisdictional responsibility for your project must review it under their requirements of the **California Environmental Quality Act (CEQA)**. The main purpose of CEQA review is to identify and prevent potentially significant environmental impacts from proposed projects. Most private-land projects do not require CEQA review unless they receive public assistance through grant funds or agency sponsorship. In that case, the granting or sponsoring agency typically handles the CEQA process on the project proponent's behalf.

California Department of Fish and Wildlife (DFW): The DFW requires a **Streambed Alteration Agreement (1600 Permit)** for any work that occurs in, on, over or under a waterway, from the bed of a stream to the top of the bank, any work that will divert or obstruct the natural flow of water, change the bed, channel, or bank of any stream, or use any material from the streambed. This permit is also required when removing exotic vegetation from a riparian area. **Contact: Robert Tibstra, Associate Fishery**

Biologist, DFG San Luis Obispo Office at (805) 748-6168.

State Water Resources Control Board (SWRCB): The SWRCB Division of Water Rights requires a **Water Rights Permit** when there is intention to take water from a stream for storage or for direct use on non-riparian land. In Carmel Valley, for any water-use related matters, it's best to start with with Monterey Peninsula Water Management District as mentioned under Local Agencies above.

Central Coast Regional Water Quality Control Board (RWQCB): The Central Coast RWQCB requires a **Federal Clean Water Act (CWA) Section 401 Water Quality Certification** for every federal permit or license for any activity which may result in a discharge into any waters in the United States. Activities include flood control channelization, channel clearing, and placement of fill. Federal CWA Section 401 requires that every applicant for a U.S. Army Corps of Engineers CWA Section 401 permit or Rivers and Harbors Act Section 10 permit must request state certification from the RWQCB that the proposed activity will not violate State and Federal water quality standards. **Contact: Cecile DeMartini, CCRWQCB, San Luis Obispo office at (805) 541-4782.**

Federal Agencies

National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS): NOAA's National Marine Fisheries Service is responsible for the management, conservation and protection of living marine resources within the United States' Exclusive Economic Zone (water three to 200 miles offshore). NMFS consults with project planners, in conjunction with the Fish and Wildlife Service to consider and mitigate for potential activities that would harm marine resources under their jurisdiction (such as steelhead trout). **Contact: Jacqueline Meyer, Fishery Biologist, NOAA, at (707) 575-86057 or jacqueline.person-meyer@noaa.gov.**

U.S. Army Corps of Engineers (ACOE): A **Federal Clean Water Act (CWA) Section 404 Permit** is required when work involves placement of fill or discharge of dredged materials into any "waters of the United States." ACOE may issue an individual permit or a general permit based on level of impact to the aquatic resource. A **nationwide permit** is a type of general permit issued by ACOE that authorizes certain activities that will result in minimal impacts on waters of the United States. For example, implementation of restoration activities may be covered under **Nationwide Permit 27**, which includes activities associated with the enhancement of degraded wetlands and riparian areas on nonfederal public land. **Contact: Cameron Johnson, South Branch Chief, ACOE, at (415) 503-6773.**

U.S. Fish and Wildlife Service (USFWS): Issuance of a **CWA Permit** may require consultation with the appropriate resource agency, such as USFWS or NMFS, if implementation of the project would result in 'incidental take' of a federally 'listed' (protected) species. Take is defined under the federal Endangered Species Act as any activity that would harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species. **Contact: Diane Noda, USFWS, Ventura Fish and Wildlife Office, at (805) 644-1766.**

Federal agencies are responsible for upholding the **National Environmental Policy Act (NEPA):** NEPA requires that all branches of the federal government give proper consideration to the environment prior to undertaking any major *federal action* that significantly affects the environment. In order to reach an informed decision, NEPA requires a prescribed process, including public involvement, scientific analysis and potential mitigations. NEPA compliance is mandated when the Natural Resource Conservation Service (NRCS) provides financial assistance. As is the case with CEQA, the associated federal agency, in this case, NRCS, conducts the NEPA review on behalf of the project proponent.

12 PRACTICAL TIPS FOR GETTING YOUR PROJECT APPROVED

1. **Consult Early.** Consultation with permitting and regulatory agencies should begin as early as possible in planning your project. This way potential concerns can be addressed and potential problems identified.
2. **Carefully Select and Design Your Site.** Evaluate several alternative sites and designs before making your choice.
3. **Have Written Descriptions and Site Plans Available.** You may need to provide a written description as well as a map and site plan of your project at your first meeting with each agency.
4. **Learn the Rules.** Take time to study the protocols and regulations of those agencies that must approve your project. Study all applicable federal, state, and local agency permitting requirements.
5. **Know the Players.** Become familiar with the regulators and how they function.
6. **Approach the Process with a Positive, Non-Adversarial Attitude.** It is generally counterproductive to resist the permit process as you are going through it. Indeed the squeaky wheel gets the grease. But be polite.
7. **Reduce Adverse Environmental Impacts.** Design your project to eliminate or reduce as many potential environmental impacts as possible. Consider other environmentally-beneficial alternatives. Incorporate suggestions you learned during early consultation.
8. **Involve the Public.** Meet with members of your community to get their ideas and views of your proposed project. Avoid surprises.
9. **Pay Attention to Details.** Follow all the rules. Respond promptly to requests for information. Do not cut corners.
10. **Be Willing to Negotiate.** The permit process has been established because of the public concern for protecting the waterways, and this is the prime responsibility of the agency reviewer. The reviewers are sensitive to the concerns of individuals and property rights and are willing to consider alternative project designs to meet the needs of the property owner and still protect natural resources.
11. **When in Doubt, Ask.** If you are not sure whether your project needs a permit, ask. Going ahead without all proper permits or without following conditions of approval will very likely cost you time and money.
12. **Get Everything in Writing.** Request each agency you contact put everything in writing. This will help prevent any misunderstandings.

CARMEL RIVER WATERSHED STAKEHOLDERS

Below is a listing of the major local, state and federal and non-governmental organization (NGO-public and private) stakeholders for the Carmel River Watershed. Most of these stakeholders hold that position as a function of their job. The other major group of stakeholders is comprised of the people who live, work and play in the watershed.

State and District Elected Officials

Assemblyman William “Bill” Monning, CA Assembly

<http://asmdc.org/members/a27/>

Represents the 27th Assembly District (which includes portions of Monterey) in the CA State Assembly.

Congressman Samuel “Sam” Farr, US House Of Representatives

<http://www.farr.house.gov/>

Representative for California’s 17th congressional district (which includes Monterey County) in Congress.

Local Government

Carmel River Advisory Committee (CRAC), Local, Regional

<http://www.mpwmd.dst.ca.us/programs/river/crac/cracinfo.htm>

Committee of the Monterey Peninsula Water Management District. They provide recommendations to the District Board of Directors on the management of the Carmel River and its riparian corridor.

Carmel Valley Land Use Advisory Committee (CVLUAC), County

http://www.co.monterey.ca.us/planning/cca/luac/luac_agenda.htm

Within the Planning Department in the Monterey County Resource Management Agency. They provide comments and recommendations on land use planning projects to the authorities responsible for permitting and county zoning ordinances. They meet twice a month and provide a venue for interested parties to provide input on proposed projects.

Carmel Valley Roads Committee (CVRC), County

Required by the County in the 2010 Monterey County General Plan. The members of the Committee represent business, residential, environmental, and development interests. The Committee provides input on the prioritization of road improvements and any other reviews requested by the Board of Supervisors.

City of Pacific Grove City Council, Local-City

<http://www.ci.pg.ca.us/citycouncil/default.htm>

Legislative and policy-making branch of the municipal government. They establish policies and provide general direction for the City.

City of Carmel-by-the-sea City Council, Local-City

<http://ci.carmel.ca.us/carmel/index.cfm>

Legislative and policy-making branch of the municipal government. They establish policies and provide general direction for the City.

City of Monterey City Council, Local-City

<http://www.monterey.org/en-us/cityhall/citycouncil.aspx>

Legislative and policy-making branch of the municipal government. They establish policies and provide general direction for the City.

County Service Area 1 Advisory Committee (CSA 1), Local

Service Area that encompasses Carmel Point. Originally set up for street lightening and fire protection, currently being expanded to also provide flood protection.

County Service Area 50 Advisory Committee (CSA 50 Adv. Committee), Local

<http://www.co.monterey.ca.us/bcandc/csa50.htm>

Created in 1995, consists of seven CSA 50 representatives, appointed by the Board of Supervisors. They provide advice to the Board of Supervisors and the Public Works Department regarding flood control.

Monterey County Board of Supervisors Local-County

<http://www.co.monterey.ca.us/cob/supervisor.htm>

Supervise the operation of county government. Monterey County is subdivided into 5 districts and each district has a supervisor. Carmel and Monterey belong to District 5.

Monterey County Department of Public Works (MCDPW), Local-County

<http://www.co.monterey.ca.us/publicworks/>

Responsible for management, operation, and maintenance of public roads and bridges, County buildings and facilities, fleet, storm drains within the public right of way, sanitation district collection, treatment, and disposal facilities, County Service Area urban services, and closed County landfills.

Monterey County Parks Department, Local-County

<http://www.co.monterey.ca.us/parks/>

Management of eight County Parks throughout Monterey: Laguna Seca, Lake San Antonio North Shore and South Shore, Lake Nacimiento, San Lorenzo, Jacks Peak, Manzanita, and Royal Oaks.

Monterey County Resource Management Agency (MCRMA), Local-County

<http://www.co.monterey.ca.us/rma/>

Created in 2005 to help the County provide land use related services. They develop land use plans and regulate new developments by permitting and inspecting. They also plan, design, construct, operate and maintain roadways and manage water and sanitation systems in County Service Areas.

Monterey County Resource Management Agency Planning Department, Local-County

<http://www.co.monterey.ca.us/planning/>

Within the Resource Management Agency, the Planning Department processes planning permits and develops and administers land use policies.

Monterey County Water Resources Agency (MCWRA), Local-County

<http://www.mcwra.co.monterey.ca.us/>

Their mission is to “manage, protect, and enhance the quantity and quality of water” in Monterey County. They also provide flood control services. Prior to 1990, these functions were performed by the Monterey County Flood Control and Water Conservation District.

Monterey Peninsula Regional Park District (MPRPD), Local-Regional

<http://www.mprpd.org/>

Formed in 1972, they manage several parks and preserves. In the Carmel River Watershed, they manage Cachagua Community Park, de Dampierre Park, Garland Ranch Regional Park, Palo Corona Regional Park, Blomquist Open Space Preserve, and the San Clemente-Blue Rock Open Space.

Monterey Peninsula Water Management District (MPWMD), Local-Regional

<http://www.mpwmd.dst.ca.us/>

Created in 1977 to address the need for conservation and augmentation of water supplies on the Monterey Peninsula. Their functions include augmenting the water supply and promoting water conservation, and reclamation of storm and waste water. In the Carmel River watershed, MPWMD is involved in the management of environmental resources and services, such as vegetation and steelhead.

Monterey Regional Waste Management District (MRWMD), Local-Regional

<http://www.mrwmd.org/>

Manages the Monterey Peninsula area's solid waste through reduction, reuse, recycling, and safe disposal.

Monterey Regional Water Pollution Control Agency (MRWPCA) Local-Regional

<http://www.mrwPCA.org/>

Operates the regional wastewater treatment plant that serves most of the Monterey Peninsula along with the distribution system that provides treated water for irrigation on 12,000 acres of farmland

Resource Conservation District of Monterey County (RCDMC), Local-Regional

<http://www.rcdmonterey.org/>

Established in 1942, the RCD is a non-regulatory local agency, funded by grants and contracts. Their mission is to conserve and improve natural resources, integrating the demand for environmental quality and the needs of agricultural and urban users.

Santa Lucia Community Services District, Local-Regional

Special district within Monterey County, with a general manager as the head of the agency. They provide services to the Santa Lucia area, located around the Carmel River in the upper watershed.

Education

Carmel Unified School District (CUSD), Education/ Research

<http://www.carmelunified.org/carmelunified/site/default.asp>

Includes Captain Cooper Elementary, Carmel River Elementary, Tularcitos Elementary, Carmel Middle, Carmel High, Carmel Valley High, and Carmel Adult Schools. They implement education programs on conservation in the watershed for school children and their families.

Hastings Reserve (Hastings), Education/Research

<http://www.hastingsreserve.org/>

Biological Field Station of the University of California located in the Santa Lucia mountain range. They provide lands and facilities to conduct research of wildlife and ecosystems.

Hopkins Marine Station (Hopkins), Education/ Research

<http://hopkins.stanford.edu/>

Marine laboratory of Stanford University located in Pacific Grove. Founded in 1892, they conduct research and teach courses

Watershed Institute at CA State University Monterey Bay, Education/ Research

<http://watershed.csumb.edu/wi/>

Located in the CSUMB campus in Seaside. The Watershed Institute consists of researchers, educators, planners, students, and volunteers. They promote a systems approach to the management of watersheds.

State Government

California Coastal Commission (CCC)

<http://www.coastal.ca.gov/>

Within the Resources Agency. Plans, regulates, and issues permits for the use of land and water in the coastal zone.

California Department of Fish and Wildlife (CDFW)

<http://www.wildlife.ca.gov/>

Their mission is to manage California's fish, wildlife, and plant resources, for "their ecological values and for their use and enjoyment by the public".

California Department of Parks and Recreation (CADPR)

<http://www.parks.ca.gov/>

See California State Parks.

California Department of Transportation (CALTRANS)

<http://www.dot.ca.gov/>

Manages highway transportation, mass transportation, transportation planning, and aeronautics in the State of California.

California Department of Water Resources (DWR)

<http://www.water.ca.gov/>

They manage water resources in the State. They promote water conservation and have programs to preserve wildlife and the environment. They operate and maintain the California State Water Project (SWP) and monitor dam safety (the Division of Dam Safety operates within the DWR).

California Public Utilities Commission (CPUC)

<http://www.cpuc.ca.gov/puc/>

They regulate privately-owned utility companies, such as those that extract resources from the Carmel River.

California State Coastal Conservancy (SCC)

<http://scc.ca.gov/>

This is a conservancy within the CA Department of Resources. They work in partnership with local governments, public agencies, NGOs, and private landowners to manage coastal resources and access to the shore. They also work in habitat restoration and other projects serving the goals of California's Coastal Act.

California State Parks (CSP)

<http://www.parks.ca.gov/>

Manages more than 270 State Park units, among them, the Carmel River State Beach. Sometimes referred to as the California Department of Parks and Recreation.

California Wildlife Conservation Board (WCB)

<http://www.wcb.ca.gov/>

Within the CDFW, the WCB's three main functions are land acquisition, habitat restoration and development of wildlife oriented public access facilities.

Central Coast Regional Water Quality Control Board (CCRWQCB)

<http://www.swrcb.ca.gov/centralcoast/>

One of nine regional water quality boards in California. They set water quality standards, issue waste discharge requirements, and determine and enforce compliance of standards in the Central Coast.

Division of Ratepayer Advocates (DRA)

<http://www.dra.ca.gov/dra/>

Independent arm of the Public Utilities Commission. Their mission is to obtain the lowest possible rate for utility services consistent with reliable and safe levels.

Division of Safety of Dams (DOSD)

<http://www.water.ca.gov/damsafety/>

Created by State Legislature in 1929, they operate within the Department of Water Resources. Their mission is to protect people and property from dam failure.

State Water Resources Control Board (SWRCB)

<http://www.waterboards.ca.gov/>

Created by the Legislature in 1967, their mission is to "preserve, enhance and restore the quality of California's water resources, and ensure their proper allocation and efficient use". It consists of five full-time

salaried members, appointed by the Governor and confirmed by the Senate.

Federal Government

Monterey Bay National Marine Sanctuary (MBNMS)

<http://montereybay.noaa.gov>

Federally protected marine area. They engage in research, education, and outreach, and their official mission is to “understand and protect the coastal ecosystem and submerged cultural resources of central California”.

National Oceanic and Atmospheric Administration (NOAA)

<http://www.noaa.gov/>

Within the Department of Commerce, they have regulatory, operational, and information service responsibilities in every State. They provide services related to oceanic and atmospheric conditions, such as providing weather forecasts and guiding the use of ocean and coastal resources. Within NOAA, the National Marine Fisheries Service (NMFS) is tasked with the protection of endangered marine life, such as the steelhead.

Natural Resources Conservation Service (NRCS)

<http://www.nrcs.usda.gov/>

Originally established by Congress in 1935 within the U.S. Department of Agriculture as the Soil Conservation Service (SCS), NRCS has expanded to become a conservation leader for all natural resources, ensuring private lands are conserved, restored, and more resilient to environmental challenges. NRCS works with landowners through conservation planning and assistance designed to benefit the soil, water, air, plants, and animals that result in productive lands and healthy ecosystems.

US Army Corps of Engineers (USACE)

<http://www.usace.army.mil/Home.aspx>

They manage and operate several dams, inland navigation channels, and coastal and lake harbors throughout the country, and they work on wetland creation and restoration. They review and issue permits for projects conducted in wetlands.

US Fish and Wildlife Service (USFWS)

<http://www.fws.gov/>

Main government agency dedicated to the “conservation, protection, and enhancement of fish, wildlife and plants, and their habitats”. They implement and enforce environmental laws, such as the Endangered Species Act, the Migratory Bird Treaty Act, and the Marine Mammal Protection. The State of California belongs to the FWS Region 8.

US Forest Service (USFS)

<http://www.fs.fed.us/>

Within the U.S. Department of Agriculture, the service manages public lands in national forests and grasslands. It was established in 1905.

Non Governmental Organizations

Big Sur Land Trust (BSLT), local

<http://www.bigsurlandtrust.org>

Design, implement, and fund conservation projects in Big Sur and the Carmel River Watershed.

California Native Plant Society, Monterey Bay Charter (MBCNPS), local branch of state organization

<http://montereybay.cnps.org/>

Their mission is to “to conserve California native plants and their natural habitats, and increase

understanding, appreciation, and horticultural use of native plants.”

Carmel Point and Lagoon Preservation Association (CPLPA), local

Carmel River Steelhead Association (CRSA), local

<http://www.carmelriversteelheadassociation.org/>

Conservation group; all the members are volunteers with the primary goal of restoring the Carmel River watershed to a natural state to maintain an annual run of adult steelhead that exceeds 2000 individuals.

Carmel River Watershed Conservancy (CRWC), local

<http://carmelriverwatershed.org/>

Primary mission is to protect natural resources in the Carmel River Watershed in a way that incorporates the diverse needs of the community. CRWC provides tours of the watershed to stakeholders and partners.

Carmel Valley Association (CVA), local

<http://www.carmelvalleyassociation.org/>

They engage in preservation and protection activities in Carmel Valley through several committees, which include Land Use, Water and Environment, Roads and Traffic, and Community Outreach.

Coastal Watershed Council (CWC), Monterey Bay region

<http://www.coastal-watershed.org/>

Their mission is to “preserve and protect watersheds through community stewardship, education, and monitoring”

LandWatch Monterey County, county

<http://www.landwatch.org>

LandWatch engages in public outreach regarding the status of land use planning in Monterey County. They promote land use policies that protect the environment, and that maintain economic vitality.

MEarth, local

www.MEarthCarmel.org

MEarth (pronounced ME-Earth) is an environmental education nonprofit with roots in Carmel, that grows environmental leaders through education, collaboration, partnerships and community action.

Planning and Conservation League Foundation (PCLF), statewide non-governmental organization

<http://pclfoundation.org/index.html>

They engage in public policy research and community outreach. They have been involved with conducting public outreach regarding the Carmel River Reroute and the San Clemente Dam Removal Project in the Carmel Valley for the past several years.

Santa Lucia Conservancy (SLC), local

<http://www.slconservancy.org>

Permanently protects 18,000 acres of land located within the Santa Lucia Preserve through land management, conservation easement, ecological research, and environmental education programs

Trout Unlimited (TU), nationwide organization

<http://www.tu.org>

National organization with an interest in conservation and restoration of fisheries and watersheds.

Business

California American Water (Cal-Am), Private Company

<http://www.amwater.com/caaw/>

Main water supplier of potable water to the Monterey Peninsula. Between 70% and 80% of the water they extract and distribute comes from the Carmel River watershed.

GLOSSARY

The definitions in this glossary were originally developed by Salix Applied Earthcare based on other glossaries, including those by D.H. Gray and A.T. Leiser, 1982; CIRIA and the British Trust for Conservation Volunteers, 1990; *The Engineering Field Handbook*, USDA SCS, 1992; *Erosion and Sediment Processes, Prediction and Control*, Camp Dresser and McKee, Woodward-Clyde, 1998; *The Practical Streambank Bioengineering Guide*, USDA NRCS, 1998; and other sources.

Aggradation	To fill and raise the level of the bed of a stream by deposition of sediment.
Alluvial	Referring to deposits of silts, sands, gravels and similar detrital material which have been transported by running water.
Bank	The lateral boundary of a stream confining water flow; the bank on the left side of a channel looking downstream is called the left bank.
Bankfull discharge	The discharge corresponding to the stage at which the natural channel is full.
Bar	An elongated deposit of alluvium within a channel or across its mouth.
Base flow	The flow contribution to a creek by groundwater. During dry periods, base flow constitutes the majority of stream flow.
Bed load	Sediment that moves by rolling, sliding, or skipping along the bed and is essentially in contact with the stream bed.
Bench	A horizontal surface or step in a slope.
Bioengineering	The integration of living woody and herbaceous materials along with organic and inorganic materials to increase the strength and structure of soil.
Canopy	The overhead branches and leaves of vegetation.
Coir	A woven mat of coconut fibers, used for soil erosion control applications.
Community (Plant)	A particular assembling of plant species reflecting the prevailing environment, soil type and management.
Concentrated flow	Flowing water that has been accumulated into a single, narrow stream.
Cutting	A branch or stem pruned from a living plant.
Dead stout stake	A 2x4 timber that has been cut into a specific shape and length—usually cut diagonally.
Degradation	The process by which stream beds lower in elevation; the opposite of aggradation.
Deposition	The settlement of material out of water.
Ecotype	A naturally-occurring variant of a species that is adapted to a particular set of ecological or environmental conditions.
Ephemeral	Of brief duration, as in the flow of a stream in an arid region.

Erosion	Removal of surface soils and rocks by action of water, wind, frost, ice and extreme sun/heat; internal erosion leads to change of the earth structure and piping.
Erosion and accretion	Loss and gain of land, respectively, by the gradual action of a stream in shifting its channel by cutting one bank while it builds on the opposite bank; property is lost by erosion and gained by accretion.
Erosion control	Materials such as vegetation, straw, fiber, stabilizing emulsion, protective blankets, rocks, etc., placed to stabilize areas and reduce loss of soil due to the action of water or wind, and prevent water pollution.
Establishment period	1. The time between sowing of the seed and the stage at which the plant is no longer reliant on the nutrient supply in the seed; 2. The time between planting and the stage at which special care is not required to ensure survival.
Filter fabric	An engineering fabric placed between the backfill and supporting or underlying soil through which water will pass and soil particles are retained.
Fluvial geomorphology	The study of land forms created by and pertaining to the flow of water through the landscape.
Forbs	Broadleaved herbaceous plants such as wildflowers.
Geotextile	Synthetic or natural permeable fabric used in conjunction with soil and vegetation; principally for erosion control, filtration, separation, soil reinforcement and drainage.
Gradient (slope)	The rate of ascent or descent expressed as the percent or the ratio of the change in elevation relative to the horizontal distance travelled.
Gully	A steep-sided erosion feature formed by downslope water action; unstable and recently extended drainage channel that transmits ephemeral flow, has steep sides, a steep head scarp and width greater than 1 foot, depth greater than 2 feet; enlarges by bed scour, by head migration upslope and by side collapse.
Headcutting	The progressive scouring and degrading of a streambed or gully at a relatively rapid rate in the upstream direction, usually characterized by one or a series of vertical falls.
Herbaceous plants	Non-woody vegetation
Hydrograph	A graph showing stage (see definition), flow, velocity, or other property of water with respect to time.
Hydroseeding	The rapid application of seeds, filler, mulch, soil ameliorants and fertilizers in water suspension onto an area where, for reasons of access, speed of application or ground condition, conventional grass seeding techniques cannot be used.
Incised channel	A channel which has been cut relatively deeply into underlying formations by natural processes; characteristics include relatively straight alignment

	and high, steep banks such that overflow rarely occurs.
Infiltration	The passage of water through the soil surface into the ground.
Inoculation	Method of artificially infecting shrubs and trees or herbaceous legumes with, respectively, mycorrhizae or rhizobium bacteria that normally live in symbiosis with them.
Legumes	Herbs, shrubs, and trees of the pulse family, that serve as nitrogen gatherers because of a specific root-clad bacteria; good soil improvers; many form strong and deep-reaching roots and are good ground stabilizers; an important part of seed mixes.
Live branch cuttings	Living, freshly cut branches of woody shrub and tree species that propagate from cuttings embedded in the soil.
Live fascines	Bound, elongated sausage-like bundles of live cut branches that are placed in shallow trenches, partly covered with soil, and staked in place to arrest soil erosion and shallow mass wasting.
Live pole planting	Ground bioengineering technique comprised of the installation of long live stakes, rods or poles of 1-2.5 meter length (of cottonwood or willow or any plant that propagates from cuttings) at close spacing for slope stabilization purposes.
Live stake	Cuttings from living branches that are tamped or inserted into the earth; the stakes eventually root and leaf out.
Mass movement (or Mass wasting)	The movement of large, relatively intact masses of earth and/or rock along a well-defined shearing surface as a result of gravity and seepage.
Meander	In connection with streams, a winding channel usually in an erodible, alluvial valley; a reverse or S-shaped curve or series of curves formed by erosion of the concave bank, especially at the downstream end, characterized by curved flow and alternating shoals and bank erosions; meandering is a stage in the migratory movement of the channel, as a whole, down the valley.
Mulch	A natural or artificial layer of plant residue or other material that covers the land surface and conserves moisture, holds soil in place, aids in establishing vegetation, and reduces temperature fluctuations.
Nonpoint source pollution	Pollution that originates from many diffuse sources.
Ordinary high water mark	The line on the shore established by the fluctuation of water and physically indicated on the bank (1.5+ years return period)
Peak flow	Maximum momentary stage or discharge of a stream.
Perennial	Term for plants which grow and reproduce for many years, or for streams that flow year round.
Permeability	The property of soils or surfaces which permits the passage of any fluid; permeability depends on grain size, void ratio, shape and arrangement of pores.

Piping	Flow of water through subsurface conduits in the soil.
Reach	The length of a channel uniform with respect to discharge, depth, area, and slope; more generally, any defined length of a river or drainage course.
Revegetation	Planting of native plants to replace natural vegetation that has been damaged or removed. This work includes provisions for irrigation.
Revetment	Bank protection to prevent erosion.
Rhizobium	The nitrogen-fixing bacteria capable of living in symbiotic relationship with leguminous plants in nodules on the roots.
Rhizomes	Stem growth which creeps beneath the soil surface; rooting at nodes to form new individuals; found in many grasses.
Rill	Shallow downslope erosion feature normally less than 0.3m wide and 0.6m deep.
Riparian area	An ecosystem situated between aquatic and upland environments that is at least periodically influenced by flooding.
Riprap	A layer, facing, or protective mound of broken concrete, sacked concrete, rock, rubble, or stones randomly placed to prevent erosion, scour, or sloughing of a structure or embankment; also, stone used for this purpose.
Runoff	1) The surface waters that exceed the soil's infiltration rate and depression storage; 2) The portion of precipitation that appears as flow in streams; drainage or flood discharge which leaves an area as surface flow or as pipeline flow.
Sand	Granular soil coarser than silt and finer than gravel, ranging in diameter from 0.05 to 5mm.
Scour	The result of erosive action of running water, primarily in streams, excavating and carrying away material from the bed and banks; wearing away by abrasive action.
Sediment	Fragmentary material that originates from weathering of rocks and is transported by, suspended in, or deposited by water.
Seed bank	The store of dormant seed in the soil.
Seepage	Groundwater emerging from the face of a streambank or roadside cut; flow of water in the pores of soil under influence of gravity or capillary action.
Shallow mass movement	Near-surface sliding or movement of earth and/or rock masses usually along planar failure surfaces parallel to the slope face.
Sheet erosion	Erosion of thin layers of soil by sheets of flowing water.
Sheet flow	Any flow spread out and not confined; i.e. flow across a flat open field.
Shrub	Woody growth whose main and side shoots form multiple branches from the root crown or form below-ground side shoots on which several stems grow.

Silt	1) Waterborne sediment. Detritus carried in suspension or deposited by flowing water, ranging in diameter from 0.005 to 0.05 mm. The term is generally confined to fine earth, sand, or mud, but is sometimes both suspended and bedload. 2) Deposits of waterborne material, as in a reservoir, on a delta, or on floodplains.
Sinuosity	The degree to which a stream meanders, measured as the length of the thalweg (see definition below) relative to the length of the valley it passes through.
Slide	Gravitational movement of an unstable mass of earth from its natural position.
Slope	1) Gradient of a stream; 2) Inclination of the face of an embankment, expressed as the ratio of horizontal to vertical projection; or 3) The face of an inclined embankment or cut slope.
Soil bioengineering	Use of live and dead plant materials along with rock to repair slope failures and increase slope stability; plant cuttings serve as primary structural components, drains, and barriers to earth movement.
Species	Group of plants similar in all respects and able to interbreed.
Stage	The elevation of a water's surface above its minimum; also above or below an established "low water" plane; hence above or below any datum of reference; gage height.
Stem cutting	Cuttings made from shoots; according to the nature of the wood they can be divided into hardwood, semi-softwood, softwood, and herbaceous cuttings.
Stream	Water flowing in a channel or conduit, ranging in size from small creeks to large rivers.
Stream power	An expression used in predicting bed forms and hence bed load transport in alluvial channels. It is the product of the mean velocity, the specific weight of the water-sediment mixture, the normal depth of flow and the slope.
Substrate	1) The mineral and organic material that forms the bed of a stream; 2) The layer of earth or rock immediately below the soil surface.
Suspended load	Sediment that is supported by the upward components of turbulent currents in a stream and that stay in suspension for an appreciable amount of time.
Swale	A shallow, gentle depression in the earth's surface. This tends to collect runoff water to some extent and serve as a small drainage course, although not bearing stream channel characteristics of a defined bed, bank, and riparian vegetation.
Thalweg	A longitudinal line that follows the deepest part of the channel of a stream.
Transport	To carry solid material in a stream in solution, suspension, saltation, or entrainment.

Undermining	The removal of lateral support at the base of a slope by scour, piping, erosion, or excavation.
Watershed	An area of land that drains into a particular river, lake, or ocean, usually divided by topography.
Wattle	A sausage-like bundle of plant cuttings used to stabilize streambanks and other slopes.

REFERENCES

The following is a list of materials used to create this manual. Additional useful reference materials are also listed.

Big Sur Land Trust. Lower Carmel River and Lagoon Floodplain Restoration and Enhancement Project. Carmel, California. www.mpwmd.dst.ca.us/Mbay_IRWM/IRWM_library/LCR/LCRproject.pdf.

California American Water. 2012. Monterey's San Clemente Dam Removal Project [Internet]. [Cited 2012 March 05]. Available from: <http://www.amwater.com/caaw/customer-service/rates-information/monterey-san-clemente-dam-removal-project.html>.

California American Water. 2006. Monterey District Urban Water Management and Water Shortage Contingency Plan 2006-2010.

California American Water. 2011. Customer & Consumption by Political Jurisdiction, Monterey County District.

California Association of Resource Conservation Districts. 2009. *Guide to Watershed Project Permitting for the State of California*.

Carmel Lagoon Technical Advisory Committee. 2007. *Study plan for long term adaptive management of the Carmel River State Beach and Lagoon*. [Internet] [Cited on 2012 March 21]. Available from: http://www.mpwmd.dst.ca.us/Mbay_IRWM/IRWM_library/CarmelBay/LongTermStudyPlanFinal2007-04-17.pdf.

Carmel River Watershed Council. 2004. "Carmel River Watershed Action Plan". available online at http://www.mpwmd.dst.ca.us/Mbay_IRWM/IRWM_library/IRWM-library.htm.

De Santis A, Asner GP, Vaughan PJ, Knapp DE. 2010. "Mapping burn severity and burning efficiency in California using simulation models and Landsat imagery". *Remote Sensing of Environment* 114: 1535–1545.

Doubledee RA, Muller EB, Nisbet RM. 2003. "Bullfrogs, Disturbance Regimes, and the Persistence of California Red-Legged Frogs". *The Journal of Wildlife Management* 67 (2): 424-438.

Dunne, T., and L.B. Leopold. 1978. *Water in Environmental Planning*. W.H. Freenam Co., San Francisco.

Emery, Dara E. 1988. *Seed Propagation of Native California Plants*. Santa Barbara Botanic Garden.

"Endangered and threatened wildlife". Title 50 Code of Federal Regulations §17.11. [Internet]. [Cited 2012 March 25].

Faber, Phyllis M. and Robert F. Holland. 1988. *Common Riparian Plants of California*. Pickleweed Press.

FireScope Monterey. 2012. "Keeping Wild Fires in its Natural Place". [Internet] [Cited 2012 April 1]. Available from <http://firescape.ning.com/>.

Fishnet4C. "Fishnet 4C Roads Manual". Available online at <http://www.fishnet4c.org/roads-manual.html>.

Heady, H.F. and D.R. Child. 1994. *Rangeland Ecology & Management*. Westview Press, Inc.

Hickman, James C. 1993. *The Jepson Manual*. University of California Press.

Kondolf GM. 1982. "Recent channel instability and historic channel changes of the Carmel River,

- Monterey County, California". [master's thesis]. Santa Cruz: University of California Santa Cruz.
- McCullah, J.A. 2000. *BioDraw 1.0 CD-ROM*. Salix Applied Earthcare.
- McCullah, J.A. 1999. *Erosion Draw 3.0 CD-ROM*. Salix Applied Earthcare.
- McEwan D, Jackson TA. 1996. "Steelhead Restoration and Management Plan for California", Department of Fish and Game. <https://nrmsecure.dfg.ca.gov/filehandler.ashx?documentid=3490>.
- Monterey County Water Resources Agency. 2008. Monterey County floodplain management plan.
- Monterey County Water Resources Agency. 2009. [Internet] [Cited on 2012 March 21]. Available from: <http://www.mcwra.co.monterey.ca.us/Floodplain%20Management/Historical%20Flooding.htm>.
- Monterey Peninsula Water Management District. 2004. "Environmental and biological assessment of portions of the Carmel River Watershed". http://www.mpwmd.dst.ca.us/programs/river/watershed_assessment/watershed_assessment.htm.
- Monterey Peninsula Water Management District. 2008. "California American Water production by source for customers its main system, water years 1996-2007". Hearing before the State Water Resources Control Board. July 23-25, 2008.
- Monterey Peninsula Water Management District. 2012. "Carmel River Fisheries. Historical Los Padres Dam Adult Counts". [Internet] [cited 2012 March 28]. Available from: http://www.mpwmd.dst.ca.us/wrd/fisheries/lpcounts/lpcounts49_11.htm.
- Monterey Peninsula Water Management District. 2011. "Draft Water Production Summary for Water year 2010 October 2009 - September 30, 2010".
- Munz, Philip A. 1959. *A California Flora and Supplement*. University of California Press.
- NOAA Fisheries. Office of Protected Resources. [Internet]. [Cited 2012 March 25]. Available from: <http://www.nmfs.noaa.gov/pr/species/esa/>.
- Olmsted SC. 1921. *The San Clemente Dam. The Architect and Engineer* 67(2): 109.
- Queheillalt DM, Morrison ML. 2006. "Vertebrate use of a restored riparian site: A case study on the Central Coast of California". *The Journal of Wildlife Management* 70 (3): 859-866.
- Rathbun GB, Schneider J. 2001. "Translocation of California Red-Legged Frogs (*Rana aurora draytonii*)". *Wildlife Society Bulletin* 29 (4): 1300-1303.
- RCDs of Monterey, Santa Cruz and San Mateo Counties, *Central Coast Rural Roads Handbook*. 2013.
- Robins, P., R. Bresnick Holmes, and K. Laddish, ed. 2001. *Bring Farm Edges Back to Life!* 5th edition. Yolo County Resource Conservation District.
- Sawyer, John O. and John D. Stewart. 2001. *Trees and Shrubs of California*. University of California Press.
- Schiechtl, H.M. and R. Stern, 1997. *Water Bioengineering Techniques for Watercourse Bank and Shoreline Protection*. English Translation with additions. Blackwell Science, Ltd.
- Schmidt, Marjorie G. 1980. *Growing California Native Plants*. University of California Press.
- Smith DP, Newman WB, Watson FGR, Hameister J. 2004. Physical and hydrologic assessment of the Carmel River Watershed, California. The Watershed Institute, California State University Monterey bay, Publication No. WI – 2004 -05/2. http://www.mpwmd.dst.ca.us/Mbay_IRWM/IRWM_library/IRWM-library.htm.

State Coastal Conservancy. 2011. San Clemente Dam removal project: Implementation phase. Staff Recommendation. Project No. 07-004-03.

State of California, California Department of Fish and Game. 1998. *California Salmonid Stream Habitat Restoration Manual*. Third edition. <http://www.dfg.ca.gov/fish/resources/habitatmanual.asp>.

State of California State Water Resources Control Board. 1995. Order No. WR 95-10. Order on Four Complaints Filed Against the California-American Water Company.

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 1998. *The Practical Streambank Bioengineering Guide*.

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 1999. *Stream Corridor Restoration: Principles, Processes, and Practices*, Part 653. National Engineering Handbook (NEH).

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 1992. Soil Bioengineering for upland slope protection and erosion protection. *In National Engineering Handbook (NEH)*, Part 650, Chapter 18.

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). *Field Office Technical Guide* (Available at NRCS county field office locations).

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). *Field Office Technical Guide*. Range Planting Code 550.

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS) Grazing Lands Technology Institute. 1997. *National Range and Pasture Handbook*.

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 1985 *Fact Sheet 22. Reseeding Grasses and Clovers on Burned Areas*.

United States Department of Agriculture, Natural Resource Conservation Service (USDA-NRCS). 1985 *Fact Sheet 23. Broadcast Seeding Method for Burned Areas*.

United States Department of Interior--Bureau of Land Management (USDI-BLM). 1996. *Utilization Studies and Residual Measurements*. Interagency Technical Reference 1734-3.

Vallentine, John R. 1989. *Range Development and Improvements* 3rd edition. Academic Press.

Weaver, W.E. and D.K. Hagans. 1994. *Handbook for Forest and Ranch Roads*. Mendicino County Resource Conservation District.

Wrysinski, Jeanette. 2000. *Know Your Natives*. Yolo County Resource Conservation District.

Wrysinski, Jeanette. 1996. "Cover Crops for Agriculture and Wildlife." *Valley Habitats*, Number 15. Ducks Unlimited, Inc.

IMAGES AND SOURCES

Resource Conservation District Monterey County: cover, pages 10, 18, 27, 33, 42, 51, 59, 60, 61, 65, 73, 77, 83, 95

Yolo County Resource Conservation District: cover, pages 63, 69, 70, 71, 76, 91

Monterey Peninsula Water Management Agency: pages 5, 11, 42, 43, 79

Paul Robins (based on original art from multiple sources): pages 12, 13, 14, 20, 22, 24, 28, 30, 35, 51, 52, 54, 57, 63, 66, 68, 77, 78, 80, 84, 85, 86, 88, 90, 92, 94, 96

Resource Conservation District of Santa Cruz County: page 29

Natural Resources Conservation Service: page 45, 47, 49, 53, 76, 93

Davis Enterprise: page 23

Audubon California: page 42

Larry Ford: page 42, 55

Wikimedia commons: page 19, 21, 31

Canadian Forest Service: page 75, 76, 87, 89

Livestock and Land Program: page 41

Monterey County Herald: page 34

National Park Service, Forest & Rangelands: page 37, 39

Clackamas County Soil and Water Conservation District: page 81