Private Roads Maintenance Guide for Santa Cruz County

A Guide for maintaining your private road

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Statement of Purpose

This manual has been developed for educational purposes. The road drainage improvement practices included in this guide are to be used as general guidelines and are not to be used as professional engineered specifications. Prior to implementation of these practices please seek further technical assistance from a licensed professional engineer and/or certified professional in erosion and sediment control for engineered specifications of these road drainage improvement practices.

ACKNOWLEDGEMENTS

There were many contributors in the development of this guide. The Santa Cruz County Resource Conservation District has produced this road guide with California Coastal Salmon Recovery Program funds administered by the California Department of Fish and Game.

The Resource Conservation District would like to acknowledge the USDA Natural Resources Conservation Service for content and technical review of the road maintenance guide and for technical information provided. The USDA NRCS employees responsible for review were: Kelli Camara (Soil Conservationist), Rich Casale (District Conservationist), Craig Ficenic (Engineer), and Joshua Schwartz (Road Engineer). Several other resource professionals also reviewed this document for content and technical accuracy. These professionals include John Ricker (County of Santa Cruz Environmental Health), Kristen Schroeder (County of Santa Cruz Planning Department), John Cunliffe (Road Association member), Roberta Smith (local geologist), Steve Butler (local forester and Certified Professional in Erosion and Sediment Control), and Howard Liebenberg (Roads engineer and contractor). Invaluable ideas and discussions came as a result of these comments.

A summary book like this necessarily draws from a variety of sources for ideas and technical information. Ideas for some of the layout came from the *Santa Cruz County Stream Care Guide* produced by the Santa Cruz County Planning Department as well as from the *Handbook for Forest and Ranch Roads* produced by Pacific Watershed Associates. Special thanks are also extended to the Pacific Watershed Associates for permission to use graphics and ideas from their publication *Handbook for Forest and Ranch Roads*.

Note: Local, County and State regulations in California cover many of the same subjects presented in this guide. Regulations change quickly, as do the technical methods of roading and standards for environmental protection. Be sure to follow applicable regulations covering private land road maintenance and related activities for your area. We have provided general descriptions of the laws of many (but not all) regulatory agencies in Santa Cruz County, but these will change.

Introduction

Santa Cruz County has approximately 1600 miles of private roads. Unlike County maintained roads, private road care and upkeep is the responsibility of people owning property along these roads. To ensure that 1) all road users assume their fair share of this responsibility and 2) the overall approach to road maintenance is comprehensive (including both long and short-range plans), many people living on private roads are coordinating their efforts and forming road maintenance organizations. Included in this educational manual is information on how to form two types of road maintenance organizations: Road Associations and County Service Areas (CSAs). Road maintenance organizations can make the task of road maintenance much more manageable.

Road maintenance often requires professional technical assistance. This educational manual provides vital information on how to properly construct and maintain private roads in the form of user- friendly Best Management Practices (BMPs). Included in this manual is a contact list of certified professionals in erosion and sediment control. These people can be contacted for technical advice, and most often contacting the right professionals before going ahead with roadwork can save you time and money. Proper and timely surface maintenance, selectively performed, will help reduce the frequency and amount of roadway being disturbed and thus COST!

Properly maintained private roads are also essential to reducing runoff that can pollute our local streams. Erosion is a natural occurrence in most of our local watersheds in coastal Santa Cruz County. However, human-induced erosion can cause an unhealthy abundance of sediment in our local streams. Erosion due to improperly constructed and poorly maintained roads is very common. This excessive erosion can cause flooding and can be detrimental to the survival of our local fish populations.

When sediment enters streams excessively, both bank stability and the stream's ability to carry floodwaters are directly impaired. Excessive sediment can also adversely affect drinking water quality, supply and cost. Sediment in drinking-source water fills basins at the water treatment plant and fouls water pumps. In local streams excessive fine sediment, especially sand, is also a primary factor limiting the habitat for steelhead, coho salmon, and other aquatic species.

Excess sand degrades fish spawning and rearing habitat and reduces aquatic insect habitat, which diminishes food supplies for steelhead and coho salmon.

Both coho salmon and steelhead have experienced a significant decline in the past 40 to 50 years. Coho abundance, including hatchery stocks, has declined at least 70% since the 1960s and is currently 6 to 15% of their abundance during the 1940s (http: //endangered.fws.gov). Both coho salmon and steelhead are now listed as threatened under the Federal Endangered Species Act. Coho salmon are also listed as endangered under the California ESA. Endangered Species Act listings promote preservation and/or restoration of watershed health as the preferred means to assure survival of aquatic species.

Use of Best Management Practices (BMPs) to properly construct and maintain roads can protect and help restore salmonid habitat. Proper road maintenance also secures road safety and access, and home and property values, and protects scenic beauty. In addition, use of BMPs often costs less than repeated repair and maintenance of ineffective road drainage systems. BMPs include installation of properly sized (and located) culverts, energy dissipaters at culvert outfalls, cross-drains such as waterbars and rolling dips, and proper disposal of soils from construction and maintenance of road surfaces. The appropriate BMPs to implement on your specific private road are best identified by consulting with a professional certified in erosion and sediment control.

As a land manager or a homeowner with private road(s), this manual should prove to be very useful for you in maintaining your private road(s). Included within this manual are several user-friendly Best Management Practices (BMPs) for road maintenance, how to form two types of road maintenance organizations: Road Associations and County Service Areas (CSAs), and technical, regulatory and support contact lists.

This educational manual was originally created by the County of Santa Cruz Planning Department Environmental Division and has since been updated by the Santa Cruz County Resource Conservation District (SCCRCD) with the aid of our technical partner, the NRCS. The mission of the SCCRCD is to help people protect, conserve, and restore natural resources through information, education, and technical assistance programs. The District provides an active program for the conservation of soil, water, plant, and wildlife resources in Santa Cruz County.

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I. EROSION

SOIL EROSION AND ROADS - WHAT'S THE CONNECTION?

Paved and unpaved roads, driveways, trails, and footpaths can collect and channel surface runoff, resulting in erosion and possible slope instability. Erosion of unpaved roadways occurs when soil particles are loosened and carried away from the roadway base, ditch, or road bank by water, wind, traffic, or other transport means. Loosened soil particles may be carried from the roadbed into the roadway drainage system where they diminish the carrying capacity of roadside ditches, culverts and other road drainage facilities. This diminished carrying capacity can cause roadway flooding, which subsequently leads to more roadway erosion.

WHY SHOULD YOU CARE ABOUT THE RELATIONSHIP BETWEEN ROADS AND EROSION?

Incorrectly placed cross-drains can weaken slopes or create a threat to neighboring properties. If your road drainage is inadequate or improperly installed, you could be liable for damages.

Actions to minimize erosion:

The longer water travels, the faster it moves and the more erosive it becomes!!

Have runoff travel as short a distance as possible before safely crossing the road

Have runoff leave the road at a well protected, non-erodible point

Plant vegetation to improve infiltration and decrease runoff.

Plant herbaceous vegetation on roadsides and hillsides to protect your roads (Note: Use surfacing materials, such as screening or gravel, on road which are more traveled or vegetating is not an option)

Perform routine maintenance
Proper and timely surface maintenance, selectively performed, will help reduce the frequency and amount of roadway being disturbed-and thus COST!

Improper drainage can result in ponded water on your road surface, increasing the chance for potholes to develop and the cost to repair them. Proper, timely, and selective surface maintenance, including water disposal, can prevent and minimize erosion problems and thereby lengthen the life of your road.

Deterioration of a road surface can be caused by frequent and excessive disturbance of the roadway surface and ditches as well as failure to slope road surfaces for drainage. This can lead to other roadway problems, which may impair traffic flow and traffic safety.

FOUR MAJOR PHYSICAL FACTORS THAT INFLUENCE EROSION

Climate
The climatic parameters affecting erosion include the amount, intensity and frequency of rainfall, and the temperature. Although erosion is normally more severe on bare soils in areas having abundant rainfall than in areas having little rainfall, intensity and frequency of rainfall must be considered when comparing areas of similar precipitation. Both of these rainfall factors influence the amount of runoff that occurs. Runoff occurs when the intensity of rainfall exceeds the infiltration rate of the soil and the surface or depression storage. Frequency of rainfall influences the moisture content of the soil, which in turn has a major influence on the infiltration rate. The higher the moisture content, the lower the infiltration rate and the greater the potential for runoff.

Factors which increase erosion potential:

Exposed soils
High runoff velocities
Concentrated volumes of water
Inadequate maintenance
Sandy or silty soil types
Oversteepened cutbanks
Poor compaction
Steep road grades
Disturbances to unpaved road-way surfaces
Road surface drainage
Improper placement of road drainage measures
Undersized road drainage

Vegetation

Vegetation is one of the more important factors influencing soil erosion. In most instances, vegetation is the most desirable material for controlling soil erosion. It performs a number of important functions: shielding the soil from the impact of the raindrops; retarding surface flow of water thereby permitting greater infiltration; maintaining a pervious soil surface capable of absorbing water; and removing subsurface water between storm events by transpiration. On a graded slope, the condition of the installed vegetation will determine its effectiveness in reducing erosion. A cover of vegetation that is not properly established or maintained will not be fully effective in controlling erosion.

Soil

The types of soil at a site are another major factor affecting soil loss. Soil properties most closely associated with erodibility are texture, structure, and moisture content. Texture refers to the relative distribution of the various sized soil particles. A fine-textured soil having large amounts of clay is least susceptible to erosion from raindrop splash and runoff. Soil structure, on the other hand, refers to the arrangement of soil particles. It influences both the ability of the soil to absorb water and its physical resistance to erosion. Granular structured soils containing large amounts of fine sands and silts with little clay are usually more erodible than soils with a blocky or massive structure. Erodibility is also affected by moisture content because water will become runoff a lot easier if the moisture content is at capacity (or the soil profile is full).

Length And Steepness Of Slope

All other factors being equal, long slopes will collect more runoff than short slopes. The more water collected, the greater the concentration of water at the base of the slope and the greater the likelihood of erosion. To minimize this problem, long slopes can be constructed so they function as a series of short slopes by utilizing diversion structures such as benches, terraces, ditches, or dikes. Steepness of slope, surface roughness, vegetative cover and the amount and intensity of rainfall govern the velocity of the runoff flowing down the slope.

Winter Preparation Tips:

- Keep it covered. Plant grasses, groundcovers, and woody vegetation on all bare and disturbed soil, and especially on slopes and sandier soil types.
- Detain, Decrease, Dissipate or Divert your runoff. Use diversions with caution so as not to divert your problem as well!
- Work with the natural terrain. Whenever possible, do not concentrate runoff. Never underestimate the power of water.
- Plan secondary defenses. Primary erosion, sediment and runoff control structures may fail.
- Check roof drains, gutters and downspouts to be sure they are clear.
- Check drainage ditches and check them frequently during the rainy season.
- Work with your neighbors. Problems usually extend beyond property lines.
- Be sure that drain outlets are open and clear of debris and vegetation that could block them in a storm. If blocked, then have them cleared.
- Exercise precaution and learn to be prepared all year around!

II. DRAINAGE

INTRODUCTION

Road erosion and washouts are a problem for many residents of the central California coast. This is especially true for those living along unpaved roads in mountainous areas. Many conditions combine to cause soil instability, erosion, and drainage problems which can pollute streams with sediment, damage or destroy roads, and threaten other property as well.

It is important to design road drainage systems properly. Incorrectly placed cross-drains can weaken already unstable slopes and also create a threat to neighboring properties.
If your road drainage is inadequate or improperly installed, you could be sued by your neighbor for damages.
The key to proper road drainage is to divert runoff water from the road frequently before it causes erosion on the road itself or on the slope below.

Waterbars, Rolling Dips, and Channel Drains are described later in this booklet as three types of cross-drains (road surface drainage improvement methods) that can be very useful in controlling drainage on both paved and unpaved roads. They are inexpensive to install and can be used to correct existing drainage problems with a minimum of disturbance to the road.

If permanent cross-drains are desired, such as culverts or cement waterbars, they should not be installed unless the road surface is already stabilized. Otherwise they will interfere with any necessary regrading. Earthen waterbars can be used until a stabilized road surface is achieved.

On both outsloped and insloped roads, cross-drains help keep surface runoff from causing erosion, potholes and a slippery or muddy road surface. On roads which are neither outsloped nor insloped, cross-drains should be used regardless of the grade of the road. When the grade of your insloped road is steeper than 8 percent, cross-drains should be used (see Figure 1).

Installing cross-drains on insloped roads (see Figure 1) is more difficult since the road surface must be reshaped into a dip or swale around each cross-drain, to ensure the proper gradient for the cross-drain. However, if water drains into a stabilized inside ditch from an insloped road, no reshaping of the roadbed is necessary.

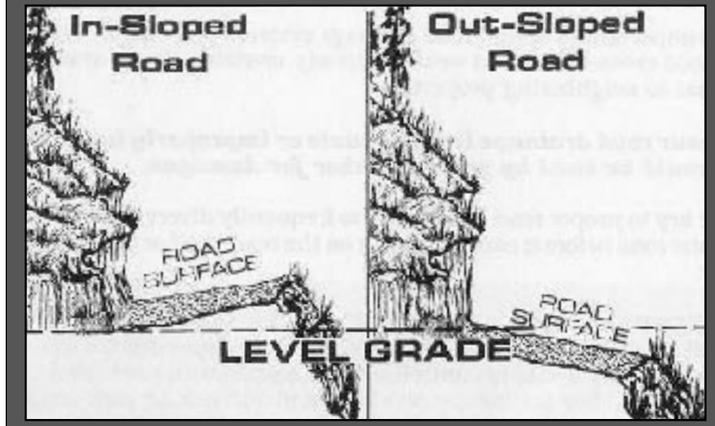


Figure 1.

Side view of in-sloped and out-sloped roads

CROSS-DRAINS

Water Bars

A waterbar, also known as a water break, consists of a shallow trench with a parallel berm or ridge on the downslope side and is angled down across roads. Waterbars can be constructed by hand, with a backhoe, or with a blade-equipped tractor. They are usually made of compacted soil, but can also be asphalt or cement for longer life. Asphalt or cement waterbars can be smaller in size and thereby provide greater ease of access.

These more permanent type waterbars should not be installed until the road surface is stabilized.

- Do not forget to install energy dissipaters at all waterbar outlets (see Figures 8 & 9).
- Waterbars should be installed at a 30 to 45 degree angle (see Figure 4).

Earthen waterbars are best used for low or seasonal access unpaved roads. For driveways or other roads used by passenger cars, a “drainage bump” can be constructed. This is similar to a

speed bump except they should be installed at a 30-45' angle like waterbars. A "drainage bump" can be made of soil, as shown on the following page.

Things To Remember About Waterbars

- The optimal size of an earthen waterbar is 12 inches above the road surface and 6 inches below the road surface. If it is smaller, it may be less effective in diverting water, will require increased maintenance and will probably break down faster. However, for well-traveled roads, smaller waterbars may be necessary.
- In order to prevent water from bypassing the waterbar, cut the trench 4 to 6 inches into the cutbank.
- Angle the drain no less than 30 degrees from a line drawn perpendicular to the direction of travel (see Figure 4).
- Keep the outlet clear of debris and sediment so that water drains freely onto an energy dissipater (see Figures 6, 8 & 9).
- Asphalt or cement "drainage bump"can be as low as 6 inches. They should be anchored into the roadbed at least 6 inches deep, as well as into the cutbank, to prevent water from by-passing this type of cross-drain.

Rolling Dips

Rolling dips are simply breaks in the grade of the road. They are flat-bottom swales constructed diagonally across a road that is subject to erosion. In other words, a rolling dip is a shallow, rounded dip in the road that reverses grade for a short distance, and directs runoff off the surface of the road. Rolling dips are installed in the roadbed as needed to drain the road surface and prevent surface erosion, and are most frequently used on insloped roads. If done correctly a rolling dip is hardly noticable to the eye. As a road becomes steeper, rolling dips should be made deeper and wider to capture and divert road runoff adequately. Rolling dips are much easier to traverse and require less maintenance than waterbars.

Limitations

- Never outlet rolling dips onto unprotected fill slopes. Install energy dissipaters or oversize drains at outlet ends.
- Use gravel to stabilize the diversion where significant vehicular traffic is anticipated.
- Rolling dips should not be constructed in areas of high-speed vehicle travel.

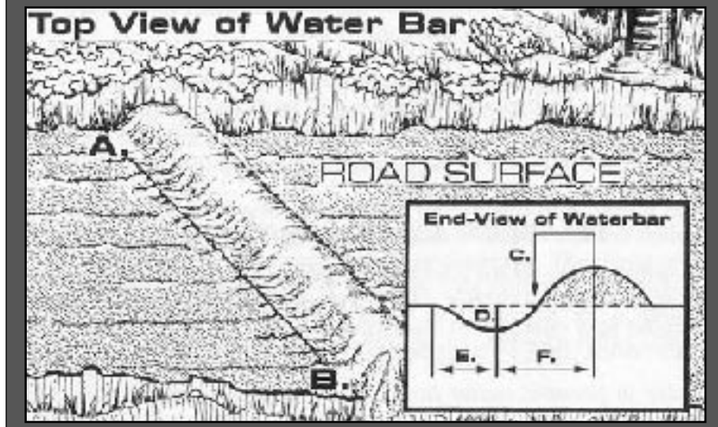


Figure 2.

Details of Earthen Waterbars

A. Cut-Bank tie-in point
B. Cross-drain outlet
C. 12 inches high
D. 6 inches deep
E. 3 to 4 feet wide
F. 5 feet wide

Figure 3.

Side view of a "Drainage Bump"

Construction Guidelines

- Rolling dips should be built at an angle of 45 to 60 degrees from the centerline.
- The diversion should have a positive grade of 2% minimum.
- For rolling dips the height of the channel bottom to the top of the settled ridge shall be 18 inches and the side slopes of the ridge shall be 2:1 or flatter where practicable.
- The distance it takes for the unrocked, unprotected running surface of a nearby road to develop a 1-inch rill is a rough measure of the appropriate spacing distance.
- Signs alerting motorists to the dip or waterbars shall be installed in both directions.

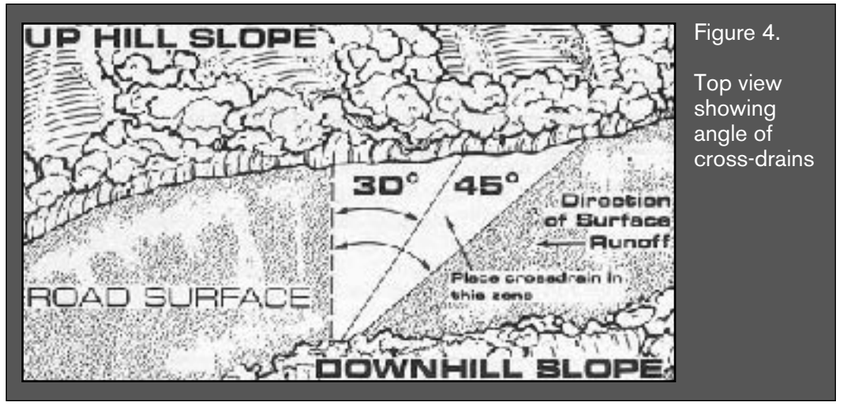


Figure 4.

Top view showing angle of cross-drains

Maintenance

- Periodically inspect rolling dips. Inspect after every heavy rainfall for erosion damage. Immediately remove sediment from the flow area.
- Check outlet areas and make timely repairs as needed.

ADDITIONAL RESOURCES

Handbook for Forest and Ranch Roads, Mendocino County Resource Conservation District, June 1994.

Channel Drains

To minimize disturbance to vehicles, a channel drain may be installed. Channel drains are the most desirable cross-drainage structures. They can last several years on most low volume roads provided they are adequately installed, maintained, and built of durable materials.

Channel drains (see Figure 5) can be constructed of logs or treated lumber. The trough of the drain should be four inches wide and six inches deep to ensure adequate drainage. The slope of the drain should be no less than 1/2 inch per foot of length, to prevent clogging from sediment and debris. As an example, for a 16-foot-long channel drain, the outlet should be 8 inches lower than where the drain ties in with the cutbank (see Figure 6).

In areas where twig and leaf accumulation is high, channel drains may fill with debris quickly. Under these conditions, it may be better to install a culvert or use a “drainage bump”.

The diagram below shows a channel drain constructed out of treated rough-sawn planks.

Consider The Following Points When Designing Channel Drains:

Channel drain spreaders should be spaced about every 3 to 4 feet to keep culvert sides from collapsing. Spreaders can be made of wood or metal pipe and should also be placed at both ends of the drain.

As with the waterbar, remember to connect the end of the channel drain into the cutbank by extending the downhill plank 4 to 6 inches into the bank.

Channel drains should be placed at a 30 to 45 degree angle from an imaginary line drawn perpendicular to the direction of travel (see Figures 4 & 6).

INSTALL ADDITIONAL CROSS-DRAINS ACCORDING TO THE FOLLOWING DO’s AND DON’TS:

DON’T allow high volume drainage on to fill slopes.

DON’T allow concentrated drainage onto landslide deposits, potential slide areas, very steep slopes or otherwise unstable material. (Unstable areas can be recognized by tilting trees and by both benches and bowl-shaped depressions on otherwise uniformly sloping hillsides. Natural ponds, seep areas, and hummocky topography can also point to unstable ground.)

DON’T allow drainage into active gullies or eroding areas.

DON’T allow drainage onto septic leach fields.

DON’T allow concentrated drainage directly into a stream or other water supply.

DO disperse drainage as much as possible.

DO place cross-drains above grade changes.

DO place cross-drains above curves in road to prevent bank-cutting.

DO place cross-drains above level areas to prevent water from puddling on the road surface.

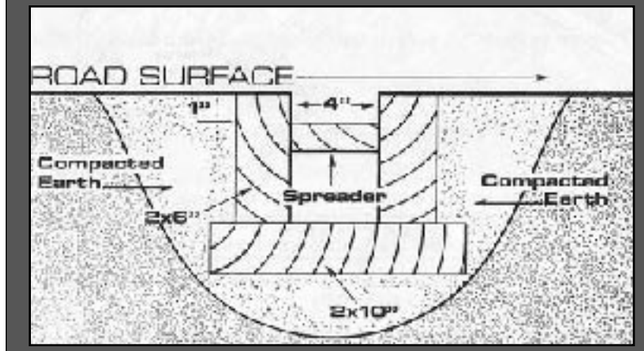


Figure 5.

Detailed end view of channel drain

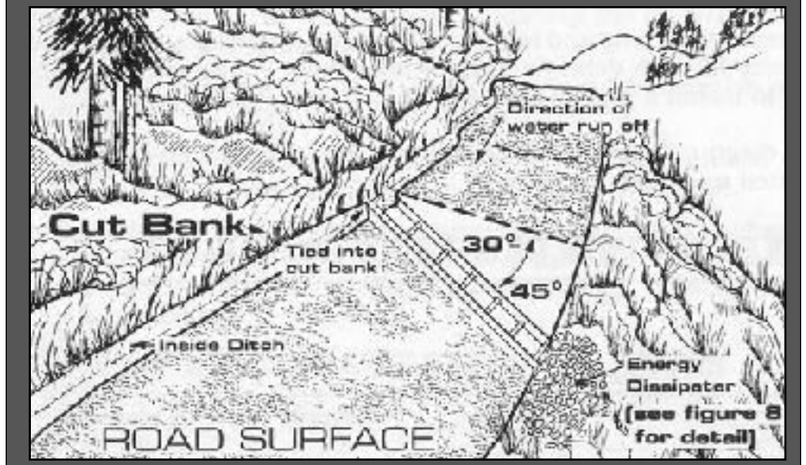


Figure 6.

Placement of channel drain

Cross-Drain Spacing

The following is a general guide for drainage spacing based on the road grade.

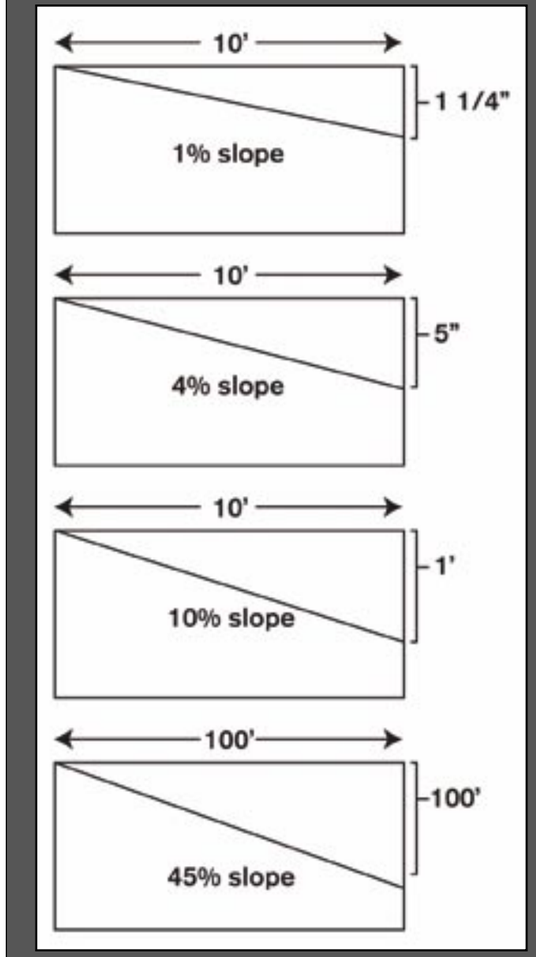
Cross-drain spacing for unpaved roads in the central california coast

Slope of Road	Cross drain spacing
5%	150 feet
10%	100 feet
15%	75 feet
25%	45 feet
30%	35 feet

Another way to determine proper spacing is to look at the surface of the unpaved road and note the distance it takes runoff water to cut a one-inch deep groove on the road surface. This is a rough measure for cross-drain spacing.

Follow these guidelines carefully, since the concentration of water on an unstable area can cause additional drainage problems and increase landslide hazard. Downdrains (pipe extensions or redwood flumes) can sometimes be used to carry water across unstable areas and excessively steep slopes to safer release points.

Defining Slope



If you are unable to install cross-drains in the proper locations and with adequate spacing, install inside ditches (on insloping roads) and pipe culverts at longer intervals. Consult with a private engineer experienced with road drainage for more advice. An engineer can also help you with the design of energy dissipaters, which should be used below the outlet of all culverts, waterbars, and downdrains.

PROPER ROAD CULVERT USE

A ditch relief culvert is used to convey water (often storm water runoff) from one side of the road to the other. Culverts can be made out of corrugated metal pipe, corrugated plastic pipe, rigid plastic pipe, concrete pipe, or other suitable materials.

Design Considerations

Engineering

Culverts for road drainage should be part of an overall road runoff management system that considers type of road surface, road cross-slope, road gradient, roadside ditch design, size of drainage area, and protection of cut/fill slopes. Culverts for stream crossings should be designed by a registered engineer and approved by state and local officials. They should be designed with consideration of stream alignment, anticipated flood flows, stability of the existing channel location, and the need for fish passage. This type of installation will require a Department of Fish and Game Streambed Alteration Agreement and review of the work plan by County Planning.

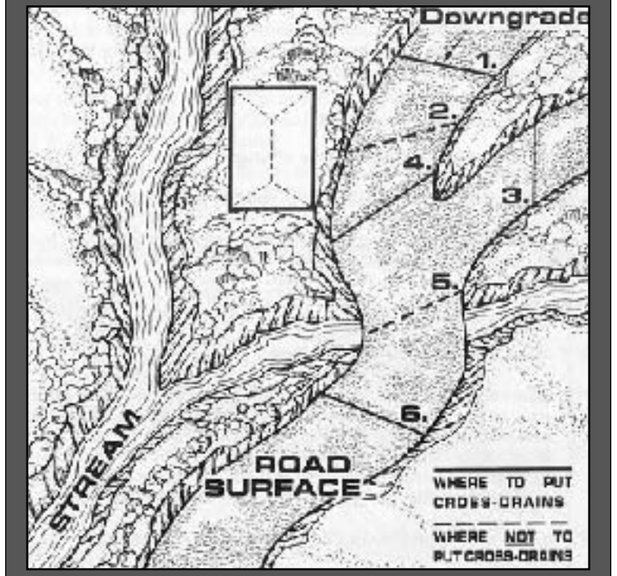


Figure 7.

Top view showing placement of cross-drains

Where to putt cross-drains:
1 - above curves
3,4 - above junctions
6 - at recommended spacing

Where not to put cross-drains:
2 - pointed towards buildings
5 - directly into streams at crossings

Culvert Capacity

The capacity of a road drainage culvert should be designed for at least the peak runoff from a 10-year, 24-hour storm. Stream crossing culverts should have an opening at least equal to the cross-sectional area of the entering stream during flood periods. The factors involved in culvert sizing include fish passage, intensity, duration, and frequency of maximum rainfall, area and shape of the watershed drained by the watercourse, soil, and vegetative cover. Engineers have formulas, special tables, and other devices to compute the needed sizes.

To reduce clogging in road drainage culverts, the minimum diameter should be 18 inches. As a rule-of-thumb, an 18-inch culvert in the Santa Cruz Mountains will adequately handle runoff from a six-acre watershed if property installed and maintained.

Alignment and Elevation

Where streams or natural drainage ways cross the roadway, culverts should have the same alignment as the drainage channel and should be placed on the normal stream grade. All stream-crossing culverts should be approved beforehand by the California Department of Fish and Game. Culverts that drain a roadside ditch should be skewed downslope at a 30 to 45 degree angle from a line drawn perpendicular to the direction of travel. Culvert inlets should be slightly higher than the ditch bottom. The culvert grade should be at least one or two percent more than the ditch grade. A slope of at least five to ten percent is recommended to prevent clogging.

Location and Spacing

Culverts should be installed at each stream or drainageway crossing unless a bridge or ford is used. The location and spacing of culverts that drain roadside ditches is a site-specific determination to be made by an engineer or erosion control specialist. Spacing is based on the amount of runoff, the terrain, the size and erodibility of roadside ditches, and capacity of

COMMON MISTAKES MADE WHEN USING CULVERTS FOR ROAD DRAINAGE

1. Not keeping culverts open during a heavy rain (plugging often occurs when culverts are too small to pass normal storm debris)
2. Using too few culverts or culverts that are too small to accommodate runoff from a heavy rain
3. Placing culverts too low or on too slight a gradient so that sediment accumulates inside and reduces the water capacity
4. Allowing water from culvert outlets to spill directly onto erodible soil
5. Not compacting the soil around the pipe, thus allowing water to flow through the road fill materials

culverts being used, and the configuration of the road. An overriding rule is that culverts should not be placed in locations where they will cause flooding or erosion damage to downhill property owners.

Installation

Culverts should be seated on two to four inches of compacted clean fill bedding in a trench that is twice the diameter of the pipe. It should be surrounded with compacted or clean fill to a depth of at least one-half the pipe diameter. Fill depth (cover) above the top of the culvert should be at least equal to the thickness of one-half the diameter of the pipe, but never less than one foot. The depth of cover depends on the type of culvert, its size, and the traffic load anticipated. The pipe manufacturer often determines cover requirements. In case of culvert clogging or other failure, a "secondary defense" location should be designed along with installation to handle anticipated flows.

Entrances

If erosion at the culvert entrance is a problem, a watertight headwall must be provided. Concrete, "sakcrete", or pre-fabricated fittings are suitable. Design by a registered engineer is helpful. Properly designed headwalls can increase the capacity of existing culverts during periods of heavy flows.

Debris control measures may be necessary. Sediment boxes (drop inlets) may be used at culvert entrances to catch sediment and prevent erosion. The pipe entrance should be flush with the box wall and the connection between the two should be watertight. Where sediment storage is desired, the depth of box below the pipe may be increased (see Figure 7b).

Outlets

Culvert outlets should extend at least two feet beyond the road edge, and should spill onto an apron, stilling basin, rock riprap blanket or other type of energy dissipater that will slow water velocity.

On steep slopes, outlets should release water directly onto paved channels, pipe drops, or wood/metal chutes that carry water to the toe of the slope, insofar as possible, (some slopes are very long) and release it onto an energy or velocity dissipater. "T-fittings" are not recommended at pipe ends because of their tendency to clog.

Debris Control

An engineer or erosion control specialist shall determine the need for a trash barrier at the entrance of all channel culverts. Trash barriers should be designed to catch only large debris that could plug the culvert. They should be designed so that ponded water behind a blocked debris barrier will still flow into the culvert entrance. An improperly designed debris barrier is worse than none at all. A simpler way to prevent clogging is to remove all floatable debris (leaf litter, small sticks snd branches) from in or near the channel for a distance of 100 feet upslope.

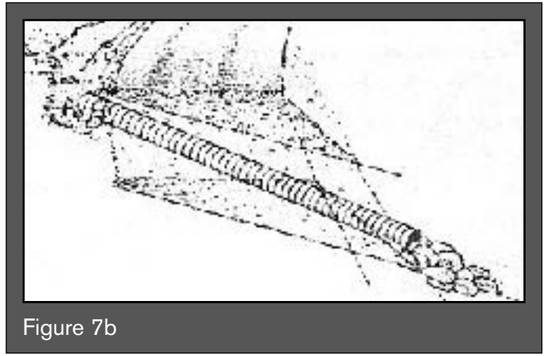


Figure 7b

Maintenance

Culverts should be inspected during and after each major storm. Entrances should be inspected for damage or clogging. Outlets and associated structures should be inspected for instability, undermining, gullying, or other erosion. Upstream channels should be cleared of debris.

Considerations of Structural Drainage Control Measures

- They have a design capacity for a specific storm/runoff event.
- Constant maintenance is required.
- They need to be designed to fail, requiring a back-up measure to safely convey runoff.
- They have a life expectancy and are subject to damage.
- If not installed properly or maintained, they can provide a false sense of security.
- They are expensive.
- They usually require a specific design by an appropriate professional.
- Some may also require a permit.

ENERGY DISSIPATERS

An energy dissipater is a structure at the outlet of a cross-drain which reduces the velocity of water after it leaves the drain (see Figures 8 & 9). This is very important for protecting the slope below the road from erosion. An energy dissipater should be a part of most cross-drains.

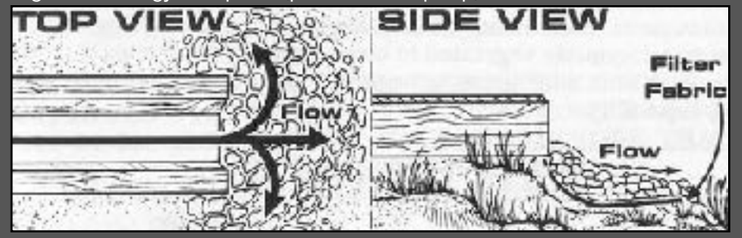
Rock “rip-rap” is usually the most effective energy dissipater for cross-drain outlets. Rock should be heavy and large enough (six inch minimum diameter) to stay in place. Rock should be carefully laid by hand, forming an evenly lined depression or basin to slow the water down with no spaces left between rocks. If rock is haphazardly piled below the drain outlet, it could cause greater erosion damage or undercutting of the cross-drain. A piece of filter fabric placed between the ground and the rock will increase the stability of an energy dissipater.

FILTER STRIPS

In addition to controlling erosion on slopes below the road, it is important to avoid polluting streams with sediment produced from soil erosion upslope. A filter strip is a vegetated area below the road, which can catch sediment before it reaches a stream.

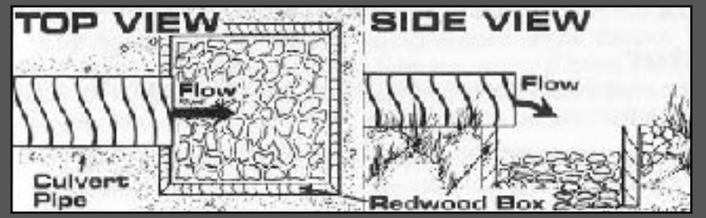
Design a drainage system so that each cross-drain releases onto an energy dissipater. Each energy dissipater in turn should release onto a filter strip adequately vegetated to trap sediment. If necessary, seed the filter strip area with grass to improve its stability and sediment trapping capability.

Figure 8. Energy dissipater (placed rock rip-rap)



If the rock is not heavy enough, water flow can dislodge it and decrease the effectiveness of the energy dissipater. If necessary, cement grouting, a redwood box, or a section of large culvert pipe can be used to hold rock in place.

Figure 9. Energy dissipater (rock filled container)



In some cases, energy dissipaters can be made of materials on hand, such as logs and stumps. Shrub thickets of other dense vegetiation can sometimes take the place of a constructed energy dissipater. Local offices of the U.S.D.A. natural resources conservation service and the resource conservation districts can advise whether or not this is feasible, and can help with the selection of an approproate energy dissaptere if necessary

MAINTENANCE

Regular maintenance is vital for all the cross-drain structures discussed in this guide. If there is little time to maintain these structures properly more permanent measures, such as paving or base- rocking and installing underground road culverts, should be considered. To be effective, a maintenance program must consist of two steps: MONITOR the road regularly and MAINTAIN it when necessary.

ROCK “RIP - RAP”
Ensure that riprap consists of a well-graded mixture of stone. Larger stone should predominate, with sufficient smaller sizes to fill the voids between the stones. Select stone for riprap from fieldstone or quarry stone. The stone should be hard, angular, and highly weather-resistant.

MONITORING OF THE ROAD MUST BE ONGOING. Water flow patterns can change from year to year and from storm to storm. Some factors that contribute to cross-drain failures are:

- Poor alignment or placement
- Too small to carry flow
- Not spaced correctly
- Not enough slope from cutbank tie-in point to outlet
- Lack of maintenance

Monitor

Walk the road and inspect cross-drainage frequently, especially during wet weather. A simple way to measure the effectiveness of a drainage system is to take the 3-D test below.

1. Is the DISTANCE between cross-drains proper for adequate road drainage?

2. As the water is discharged, is its energy DISSIPATED onto a non-erosive material?

3. Does the system actually intercept road runoff and DISCHARGE it from the road?

Maintain

The importance of regular maintenance work cannot be overemphasized. Most maintenance jobs are minor if dealt with immediately. Delaying necessary work can result in washed out roads and gullying, and stream pollution.

Maintenance Activities Include:

- Keeping culverts and waterbar trenches clear of sediment and debris. Make sure inlets and outlets are clear so water can flow freely

- Rebuilding earthen waterbars whenever vehicle traffic breaks them down

- Keeping inside road ditches clear of debris so they drain into cross-drains and do not overflow onto the road

- Making sure energy dissipater rocks remain in place, especially after heavy rains

- Protecting any bare or disturbed areas with erosion control grass or a groundcover

For more information consult the USDA Natural Resources Conservation Service at (831) 475-1967

Warning signs of poor drainage control:

- Puddles and potholes on the road surface
- Roadside erosion (on cut and fill banks)
- Eroding roadside ditches
- Gullies and deep wheel ruts in the road
- Accumulation of sediment or debris in cross-drains and ditches
- Overflowing drainage control structures, including waterbars, channel drains, ditches and culverts

III.ROAD CONSTRUCTION

ROAD CONSTRUCTION BEST MANAGEMENT PRACTICES

The construction phase of a road project is when planning and design decisions are carried out on the ground. To achieve a successful road standard, and to result in minimal impact to the environment, each phase of road construction should be carried out according to the formulated plans. Poor execution of plans, no matter how well designed, can result in a poorly constructed road that causes serious impact to the watershed and environment.

Plans and designs may need to be modified during construction as changing conditions are encountered in the field. Minor changes in the proposed work can be accomplished in the field by experienced supervisors and equipment operators. However, only qualified personnel should make substantial changes in road alignment or in road and drainage design.

Timing

Roads should be constructed during the time of year when the best results can be achieved with the least damage to the environment.

DO perform clearing (cutting and removal of trees and brush from the right-of-way) anytime weather permits ground crews to cut the vegetation and equipment to pile or yard it to a storage site.

DO perform grading (the excavation and creation of the road bench) only during spring, summer or early fall conditions due to the large expanses of bare soil created in the process. Note: grading may require a County grading permit. See info on County grading ordinance on page 62 for details.

DO consult an engineer or geologist if problems occur with soil moisture. Local problem areas are likely to be encountered that will need to be treated by drying or watering and an engineer or geologist can recognize soil moisture conditions by using simple field tests.

DO perform any stream crossing installation work with a Department of Fish and Game permit as quickly as possible during the dry period of summer, when streamflows are at a minimum (or the channel has dried up) and there will be minimal soil disturbance and risk of sedimentation. The timing is critical to maintaining and protecting water quality.

Precautions: Do not perform any road construction activities, including installation of stream crossings and erosion control work, after the onset of the rainy period in mid to late October. Also cutting vegetation before equipment is on-hand to remove the material is worth avoiding. Yarding (piled cut vegetation) results in soil disturbance and should be limited to reasonably dry soil conditions when rainstorms are unlikely. Using fine textured soils for compaction in overly dry or very wet conditions could be harmful because in these conditions soils often cannot be compacted enough to produce the soil strength needed to support loaded trucks or to remain stable on steep slopes.

Clearing and Grubbing

DO mark the road centerline, or cut and fill staking, on the ground prior to clearing. Also

DO flag or stake the upslope and downslope boundaries of the right-of-way to mark the limits of vegetation removal for work crews and equipment operators who will be performing any clearing. This will help prevent over-clearing.

DO keep the right-of-way width to a minimum for the planned use of the road.

DO keep stumps and other vegetative debris out of the road fill

DO disturb substantially the organic layer on the soil surface for slopes over 35 percent in gradient, remove prior to fill placement or side casting.

Grading and Compaction

Grading is when the bulk of soil excavation and disturbance occurs.

DO allow a row of slash and organic debris along the base of the side cast slope. This can help catch and filter soil eroded from the loose slope.

DO keep side casting and fill material on slopes to a minimum. Over-steepening and overloading of slopes can occur and are the single largest cause of road-related landslides.

DO use road-benching techniques on moderate and steep slopes to improve the road's stability. These techniques each utilize construction methods that can lend added stability to the road prism, compared to side casting.

DO apply coarse rock surfacing on roads experiencing wet surface conditions. From 1 to 3 inches of clean, graded rock may be needed to provide a stable, wet weather surface.

DO consult an experienced road engineer when dealing with problems of subsurface drainage. Geo-textiles are commonly used to deal with sub drainage.

DO avoid side casting on steep slopes in headwater swales, where hill slopes converge into a narrow, steep channel. These locations are prime sites for generating debris slides, which can move thousands of feet downslope, scouring steep channels and depositing large amounts of sediment and debris that severely impact fish-bearing streams and domestic water supplies. Identification of debris flow hazard can best be made by a trained geologist or engineering geologist.

DO reduce total road length, especially roads built across steep slopes, to reduce overall risk of slope failure.

Precautions: Do not cast soil onto steep or moderate slopes or where material can be eroded and delivered to a stream. In efforts to avoid increasing landslide risk, leave the toe of a steep or potentially unstable slope in place. Stay away from altering hillslope drainage by blocking or redirecting surface or subsurface water movement onto fill-slopes or unstable soils. Also pass up constructing near unstable areas and landslides if possible. If road construction must occur on unstable slopes, it is highly recommended that an engineering geologist or geotechnical engineer be consulted to develop plans and construction methods for the specific road segment. Side casting on steep slopes over about 60% should be avoided.

Constructing Stream Crossings

*Consult Department of Fish and Game for permitting

Regardless of the construction method chosen, side casting on stream crossing approaches should be avoided!

Precautions: Never use "Humboldt" log crossings and un-culverted fills for permanent stream crossings, even though they were commonly used in past decades. Common types of permanent stream crossings include bridges, culverted fills and fords.

DO use full bench construction methods where roads are to cross stream canyons or incised channels with steep side slopes.

DO identify potentially unstable soils and slopes near a crossing site before the equipment cuts into the slope, so approaches can be designed to avoid, or drain and stabilize, the unstable area.

Bridge Installation

DO use bridges for stream crossings in all possible situations. Bridge installation causes less disturbance and there is less chance they will fail during floods.

Precautions: Keep away from dragging through the streambed stringers and structural supports to be used for the bridge. A crane, excavator, or an excavator and a winch-tractor can be used to move a portable bridge into place, with one piece of equipment on each side.

DO install a low impact equipment ford if needed to prepare both abutments and approaches for placement of the bridge. A prior consultation with Department of Fish and Game is recommended.

DO remember that each bridge abutment should be leveled and secured far enough into the bank so that slumping or bank failure will not occur.

DO make sure the grade of the bridge is the same as the grade of the approaching road.

Culvert Installation

During road building, the construction of culverted stream crossings has the greatest potential of all activities to cause immediate sediment pollution. Note: permits may be required for general culvert installation from local,

state and federal agencies. See page62 for info on local ordinances and permits.

DO place stream-crossing culverts at the base of the fill, and at the grade of the original streambed.

DO use filter fabric if gravel is used for the bed of the culvert. This will minimize the potential for soil piping.

DO place fill over the top of the culvert to a depth of at least 1 foot, for 18"to 36"culverts. If adequate cover cannot be achieved, then a pipe-arch or two smaller culverts should be installed.

Precautions: Rule out installing any culvert without some type of energy dissipation at the outfall. Although, large rocks are encouraged at the outfall, steer clear of leaving large rocks and woody debris in the path of the culvert. Both the culvert foundation and the trench walls must be free of logs, stumps, limbs or rocks that could damage the pipe, or subsequently cause seepage of flow around the outside of the culvert.

DO outslope the approaching road or place a rolling dip up the road from the crossing to minimize road runoff directly entering the crossing.

DO install ditch relief culverts at a 30-degree angle to the ditch to lessen the chance for inlet erosion and plugging.

Rolling Dips

DO install rolling dips at the road edge to drain and disperse road surface runoff and prevent rilling and surface erosion.

Precautions: Avoid constructing rolling dips that are too deep to collect enough runoff to develop significant erosion. The length and depth of the rolling dip should be adequate to divert road runoff but not so great as to interrupt or endanger traffic at normal speeds.

Subgrade and Surfacing

A stable and well-drained subgrade is essential for a good road.

DO surface permanent roads that are to be used for winter and wet weather hauling, including roads used for commercial hauling of forest

SOIL CHARACTERISTICS FOR ROAD SUBGRADE MATERIALS

MATERIAL TYPE	STRENGTH, COMPACTION & FOUNDATION STABILITY	DRAINAGE	REACTION TO FROST
Clean gravels and clean sand (3)	Good to excellent	Excellent	None to slight
Gravels and sands with non-plastic (4) fines	Good to excellent	Fair to poor	Slight to high
Gravels and sands with plastic (4) fines	Fair to good	Poor to impervious	Slight to high
Non-plastic and slightly plastic (4) silts and clays	Poor to fair	Fair to impervious (mostly poor)	Medium to high
Medium and highly plastic (4) silts and clays	Very poor to poor	Fair to impervious (mostly poor)	Medium to very high
Peat and other highly organic soils	Very unstable, poor compaction	Fair to poor	Slight

products to improve traffic ability and reduce erosion. See chart above for details.

Erosion Control During Construction

DO keep soil disturbance to an absolute minimum during construction to prevent erosion.

DO integrate cuts and fill slopes at stable angles to prevent mass failure. Slopes which develop instability, especially those which threaten to

Precautions: Make sure to not leave slopes bare after construction operations. Protect these slopes until vegetation can stabilize the surface. Mulching, seeding, planting, compacting, armoring and/or benching prior to the first fall rains can minimize surface erosion on exposed cuts and fills.

deliver sediment to stream channels, need to be stabilized immediately.

DO rip compacted areas of soil to promote re-vegetation. Areas of bare rock should be outsloped and covered with several feet of soil.

Stream Crossings

DO maintain all stream crossings in efforts to prevent and control erosion. Problems are most likely to develop at culvert inlets, culvert outlets, through-fill road surfaces, fill slopes, and inside ditches. Note: Local, state and federal permits or approvals may be needed for stream crossings.

DO incorporate a fail-safe drainage design into every stream-crossing fill so that streamflow will not be diverted out of the natural channel and down the road if the culvert plugs with sediment or debris.

DO consult a trained wildland botanist, plant ecologist, or the NRCS to see what plants are recommended for your area.
NRCS contact is 831-475-1967.

Precautions: Steer clear of using silt fence barriers to prevent erosion. Silt fences merely temporarily trap the sediment and keep it from moving off the site and into a stream. If installed, it is very important to correctly apply and maintain silt fences for as long as they are left in place. In order to prevent surface erosion on slopes less than about 50%, vegetate the bare areas as quickly as possible at any visible onset. Be careful to not allow culvert outlets to discharge on the road fill. Culverts outlets should extend past the end of the road fill and discharge into the natural channel, or a flume or downspout should be attached to the pipe end and empty onto an energy dissipater.

IV. ROAD MAINTENANCE

INTRODUCTION

Regular road maintenance is essential to protect the road and to prevent environmental damage. All roads used for vehicle travel should be regularly inspected and maintained. Remember to **monitor the road regularly** and **maintain it when necessary**. A well-maintained road will reduce road user costs, prevent road damage, and minimize sediment production.

Inspection and Maintenance Schedules

Road and drainage structures along all roads should be inspected annually, at a minimum, prior to the beginning of the rainy season. Inspections should cover culvert inlets and outlets on stream crossings, ditch relief culverts, and road surface drainage such as waterbars, outsloping, and ditches.

In addition to annual maintenance, pre-winter road and drainage structure inspection crews are needed to inspect and perform emergency maintenance during and following peak winter storms. Shovel work at a culvert that is beginning to plug can save the expenditure of thousands of dollars to rebuild an entire stream crossing after it has washed out.

Some drainage structures are more prone to problems than others. For example, culverts on streams with heavy sediment loads or floating woody material may be more likely to plug. Landowners or land managers frequently know which culverts in their road system have had the most problems, and which are most likely to plug during a winter storm.

This background information can be used to develop a rating system and inspection plan for drainage structures in a watershed. Culverts can be coded by signs along the road. These signs note: 1) where the culvert is located (Road name and milepost), 2) the diameter of the culvert, and 3) a number or color coding (e.g. red, yellow and green) that signifies how likely the culvert is to plug, and therefore, its relative need for inspection during winter storms.

There are many things to know about maintaining your road. In the following section we will share with you some very important tips on how to maintain your road and stay safe.

BEST MANAGEMENT PRACTICES

Key road maintenance items to be performed routinely:

Grading and shaping the roadway surface to maintain a distinct insloped, outsloped, or crown shape to move water rapidly off the road surface.

Compacting the graded roadway surface to keep a hard driving surface and prevent the loss of fines.

Replacing surfacing material when needed.

Keeping the road surface moist!

Removing ruts through rolling dips and water bars.

Reshaping the structures to function properly.

Cleaning ditches and reshaping them when necessary to have adequate flow capacity. (Do not grade ditches that do not need it!)

Removing debris from the entrance of culverts to prevent plugging and overtopping.

Checking for damage and signs of piping or scour.

Replacing /repairing rock armor, concrete, or vegetation used for slope protection, scour protection, or energy dissipation.

Trimming roadside vegetation (brushing) adequately, but not excessively, for sight distance and traffic safety.

Replacing missing or damaged road information, safety, and regulatory signs.

USDA, Low Volume Roads Engineering; BMP Field Guide, 2003

Figure A2.
Road maintenance is needed to maintain roadway surface drainage patterns and remove slides that block ditches and culvert inlets.

MAINTAINING PRIVATE ROADS: PROBLEMS, CAUSES, CURES

Planning Considerations When Maintaining Roads

1. Identify and evaluate existing problems and prioritize (look beyond the road)
2. Inventory road drainage and erosion control measures
3 Consider environmental impacts
4. Develop a road maintenance strategy
5. Identify parties that may need to be notified or involved
6. Monitor road drainage and erosion control facilities

"Plan to fail" -- consider secondary defenses

One, all or a combination of the CAUSE(S)/ INDICATOR(S) listed below could result in the following ROAD PROBLEMS

Problem	Indicator(s)/Cause(s)	Treatment Options
Roadcut Bank Failure: the road cutbank is slumping	Vegetation removal/absence of vegetation *Over-steepened cutback* Unstable slope/seepage *Uncontrolled surface runoff* Dead, dying, diseased or undermined trees *Slope disturbance* Erosive soil/soil composition	Clean and maintain road ditch *Install retaining wall* Slope bank and revegetate *Outslope road (if possible) to eliminate inside ditch* Control surface runoff with diversion above cut slope *Remove or prune hazardous trees* Minimize disturbance *Maintain vegetative cover*
Roadfill Slope Failure	Tension cracks on the road *Un-compacted fill soil* Vegetation removal or lack of establishment *Concentrated runoff over fill* Road culvert outlets on bare soil or unstable slope *Outside berm/curb on an outsloped road* Lack of necessary retaining structures *Steep unstable slope* Erosive Soil	Compact fill slope *Plant and maintain vegetative cover* Prevent concentrated surface runoff; maintain "sheet" flow *Install velocity dissipaters at culvert outlets, extend culverts beyond fill soil* Install slope/soil-retaining devices if deemed necessary *In-slope unpaved roads to redirect surface runoff away from sensitive fill slopes* Minimize fill areas
Roadfill Slope Failure (cont.)		*Redirect all surface water to a safe location (rock "rip rap"dissipater) to prevent water from releasing on fill material*
Slope Failure: mudslide or landslide, slumps, block glides, debris flows	Unstable soil or bedrock material *Evidence of prior slope failure such as:* *A bulging toe at the bottom of the slope* *Flat spots on slopes that appear out of character for the slope* *Spring or seeps in hillside above or below road* Difference in type or maturity of vegetation *Spoon-shaped hollows in slopes created by the movement of failed material* Oversteepened cutbank *Un-retained cutbank on unstable slope, increased load* Uncontrolled surface drainage on unstable slope, causing saturated slope *Disturbance or absence of deep-rooted vegetation* Cracks perpendicular to the slope *Hummocky terrain, which looks like the "surface of a rug that has been pulled flat"* Slope undercut by stream or roadside ditch *Certain cultural features such as doors or windows stuck, cracks, breakage of underground pipes, or tilted utility poles or trees*	Do not cover with plastic *Work with neighbors to control all sources of surface and subsurface drainage on slopes* Remove excess water from the slope *Prevent the ponding of water in slide areas* Construct restraining structures such as retaining walls (with the aid of a geologist or geotechnical expert) *Revegetate all disturbed soil with appropriate plant materials after geologist recommended work is completed (consult the Natural Resources Conservation Service for planting recommendations)* Maintain toe of slide whenever possible *The slide debris at the toe acts as a temporary footing for the slope. NOTE: Removing slide debris may cause additional sliding* Avoid development on unstable or failed slopes

Problem	Indicator(s)/Cause(s)	Treatment Options
Slope Failure (cont.)	An intense storm event *Earthquake*	
Road Washout	Lack of road maintenance *Accumulation of sediment or debris in cross-drain* Undersized or damaged culverts *Improper design, placement and construction of road drainage facilities* Increased runoff and erosion in the area *Lack of velocity dissipaters at culvert outlet* No surface drainage provisions *Streambank erosion* Landslide *Lack of overflow device, "secondary defense", such as a road spillway* Concentrated runoff on unprotected roadfill	Retain unstable slopes with structures and vegetation *Perform regular maintenance* Monitor culvert inlets during peak storm events *Improve all road drainage control measures* Install secondary defense such as a spillway or "critical dip"that can safely carry flow across the road if necessary
Roadbed Erosion: rills or gullies running down roadbed	Berm/curb channeling water down road *Inadequate road drainage facilities* Poor grading *Lack of maintenance and/or heavy use of road* Poor application of surfacing materials *Poor construction* Heavy vehicle traffic creates ruts in road that channel runoff	Install appropriate road drainage facilities to redirect water to a safer location *Regrade road, outslope road if site allows* Monitor and maintain road conditions throughout the winter *Resurface road* Reconstruct or relocate all or part of the road *Install cross-drains devices for drainage*

Problem	Indicator(s)/Cause(s)	Treatment Options
Roadbed Erosion (cont.)		Limit heavy vehicle traffic on low-strength roadbeds *Perform regular maintenance*
Road Damage From Streambank Erosion	Weak roadbed underlying material *Road too close to the stream* Road in flood plain or actually constructed in historic drainage course *Increased runoff in watershed* Road runoff onto unprotected streambanks *Poor placement and installation of road culverts* Lack of proper road maintenance	Revegetate all bare and or disturbed soil and streambanks *Modify obstructions that deflect stream flows* Control surface runoff from road *Inslope road away from sensitive streambanks* Perform regular road maintenance Relocate road
Road Ditch Erosion on Insloped Roads: roadside ditch is being downcut	Lack of maintenance *Steep road ditch grade* Undersized or improperly constructed ditch *Ditch filled with debris, rock, or choked with vegetation - limits capacity* Erosive soils *Inadequate drainage control/ lack of cross-drains*	Install more frequent cross-drains *Keep ditch free of loose debris-* *DO NOT fill with rock, broken concrete, etc. because it will obstruct flows* Ditches can be lined with vegetation, concrete, grouted rock on steep grades, and loose, angular rock on gentle grades *Control excessive surface runoff* Perform regular maintenance *Consider outsloping unpaved roads eliminating need for an inside road ditch*

Problem	Indicator(s)/Cause(s)	Treatment Options
Water ponding on road surface & saturated roadbed	Wet, unstable soils *Spring in roadbed* Improper surfacing, grading, or design *Undersized or lack of road drainage facilities* Lack of drainage maintenance resulting in plugged culverts, clogged ditches *Broken water or drain pipelines buried under roadbed*	Install subsurface drain with permeable membrane below road surface on unpaved roads and cover with drain rock (consult a professional for advice and installation assistance) *Regrade unpaved road to improve surface drainage, outslope if site allows* Perform regular maintenance and remove debris from culverts, roadside ditches Install cross drains, possibly new and larger
Roadside Erosion to surrounding lands (erosion caused by road runoff)	Lack of road erosion drainage control measures *Bare, disturbed, and/or infertile soil* Uncontrolled surface drainage causing rills or gullies *Sparse vegetative cover* Unprotected or undersized drainage outlets	Hydroseed and mulch *Plant with native groundcovers* Maintain existing and newly planted vegetation *Install or improve and maintain surface drainage control measures* Compact loose and disturbed soil before revegetating *Seed and mulch bare soils*

One, all or a combination of the CAUSE(S) and INDICATOR(S) listed above could result in the ROAD PROBLEMS listed. If you notice what looks like the onset of a road problem the best thing to do is to contact your local NRCS office at (831) 475-1967 or a local Certified Professional in Erosion and Sediment Control (listings on page 66).

SURFACING YOUR ROAD

The Monterey Bay National Marine Sanctuary Water Quality Protection Program has determined that rural road surfaces and road cuts are one of the primary sources of sedimentation in coastal watersheds.

Together we can reduce sediment / silt pollution by utilizing common sense and local drainage expertise to properly stabilize the road and the road cut and to design drainage for adequate facilities. Surfacing the road might be one answer to both concerns. Surfacing has good and bad points. One of the good points is protection of the roadbed from erosion. One of the bad points is that surfacing creates an impervious surface, which increases surface runoff, often containing motor vehicle toxins, petrochemical residues and heavy metals. With the low level of development and traffic, and the very high level of sediment in the creeks of these coastal watersheds, the good points may out-weigh the bad.

Photo A1
Avoid construction and other road activities during wet periods when possible. Alternatively, add drainage and surface stabilization to the roadway in weak soil areas for all-weather use.

Surfacing: Getting the Work Done

Choose your contractor carefully. Talk to other road associations or individuals who have had work done. Choose a bonded, licensed contractor with the appropriate licensing.

Class A is a General Engineering Contractor. This person is licensed to design structures such as roads, sewer systems, retaining walls, and some buildings

Class C 1 2 is an Earth Work and Paving Contractor, licensed to do excavating, grading and paving.

Considering the liabilities and potential for problems it would not hurt to contact the State Contractor's Licensing Board in Sacramento

1-(800) 321-2752. Stay in touch with your contractor each day of construction. Make frequent site visits if possible.

If this is new construction or an extensive repair, consider consulting with a state licensed civil engineer, geotechnical engineer, soils engineer or a licensed Certified Professional in Erosion and Sediment Control (CPESC).

Permanent roads, which will be used for winter and wet weather hauling or heavy traffic, need to be surfaced with rock or paved to improve traffic movement and reduce erosion (serious damage to road surfaces usually begins with the build up of thick (1 to 4 inch) accumulations of dry dust during the summer or excess water (and mud) during the winter. Standing water is a sign of poor road drainage and cuts indicate that road strength is deteriorating.

An “all weather road” is recommended to protect the road and watercourses. An “all weather road” is one, which is surfaced with rock or paved. How the construction is done is as important as the design. The following are the basic steps in construction.

Grading and Compaction

Grading specifications can be found in the County’s Grading Ordinance on page 62. You are not expected to know these details: your contractor is! This is why a little background information on your contractor can’t hurt. Fill material (used to build the road) must be compacted to 90% of maximum density. This is done with drum rollers or other heavy equipment.

Baserock and Foundation Work

Next the baserock is laid down and compacted. The amount used will depend on the soil type and conditions. A general rule of thumb suggests a minimum of 5” for compacted roads. Class II and Class IV types of base rock - or aggregate base - are generally used for small, private roads. Class II compacts quite well due to the smaller size of the particles. It is used by government agencies for this reason. Class IV is used on less traveled roads. It may cost only a third of the cost of Class II, but is poorer in quality.

Keep the Santa Cruz County Soil Survey (available from the NRCS at www.ca.nrcs.usda.gov) close at hand. You may find areas of clay along your road, and as it is graded these areas may become exposed. Because of the ability of this soil type to swell with water, rock surfacing becomes very important. The contractor may tell you that drain rock needs to be placed over the clay areas. Drain rock is washed of most or all fine sediment material and is the best drain material available, It may cost as much as two-times the amount of the Class II aggregate rock but will save you in maintenance and repair in the future.

A large roller will compact the baserock, while a water truck sprays the baserock. The moisture lubricates the rock allowing it to slide into place, like puzzle pieces for better compaction.

TAKE NOTE: Construction and grading situations are site specific slope, soils, drainage, proximity to creeks and streams, vegetation, travel needs and emergency access needs for fire suppression all need to be considered.

Surfacing Materials

Base and Seal Coat

Base rock is compacted. A primer of penetrating oil (such as SC 70) is applied. Then, a layer of more tacky, sticky oil (RS1 or RS2) is sprayed to retard water infiltration.

Base and Oil Screen
(“Oil and Chips”)

Base rock is compacted. A primer of penetrating oil is applied. Finely graded granite rock pieces are rolled into the seal coat oil. These pieces (“chips” or “screenings”) average 1/4 to 3/8 inch in size. This surfacing can last two to six years and may then need recovering.

Double Seal Coat
(Double Oil and Screen)

Similar to Base and Oil Screen, Double Seal Coat adds another layer of granite pieces - smaller than those in the first - with a second application of the tackier R81 or RS2 oils. The smaller pieces are wedged in between the larger first layer of granite forming a harder surface.

WARNING: Decomposed granite should never be used instead of crushed granite. This may mean that your association or contractor may have to go outside the local area for crushed rock. This will increase the transport cost, but remember to consider future repair and maintenance costs when considering using lesser quality materials to save a few bucks.

Base and Hot Mix
(also known as: asphalt concrete, paving, blacktop, plant mix)
Specific proportions of liquid asphalt and aggregate are heated. The mix is then spread and compacted on a layer of base rock. Base and Hot Mix may be recommended on slopes steeper than 15%. A prime coat may be applied before the Hot Mix layer for a more lasting job. This surfacing may cost twice as much as the basic Base and Seal coat, but may last many times longer.

Concrete
The good points of concrete are that it wears very well, and it can be “scarred” for traction on steep slopes. The downside of concrete is that it is not as flexible as the other surfacing materials, which makes it susceptible to cracking. Also, it is generally more expensive than asphalt. The thickness of the concrete is dependent upon the soil, and may require a layer of sand underneath where soils are clay and expand with water. This can increase the costs.

USE AND MIS-USE OF PLASTIC ON SLOPES AND OTHER DISTURBED AREAS

WHY NOT USE PLASTIC?

If not done right plastic can often make a problem worse and/or create new problems.

Plastic use (when, where, etc.) is site-specific and not appropriate for all situations.

Black, brown, and blue plastic kills vegetation and root systems that are holding soil together.

Plastic increases runoff and retains moisture in slope and soil.

High maintenance.

Highly visual -- may cause others to also do the wrong thing.

Slows natural restoration process.

Can be very costly if extremely large areas require covering.

Only a temporary solution

WHEN IS IT OK TO USE PLASTIC?

Use as temporary measure and a last resort

Cover dry or relatively dry soil.

If soil is wet or becomes wet then remove plastic during breaks in the weather,

Provide a watertight seal.

Cover all bare and/or disturbed soil.

Use clear plastic so vegetation and/or root systems are not destroyed.

Securely fasten plastic to slope. Provide sufficient overlap and watertight seal.

Make sure that runoff from plastic is directed to a safe location and does not cause further slope saturation, erosion, or damage to downslope or adjacent properties or road drainage facilities.

Plastic is a temporary, emergency practice- do not keep on slope for years.

Use appropriate mil (millimeter thickness) of plastic (6 mil minimum).

Consult with an erosion control specialist, geotechnical expert or engineer for a site-specific design and or planning guidance before installing plastic.

V. VEGETATION

FERTILIZER, SEED, AND MULCH on steep slopes, fill slopes, and poor soils

Where

Bare soil, unprotected slopes, unpaved roads, cutbanks, and other disturbed soil areas. NOTE: In some instances, vegetation may need to be used in conjunction with structural practices to prevent erosion caused by the concentration of storm water runoff.

When to Fertilize

Fertilize prior to seeding to help achieve rapid growth before the heavy winter rains start. Fertilizer is especially crucial on sandy, shallow, or infertile soils.

Apply fertilizer, Ammonium Phosphate with Sulfur (16-20-0) at a rate of 5-10 pounds per 1,000 square feet or 200-400 pounds per acre, before mulching, either before or during seeding operations. On steep slopes, splitting fertilizer into two or three applications during the growing season will reduce the loss of fertilizer due to storm runoff.

When to Seed

If relying on winter precipitation, the best seeding time is between September 15 and October 15. If irrigation is possible, plant earlier so there is some erosion protection before the first storm Seeding should be done after drainage and erosion control structures/measures are in place so that seed is not disturbed. After October 15, germination may be reduced and plant growth may be slowed due to cold weather.

When to Mulch

Once seed and fertilizer are in place, protect planting and help retain soil moisture with mulch. Weed free barley, wheat or rice straw can be used. Apply a 1 to 2-inch thick layer (approximately 1 bale per 1,000 square feet or 45 bales per acre). “Punch” in straw to anchor it on steep slopes using a shovel or other equipment. Mulch may be used alone for erosion control without seeding when it is too late in the season for successful establishment of plants.

How

Loosen compacted soil prior to seeding. (Passing over the soil with ring shank roller prepares an excellent seed bed). The finished seedbed should be fairly firm, but loose enough so roots can penetrate. Lightly bury seed about inch deep.

SEEDING RECOMMENDATIONS

Deciding what seed to plant is a difficult task. Successful germination, growth, and longevity will depend on a variety of conditions, including soil type, climate, and competition from current plant populations. Historically, annual grasses have been the preferred choice for erosion control because they grow more rapidly than do most native grasses. Most native grasses are perennials that establish more slowly and grow less vigorously in the short-term. Non-native, annual and perennial grasses, such as ‘Blando Brome’, Annual Ryegrass, ‘Zorro’ Annual Fescue can be highly competitive with remnant populations of native grasses and are **not** recommended for wildland areas or urban built-up areas adjacent to wildland areas.

Consult your local seed vendor or a Certified Professional in Erosion and Sediment Control for specific seed mixture recommendations for your site. Seed mixtures stand a better chance of surviving pests or diseases that might wipe out a single-species planting. Consider whether you want the grass species to persist. If not, plant a non-reseeding mix of annuals. If you do want permanent grass cover, choose a mix that includes a short- lived species with high seedling vigor (rapid germination and erosion control cover) and a long-lived species with low seedling vigor (to provide long-term site stability). Here is some information on individual grass species and legumes to help you make your decision.

Several nurseries in the Central Coast have seed available that was collected from local native grasses. Contact the Santa Cruz County Resource Conservation District, in Capitola, at (831) 464-2950 for a list of nurseries that carry native grass seed and other native plants.

SEEDING RECOMMENDATIONS CHART

PLANTING DATE	SPECIES	ANNUAL or PERENIAL	CONDITIONS	SOIL	DRY	WET	SUN	SHADE	ELEVATION	SELF RESEEDING	LIFE EXPECTANCY	SEEDLING VIGOR	SEEDLING RATE	LBS/1000FT	LBS/ACRE	ESTIMATED COST $ Per lb
Prior to Sept 15	Intermediate Wheatgrass *Agropyron intermedium*	*P*		*Se*	*X*			*X*	4000-7000		*L*		*1*	*45*		
	Orchard grass *Dactylis glomerata*	*P*		*P*	*X*	*X*				*Y*	*L*	*LO*	*0.6*	*25*	*2.60*	
	Luna wheatgrass *Elytrigia intermedia*	*P*		*AT, Se*					4000-7000		*L*	*LO*	*0.7*	*30*		
Prior to Oct 15	'Lana' Woolypod Vetch *Vicia dasycarpa*	*A*		*P, Ac, Al, S*	*X*	*X*	*X*	*x*		*Y*		*HI*	*1.4*	*60*	*1.00*	
	Subterranean Clover *Trifolium subteraneum*	*A*		*P, Ac*	*X*	*	*X*	*x*	0-3200	*Y*		*MED*	*0.6*	*25*	*1.80*	
	Tomcat Clover N *Trifolium wildenovi*	*P*		*P*			*X*		0-5000	*Y*			*0.1*	*6*		
Sept 15 to Oct 15	California Brome N *Bromus carinatus*	*P*		*AT*	*X*		*X*	*x*	0-3500		*S*	*MED*	*0.8*	*35*	*7.00*	
	Creeping wildrye N *Leymus tritichoides*	*P*		*AT, S, Sa, Al, C*	*X*	*X*	*X*	*X*	0-7500	*N***	*L*	*LO*	*0.7*	*30*	*48.00*	
	'Wimmera 62' Ryegrass *Lolium rigidum*	*A*		*AT*					0-4000		*S*		*1.1*	*50*		
	'Zorro' Annual Fescue A *Vulpia myuros hirsuta*	*A*		*P, S, Ac, Se*	*X*	*x*			0-4000	*Y*		*HI*	*0.3*	*15*	*7.00*	
	Hykon Rose Clover A *Trifolium hirtum*	*A*		*S, Ac, R, P*	*X*		*X*		0-4000	*Y*		*MED*	*0.7*	*30*	*2.20*	
	California Fescue N *Festuca californica*	*P*		*P, Se*	*X*		*X*	*x*	0-6000	*N*	*L*	*LO*	*0.7*	*30*		
	Meadow Barley N *Hordeum brachyantherum*	*P*		*AT, C, Al*			*X*		0-11100	*Y*	*S*	*MED*	*0.9*	*40*	*17.00*	
	California Barley N *Hordeum brachyantherum ssp californicum*	*P*		*AT, Al*	*X*	*X*	*X*	*x*	0-8500		*S*	*MED*	*0.6*	*25*	*23.00*	

1.Planting dates are based on reliance on winter rainfall for irrigation
2.Seeding Rates based on Broadcast Method
3.Tolerated Soil Conditions: Se=Serpentine, Ac=Acidic, Al=Alkaline, Sa=Saline, C=Clay, S=Sandy, R=Rocky, AT=All Types, P=Poor, Gr=Gravelly

N/California Native
A/Can be agressive
x/partial

* Some varieties tolerate waterlogged conditions
**Does not reseed, but spreads through rhizomes

SEEDING RECOMMENDATIONS CHART CONTINUED

PLANTING DATE	SPECIES	ANNUAL or PERENIAL	CONDITIONS	SOIL	DRY	WET	SUN	SHADE	ELEVATION	SELF RESEEDING	LIFE EXPECTANCY	SEEDLING VIGOR	SEEDLING RATE	LBS/1000FT	LBS/ACRE	ESTIMATED COST $ Per lb
SEP 15 to OCT 15 cont.	California Melic N *Melica californica*	*P*		*R, P, S*	*X*		*X*	*x*	0-4000	*Y*	*L*	*LO*	*0.7*	*30*	*30.00*	
	Purple Needlegrass N *Nassella pulchra*	*P*		*R, P*	*X*	*x*	*X*	*x*	0-5000	*Y*	*L*	*V.LO*	*0.6*	*25*	*30.00*	
	Annual bluegrass *Poa annua*	*A*							0-6500			*V.LO*	*0.6*	*25*		
	Pine bluegrass N *Poa secunda*	*P*		*AT, C, S, Se, P*	*X*		*X*	*x*	0-12500			*V.LO*	*0.7*	*30*	*20.00*	
	Cereal Rye *Secale cereale*	*A*		*P, S, Gr, R, Se, Al,*	*X*		*X*		0-10000	*Y*	*S*	*HI*	*0.7*	*30*		
	Big Squirreltail N *Sitanion jubatum*	*P*		*S, Gr, R, Sa, Al, Se*	*X*		*X*		0-10000	*Y*		*HI*	*0.7*	*30*		
	Nodding Needlegrass N *Nassella cernua*	*P*		*At, S, R*	*X*		*X*	*x*	0-4500		*L*	*LO*	*0.5*	*20*	*30.00*	
	Idaho Fescue N *Festuca idahoensis*	*P*		*R, S, P*	*X*			*X*	0-5000		*L*	*V.LO*	*0.6*	*25*	*20.00*	
	Western Red Fescue N *Festuca occidentalis*	*P*		*R*	*X*		*X*		0-6500		*S*		*0.5*	*22*		
	Creeping Red Fescue N *Festuca rubra*	*P*		*S, Gr, Ac*		*X*	*X*	*X*	0-8500	*N***		*V.LO*	*0.6*	*25*		
	California Poppy N *Eschscholzia californica*	*P*		*S*	*X*		*X*		0-6500	*Y*	*S*		*0.2*	*8*	*18.00*	
	Slender Hairgrass N *Deschampsia elongata*	*P*				*X*	*x*	*X*	4500-10000		*S*		*0.5*	*20*		
NOV to DEC	Common Barley *Hordeum vulgare*	*A*		*AT, Sa, Al*	*X*	*x*			0-4000	*N*	*S*	*HI*	*4.1*	*180*	*0.25*	

1.Planting dates are based on reliance on winter rainfall for irrigation
2.Seeding Rates based on Broadcast Method
3.Tolerated Soil Conditions: Se=Serpentine, Ac=Acidic, Al=Alkaline, Sa=Saline, C=Clay, S=Sandy, R=Rocky, AT=All Types, P=Poor, Gr=Gravelly

N/California Native
A/Can be agressive
x/partial

* Some varieties tolerate waterlogged conditions
**Does not reseed, but spreads through rhizomes

VI.ROAD ASSOCIATIONS

ROAD ASSOCIATIONS

A road association can be formed whenever property owners sharing road access feel that such an organization is appropriate. **No governmental agency is necessarily involved in the process.**

Road associations can organize in a variety of ways. Some associations exist solely on verbal agreements. Others use formal written agreements that are notarized and filed with the County-Recorder, making them legally binding to the individuals who have signed them and to future property owners.

The following various types of road association organizations are possibilities gathered from the experiences of associations existing throughout the County. They can be used as is or adapted, depending on the needs of the group. There is no right, wrong, or overall best way to do things. Organization is unique for each group and whatever works for a particular group is the way to go.

WHY FORM AN ASSOCIATION?

Road Associations Can:

- Provide a vehicle for an overall road maintenance and improvement plan versus piecemeal efforts by individual property owners. (A safe, attractive, well-maintained road enhances property values.)

- Organize property owners sharing road access so that costs can be met together with each individual assuming their fair share of road costs.

- Ensure a well-maintained access for emergency vehicles such as fire trucks or for emergency exits of residents in case of natural disasters;

- Organize individuals sharing road access in order to deal more efficiently with insurance and liability claims.

- Establish a structure for other neighborhood activities such as childcare, residential security, cooperative gardening.

- Provide a communications network and basic structure for a localized community disaster plan.

- This last item proved to be a major benefit in some mountain areas after the January 1982 storm. Many associations felt that when the disaster occurred, they were already in contact with neighbors through their road system and better prepared for road clearance and rescue procedures.

HOW TO FORM AN ASSOCIATION

Any number of people sharing the use of a road can form a road maintenance association. The larger the percentage of property owners cooperating the easier it is to effectively finance and organize road maintenance.

Although each road association interviewed used a different approach to organize, many agreed on some basic steps to help get things off to a good start and also lay the foundation for smooth operations in the future:

Step 1

Start with a nucleus of really interested individuals. The group need not be large. In some cases, it initially consists of only one or two people.

This group can then plan a meeting to which others sharing road access will be invited. Residents and owners should be individually invited, as there is often an initial reluctance to get involved. It should be emphasized that this meeting will provide individuals with an opportunity to share ideas and voice concerns **before** any decisions are reached regarding road association organization. **Input from as many property owners as possible is important at this stage.**

Step 2

The initial meeting may be a social gathering as well as a business meeting. This gives residents some opportunity to get to know one another and discuss business in a relaxed atmosphere. The group should first consider the pros and cons of forming an association. Sometimes small neighborhoods decide that a road association is unnecessary, that communication and organization already exists and need not be formalized.

If the group does decide to form an association, property owners may want to discuss:

- Formality of the association - Some groups choose to exist on verbal agreements. Others

draw up written agreements, possibly involving legal assistance. Generally, written agreements do work best in the long run.

- Assessments - the amount of money collected, how and when collection will take place, and how the total maintenance bill will be divided among property owners should be determined.

- Evaluation of resources within the group. There may be lawyers, contractors, and people with other skills useful to the association who can provide expertise and possibly save the group money.

- Road construction - Determine whether a contractor will be hired to do all of the work or whether the association will be responsible for various aspects.

- Association officers - Elections can be held for Road Manager (president), secretary, and treasurer, and other positions that the association feels are necessary. It is generally wise to choose at least one spokesperson for the group.

NOTE: For this meeting, it is useful to obtain a list of current owners' names, mailing addresses, and phone numbers as well as Assessors Parcel numbers, and whether the property is improved or unimproved. A map of the area is extremely helpful in visualizing the locations of the road and the properties involved.

ASSESSMENTS:
Who pays and how much?
Some associations collect money as needed for routine maintenance and emergencies. Most though, find that a regular annual collection system works best. Road managers and treasurers generally handle the various aspects of billing on terms decided by the group.

A VARIETY OF CHOICES EXIST
Property owners may:
a. Pay a fixed amount per parcel. This is perhaps the simplest method for calculating assessments and collecting them.
b. Pay according to total acreage.
c. Pay according to front or linear footage along the road.
d. Pay according to formulas based on the distance from each parcel to the beginning of the road. Thus, homeowners living furthest down the road may pay a larger percentage of the total maintenance bill.

*Provisions are sometimes made for absentee owners and for parcels without improvements so that only a percentage of the assessment figure is paid. Provisions may also be made for individuals to contribute less money in exchange for extra hours spent on road repair work. Many associations, though, cannot afford this exchange due to the ever-existing need for additional dollars.

Step 3
Association officers should mail minutes from this meeting to all property owners, including absentee owners (persons owning but not living on site). The date for a follow-up meeting should be decided as well. For mailing purposes, a small collection for stamps should have been collected at the initial meeting so that costs are shared by all from the beginning.

Step 4
At the follow-up meeting, officers and committees can report back to the group, agreements can be reviewed and signed.

ASSESSMENTS

How are They Collected?
Because the collection of money seems to be the most common problem faced by associations, the following suggestions are provided to help make the collection process work.

Good Communication
Many associations note that good communication is the chief determining factor in avoiding potential problems. Often, this takes the time and dedication of one or two association members. Many groups feel that smooth operations are directly dependent on good diplomacy as practiced by the ROAD MANAGER. His/her ability to work with various personalities, balancing individual needs with efficient road management, is of utmost importance. **People must feel that their personal interests are being considered in order for them to fully support an overall road maintenance effort.**

The Written Agreement
For some associations, communication includes a written agreement. This provides defined rules and group priorities. Thus, association decisions are clearly of a business rather than personal nature.

This agreement might include duties of the road manager and other officers, annual meeting date, how assessments are to be collected, check signing and accounting procedures, a provision binding future buyers or heirs to the agreement, etc. **The agreement is legally binding only if it includes a legal description of the**

property involved and is signed, notarized and filed with the County Recorder.

Once the agreement becomes legal, those signing it are subject to all of its provisions. Thus, if provisions for payment are included in the agreement, associations can bring suit against 'holdouts'. Any judgment obtained in court can be recorded against their property as a lien. The lien prevents the owner from selling or borrowing money against his/her property until the lien is satisfied.

Bringing Suit Under Civil Code 845

Major difficulties sometimes arise in reaching an agreement on the method, which will be used to collect assessments. For example, persons living near the entrance to a road may feel that they should pay a smaller percentage of road maintenance costs than those living a greater distance down the road. Yet, persons with property along these furthest stretches may feel that they already lessen the financial burden of other property owners while causing insignificant additional road wear. A variety of such discrepancies may arise and in some cases, the owners of a road may not be able to reach an agreement. Individuals or an association can file suit in Superior Court under Civil Code 845, which states that all persons with a common right of way must pay an appropriate share of the maintenance of that road. **(Thus, even persons who have not signed the associations' agreement may be taken to court under Civil Code 845 to determine their responsibility to bear costs of maintenance.)**

To initiate this process, any property owner files a petition with the Santa Cruz County Superior Court for appointment of an arbitrator. The Law Library of the County Building has formbooks for petition format and style. A judge then assigns an arbitrator to the case. Costs of hiring an arbitrator vary, depending on the arbitrator's fee and the number of sessions necessary to reach a decision. Once a decision is reached, property owners not in agreement may contest the results in court. The court decision is binding to all affected property owners unless appealed.

LIABILITY

Besides the collection of assessments, the aspect of insurance and liability is of most concern to road organizations. Private roads are legally open for public use unless gated for at least 24 hours per year. This action must be initiated within one year of road construction. Thus, for persons owning property along private roads, it may be wise to seek legal advice on collective and/or individual liability insurance. Regardless of whether an individual belongs to a road association, if not covered by liability insurance, he or she may be risking exposure to damages from accidents caused by any "dangerous" conditions of that road.

VII.COUNTY SERVICE AREAS

INTRODUCTION

In 1963, the California State Legislature ruled that County Service Areas (CSAs) could be formed to provide citizens living in rural areas with services such as water, electric power, sewage disposal, and roads. Those individuals benefiting directly would finance these CSA services.

CSAs can thus provide property owners with another option for organizing the maintenance of roads not in the County system. Their organizations is very similar to that of Road Associations. CSAs can be as formal or informal as the group decides. CSAs can also provide individuals and the general road community with the same benefits derived from road association organization. They are advantageous to certain groups, depending on the specific situation and needs of the group. Many road groups choose the CSA alternative because:

•It provides an effective mechanism to collect moneys for road improvements from all property owners. Since the yearly service charge (not tax) appears on each parcel's property tax bill, it eliminates the problem of collecting from 'Holdouts'.

•Members of CSAs can ask County Public Works crew to perform the roadwork. If Public Works is over scheduled at the time of the request, a contractor will perform roadwork. For jobs less than $6,500.00 the Service Area Representatives obtain proposals from three (3) contractors and must submit these proposals to Public Works for their review and approval. Jobs greater than $6,500.00 are subject to competitive bid procedures.

HOW TO FORM A CSA:

Forming a CSA is relatively simple. An organized group, such as a road association, requests information and assistance from the County. A representative from the Local Agency Formation Commission (LAFCO) will meet with the association to outline steps involved in organizing and to answer any questions.

In Order to Form a CSA:

1. **Provide Public Works with a $1,500 deposit that covers:**
   a. Cost of public hearing, legal descriptions as needed for application purposes

2. **Supply a $2,000 deposit to LAFCO that covers:**
   a. An application to LAFCO requesting CSA status
   b. Map and legal description
   c. Mapping and title searches

3. **Pay a State Board of Equalization fee determined by acreage ($250-$900);**

After this process is completed, remaining funds are deposited in the CSA's treasury for future road repair and maintenance costs.

The road organization is responsible for collecting signatures for affected property owners as part of the application process. Although only 10% of the signatures of people sharing road access are required for LAFCO to consider the application, it is **highly** recommended that at least 65% of affected property owners favor CSA formation. This support helps ensure smooth functioning of the CSA once it is organized.
After LAFCO approval, the County Board of Supervisors reviews the application. If approved, a public hearing is held at which time any property owners opposed to CSA formation may voice their concerns. If 10% of the property owners express opposition (either written or verbal), an election is held. The measure will die unless a clear majority of residents express positive support at this point. If 50% of the affected property owners express opposition, proceedings are terminated. If the measure passes, the first year's service charge is determined according to recommendations of property owners.

LAFCO may authorize the conducting authority to form a county service area without notice, hearing, or an election, if the commission has received written consent to the formation signed by all of the landowners within the proposed service area.

VIII. ADDITIONAL RESOURCES

ENDANGERED SPECIES ACT AND EXISTING LAWS

The following laws and ordinances are important to know for private Road Associations, County Service Areas and any resident who lives on a private road. In maintaining your roads, it is crucial to be aware of endangered or threatened species in the vicinity of your project area. Knowing which laws and ordinances apply to you can save you time and money.

The federal Endangered Species Act (ESA) prohibits any person from "taking" endangered or threatened species. The federal law includes harming in its interpretation of "taking", in which harm includes modifying or degrading a species habitat in a way that would significantly impair the area's breeding, feeding, or sheltering capacity and result in injury to the species. The federal ESA is administered by USFWS (U.S. Fish and Wildlife Service) for terrestrial habitats and inland waters, and by NMFS (National Marine Fisheries Service) for coastal and marine habitats including those of anadromous fish.

THREATENED SPECIES: any species which is likely to become an endangered species.

ENDANGERED SPECIES: any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming risk for man.

As a result of the Endangered Species Act, both steelhead and coho are now a top conservation priority in the California Central Coast region. Both coho salmon (Onsorhynchus kitsutch) and steelhead trout (Oncorhynchus mykiss) are now listed as threatened under the Federal ESA and coho salmon is also listed as endangered under the California ESA.

The Endangered Species Act provides for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend, both through Federal action and by encouraging the establishment of State programs. The California Department of Fish and Game, a State program, plays a significant role in the protection of listed species. The Department of Fish and Game maintains native fish, wildlife, plant species and natural communities for their intrinsic and ecological value and their benefits to people. This includes habitat protection and maintenance in a sufficient amount and quality to ensure the survival of all species and natural communities.

CALIFORNIA MANDATES

California Endangered Species Act
The state ESA prohibits any person from "taking" endangered or threatened species, and sets forth a policy that state agencies should not approve projects that would result in the destruction or adverse modification of habitat essential to the continued existence of endangered or threatened species.

Salmon, Steelhead, Trout and Anadromous Fisheries Program Act
This program has the mandate to protect and increase naturally spawning salmon and steelhead trout through improvement of stream habitat. The program's chief activity is to identify streams where natural production can increase.

California Riparian Habitat Conservation Act
The purpose of this Act is to protect, preserve, and restore riparian habitats throughout the state by acquiring interests and rights in real property. This program purchases land for protection, preservation, and restoration as authorized by the Department of Fish and Game Code Section 1385-1391 and approved by the Wildlife Conservation Board.

Streambed Alteration Agreement - Fish and Game Code Section 1601
Under this Code Section, the California Department of Fish and Game regulates activities (grading, filling, and dredging) that occur in state waters (rivers, creeks, streams, and lakes). The California Department of Fish and Game reviews construction plans and issues "agreements" signed by the applicant that provide management practices to avoid adverse impacts to state waters and adjacent riparian areas.

Porter-Cologne Water Quality Control Act
Lead agencies: State Water Resources Control Board; Regional Water Quality Control Boards
Porter-Cologne, enacted in 1969, is California's primary water law, providing a complete regulatory framework for waste discharges to all surface and ground waters in the state. The provisions of the Act meet the water quality planning requirements of the Clean Water Act. Porter-Cologne requires the adoption of water quality control plans (Basin Plans) for surface and ground waters within each region of the state.

For more information:

U.S. Fish and Wildlife Service, Ventura, Ca 93003, (805) 644-1766 www.fws.gov

National Marine Fisheries Service, Santa Rosa, CA 95404, (707) 575-6050 www.nmfs.noaa.gov

California Department of Fish and Game, Monterey, CA 93940, (831) 649-2870 www.dfg.ca.gov

State Water Resources Control Board, Sacramento, CA 95812, (916) 657-0687 www.swrcb.ca.gov

COUNTY OF SANTA CRUZ ORDINANCES

Riparian Corridor and Wetlands Protection Ordinance

The Santa Cruz County Riparian Corridor and Wetlands Protection Ordinance was adopted to protect wildlife and aquatic habitat, reduce flooding, and safeguard water quality and cultural and aesthetic qualities. This ordinance contains guidelines for controlling development in riparian corridors. A riparian exception is required for grading, land clearing, building, and tree or shrub removal in these areas. Deposition of debris and use of pesticides are prohibited in the riparian corridor.

- The riparian corridor is the land adjacent to the stream that supports a plant and animal community adapted to flooding or wet conditions. The corridor is determined by boundaries set by horizontal measurements. For most properties, the protected riparian corridor is 50' from the bankfull flowline or the extent of the riparian woodland. For specific buffer widths, see County Code Section 16.30.040.

Grading Ordinance

Grading permits are required for activities such as moving more than 100 cubic yards of earth, creating a cut slope greater than 5 feet high, and all shoreline protection projects, including seawalls and rip-rap, even if less than 100 cubic yards of material. The ordinance provides that certain activities are exempt from grading permit requirements such as excavations for basements or routine agricultural work to prepare a field for a crop. For further information on getting a grading permit, you can call the County Zoning counter at (831) 454-3252 or (831) 335-6620.

Sensitive Habitat Protection Ordinance

This ordinance was designed to minimize disturbance in sensitive habitats and to protect these areas for their genetic, scientific, and educational value. The ordinance states that:

- No toxic substance that will have adverse effects on the biotic community can be used in a sensitive habitat.

- No development activities or land disturbance can occur in a sensitive habitat until a BIOTIC REVIEW has been completed.

Erosion Control Protection Ordinance

Erosion control efforts aim to prevent and minimize erosion and sedimentation in riparian corridors, upland areas and along streambanks. Excessive sediment in the channel bed impairs water quality, reduces the stream's ability to carry floodwaters, and causes or aggravates bank stability problems. Some of the things you can do to adhere by this ordinance are:

- Maintain runoff rates at or below predevelopment levels

- Keep grading and land clearing to a minimum

- Revegetate and protect exposed soils by October 15th

- Avoid erosion-increasing activities in the winter

- Submit an Erosion Control Plan

Geologic Hazard Ordinance

The County of Santa Cruz Geologic Hazards Ordinance, Chapter 16.10 of the County Code, describes a review process known as a geologic hazards assessment. By evaluating potentially dangerous conditions on building sites, the process protects people who will live there. A geologically hazardous condition exists when geologic or hydrologic processes threaten life and/or property. In Santa Cruz County, areas subject to hazardous conditions include: fault zones, areas subject to landsliding, areas prone to flooding, coastal bluffs and beaches.

A geologic hazards assessment is required for any construction, grading, or land division which is located within any of the four listed hazardous areas, within any area identified by a member of the Environmental Planning Staff as potentially unstable or hazardous, or on land where a site inspection reveals that more geologic evaluation or review is indicated to ensure public health & safety is maintained. To obtain a geologic hazard assessment, call (831) 454-3252 and make an appointment to apply.

If you have any questions regarding the Geologic Hazards Assessment process, please call the Santa Cruz County Geologic staff at (831) 454-3162

For further information regarding these ordinances, call the County of Santa Cruz Planning Department at (831) 454-2580 or visit their website at http://www.co.santa-cruz.ca.us

The following link will take you directly to the ordinances listed above: http://sccounty01.co.santa-cruz.ca.us/planning/environmental.htm

RESOURCES

Santa Cruz County Resource Conservation District
820 Bay Avenue, Ste. 128
Capitola, CA 95010
(831) 464-2950 www.sccrcd.org

USDA/ Natural Resources Conservation Service
820 Bay Avenue, Suite 128
Capitola, CA 95010
(831) 475-1967 www.nrcs.usda.gov

Coastal Watershed Council
Photo monitoring and water quality monitoring
P.O. Box 1459
Santa Cruz, CA 95061
(831) 464-9200 www.coastal-watershed.org

County of Santa Cruz Environmental Health
Permits for septic systems, water quality
701 Ocean Street
Santa Cruz, CA 95060
(831) 454-2022

County of Santa Cruz Public Works
Woody material removal, water conservation.
701Ocean Street, Santa Cruz, CA 95060
(831) 454-2160

California Native Plant Society Santa Cruz Chapter
(831) 429-2333 http://www.cruzcnps.org

REGULATORY AGENCIES

County of Santa Cruz Planning Department
701 Ocean Street
Santa Cruz, CA 95060
(831) 454-2580 www.co.santa-cruz.ca.us
County ordinances are available for viewing at this website

California Department of Fish and Game (CDFG)
CDFG should be contacted for any work done within a stream/riparian corridor
P.O. Box 47
Yountville, CA 94599
(707) 944-5500 www.dfg.ca.gov

Central Coast Region (3)- Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401
(805) 549-3147

State Water Resources Control Board (SWRCB)
P.O. Box 100
Sacramento, CA 95812-0100
(916) 341-5250 www.swrcb.ca.gov

National Marine Fisheries Service (NOAA Fisheries)
NOAA Fisheries must be consulted when anadromous steelhead and salmon are potentially affected by an activity
777 Sonoma Ave.
Santa Rosa, CA 95404
(707) 575-6050

U.S. Army Corps of Engineers (ACOE)
The ACOE regulates the discharge of dredged or fill material in most creeks, rivers, and wetlands. A Nationwide Permit, from the ACOE, must be obtained prior to starting such projects.
333 Market Street, 8th Floor
San Francisco, CA
(415) 977-8462

CERTIFIED PROFESSIONALS IN EROSION AND SEDIMENT CONTROL (CPESC)

The following certified professionals in Santa Cruz County provide information, services, and/or erosion control planning in their area of expertise.

Matt Baldzikowski 2ABDHIM,7
City of Santa Cruz715 Graham Hill Road
Santa Cruz, CA 95060
(831) 420-5468

Steve Butler 1,2ADEFHI,4C,7
781 Oak Drive
Felton, CA 95018
(831) 335-0249

Richard Casale 2BFHI, 5
USDA Natural Resources Conservation Service
820 Bay Avenue, Suite 128
Capitola, CA 95010
(831) 475-1967

John David 1,2ACDEFKM,3,4ABO
Prime Landscape Services
2441 Paul Minnie Avenue
Santa Cruz CA 95062
(831) 476-5999; 476-0363 (fax)
jd@primelandscape.com

Mark Foxx 1,2ACDEFGHIJM,3,4LS
1440 Sun Mountain Road
Felton, CA 95018
(831) 335-9393

John Gilchrist 1,2ACEFGIJ,3,4ADEFGOP,6,7
Gilchrist & Associates
226 Spring Street
Santa Cruz, CA 95060
(831) 429-4355

Chris Giovannoni 3,7
61 Linden Road
Watsonville, CA 95076
(831) 724-0496

Ward Hastings 1,2ACDEFIJKM,3,4A,7
Hastings Landscape Cons Services
6013 Thurber Lane
Santa Cruz CA 95065
(408) 476-5886 (ph/fax)

Steve McGuirk 1,2ABCDEFGHIJKM,
3,4ABDEFGNOPR,7
Madrone Landscape Group
PO Box 1210
Soquel, CA 95073
(831) 462-9981

James McKenna 1,2ACDEFIKM,3,4ABN,7
McKenna Landscapes
2760 Valencia Road
Aptos CA 95003
(408) 684-0400 (ph/fax)

Carol Presley, P.E. 1,2ACEFIJ3,4HJOP,7
P.O. Box 1418
Aptos, CA 95001
(831) 251- 9635
carol.presley@stanfordalumni.org

John Ricker 7
1058 Happy Valley Road
Santa Cruz, CA 95065
(831) 454-2750
Steve Singer 1,2ABCDEFGHIJLM,3,4,BT
218 Nevada Street
Santa Cruz, CA 95060
(831) 427-3297

H. Duane Smith, P.E. 1,2ACEJM,3,4HQ
Ifland Engineers, Inc.
1100 Water Street
Santa Cruz, CA 95062
(831) 426-5313 x207

KEY

1: Available for hire in Santa Cruz County
2: Specialties
A Prepares and/or reviews erosion control plans
B Provides conservation plans for agricultural lands
C Provides erosion control landscape plans
D Installs, inspects, and/or maintains erosion control measures
E Prepares designs for erosion control measures
F Provides planting and revegetation recommendations
G Provides landuse plans and/or land management plans and information
H Provides erosion control recommendations for forest management plans
I Provides recommendations for streamside or aquatic area revegetation/ restoration
J Provides streambank stabilization plans
K Provides landscape and irrigation plans
L Provides soil mapping and evaluation
M Provides drainage & erosion inspection consulting services
3: Prepares erosion control plans as required by Santa Cruz County Erosion Control Ordinance

4: Licenses, Registrations, Certifications
A Landscaping
B Horticulture
C Forestry
D Arborary
E Ecology
F Landscape Architecture
G Planning
H Civil Engineering
I Soil Engineering

5: Provides informational and/or technical advice on erosion and sediment control on urban, rural, and agricultural properties as a free government public service. Experienced in all specialties. Reviews city and county erosion control plans for subdivisions as requested by government officials. Provides training in erosion and sediment control.

6: Provides information on the Santa Cruz County Grading and Erosion Control Ordinances. Issues grading permits and provides inspections related to erosion control measures required under the Erosion Control Ordinance. Enforces both County Grading and Erosion Control Ordinances.

7: Contact to find out what services are available.

M. Kathryn Tobisch 1,2ACDEFGHLM,3
532 Dufour Street
Santa Cruz, CA 95060
(831) 423-5452

Ben B. White, P.E. 1,2AE, 4HJNQ
MacKay & Somps Civil Engineers, Inc.
1955 The Alameda
San Jose, CA 95126
(408) 985-0960

Other qualified, experienced individuals may also prepare erosion control plans as recommended by the County as long as the County recognizes them. For a list of other CPESCs certified in California, write to Richard Casale (see above address). This is a list of certified individuals. This list does not constitute a guarantee or reliability of quality or service. This list is not meant to endorse any individual or firm and no discrimination is intended by omission.

QUARRY ROCK RESOURCES

Many landscape supply stores stock many of these materials in smaller quantities, which makes it convenient for patching work on roads. The following supply stores are in Santa Cruz County:

Robertson Trucking: Santa Cruz, CA 95060
(831) 475-1060

Hastings Landscape, Inc: 6013 Thurber Lane, Santa Cruz, CA 95065 (831) 476-5886

Aptos Landscape Supply: 5025 Freedom Boulevard, Aptos, CA 95003 (831) 688-6211

Scotts Valley Garden Supply: 4425 Scotts Valley Drive, Scotts Valley, CA 95066 (831) 438-3644

Central Home Supply: 808 River Street, Santa Cruz, CA 95060 (831) 423-0763

Cabrillo Sand and Gravel: 5025 Freedom Boulevard, Aptos, CA 95003 (831) 688-6211

Local Quarry Notes

*Anything less than 1/2" moves with water; washes away in rivets. <1/4" rock with fines is good for walking path.

**High sand content makes good base, but fines wash away easily. Best for under asphalt or flat driveways. Steep slope use not recommended.

***3" x 5" creates cobblestone effect creating long term road stability. Put big rock under base for better road bed.

****CRB: Can have lower trucking costs because it is 30% lighter than other quarries.

LOCAL QUARRIES GUIDE

	Granite Rock	Olive Springs Quarry	Langley Hill	Felton Quarry	Lexington Quarry
Contact info	(831) 768-2380 www.graniterock.com	(831) 475-1610	(650) 851-0179	(Granite Const. Co.) (831) 335-3445	(408) 354-7904
Location	End of Quarry Road · Aromas, Ca	1.2 miles on Olive Springs Road off Old San Jose Rd. Soquel	4388 Alpine Road, Portola Valley, CA (15 min up Skyline Dr. from hwy 9)	End of San Lorenzo Avenue, Felton, CA	18500 Limekiln Canyon Road, Los Gatos, CA
Hours	M-F 7:00 am - 5:00 pm.	M-F 7:30 am - 3:30 pm Oils and Asphalt 3:45 pm for Aggregates	M-F 7:00 am – 5:00 pm ****	M-F 7:00 am – 3:30 pm	M-F 6:30 am – 3:00 pm
PRODUCTS					
Aggregate Base	3/4" and 1 1/2" Class 2 and Class 4 Base. Blue granite- hardest granite. Higher clay, medium dust.	3/4" Class 2 Base and 3/4" Class 4 Base 1 1/2" x 3/4" Unwashed Higher clay, medium dust.	CRB 3/4" Minus High clay content, highest dust level. Best use on steep slopes after granite is laid – acts as a mortar.	3/4" Class 2 Base/ Recycled Base and 3/4" Sub base Lowest dust level	Do not carry
Slurry Seal Aggregate	Type 1, 2 and 3 (used in oiling applications)				
*Crushed/ Drain Rock**	1/4", 1/2", 3/4" and 1 1/2" Drain Rock	3/4" x 1 1/2" and 3/4" x 1/2" Drain Rock	3/4" x 1 1/2" and 3/4" x 5/8" Drain Rock		3/4" and 1 1/2" Drain Rock 3/4" x 1/2" and 1/2" x 3/8" Crushed, 3/8" Pea Gravel
Slope protection	Slope protection (Rip Rap/Coarse Rubble/ Gabion)		Rip Rap and Non Spec Rip Rap	Rip Rap	4' x 8" Gabion
Bank Run		Fine and Coarse Bank Run	Bank Run and Bank Run Rock		
Screenings	1/4" x #10 Premium, 5/16" x #8, 3/8" x #6, and 1/2" x #4 Screenings	Screenings			1/4" x #10 and 1" x #4
*Fill Material***		Arena Sand		X and Select Fill (#4 minus), Cyclone Sand (Very Fine)	P G & E Sand
Engineered Fill				Engineered Fill (6" minus)	Washed Fines
*Large Rock****	5" x 10" (After dumping on hillside hand stack face for strength and bank stability.)	3" x 10", 5" x 10", and 6" x 18"	4" x 12"		3" x 5" bridging stone
Permeables	Class 1 Type A and B Perm	Class 1 Type A			Class 1 Type A and B Perm, Class 1 Bedding

IX.SOURCES

California Department of Fish and Game. *California Salmonid Stream Habitat Restoration Manual*, Chapter 9: Upslope Assessment and Restoration Practices. Available online at www.dfg.ca.gov. April 2001.

Gordon Keller, PE. (Geotechnical Engineer) and James Sherar, PE. (Logging Engineer). USDA Forest Service. *Low Volume Roads Engineering Best Management Practices Field Guide*, Chapter 4. Available on-line at: http: //www.zietlow.com/manual. July 2003.

San Mateo Resource Conservation District. Common Mistakes with Culverts handout.

The County of Santa Cruz Planning Department: Environmental Division. *Maintaining Your Private Road*. September 1982.

USDA Natural Resources Conservation Service. Soil Erosion and Roads handout.

USDA Soil Conservation Service (now the Natural Resources Conservation Service) and Central Coast Resource Conservation and Development Program. *Drainage Improvement Guide for unpaved roads*. January 1988.

Weaver, William E. and Hagans, Danny K. Pacific Watershed Associates. *Handbook For Forest and Ranch Roads: A Guide for planning, designing, constructing, reconstructing, maintaining and closing wildland roads*. Available from Pacific Watershed Associates at (707) 468-9223, ext.3. June 1994.