CHAPTER 5
ROAD MAINTENANCE

5.1 ROAD TREATMENT AND DESIGN PRINCIPLES

GOALS OF TREATING COUNTY ROADS

In treating maintenance and design problems on county roads, our goals are to:

- ✓ Prevent or minimize delivery of sediment and chemicals to streams.
- ✓ Prevent or minimize the interruption of natural hillslope and stream runoff patterns.
- ✓ Protect aquatic and riparian habitat.
- ✓ Restore and/or provide access for adult and juvenile fish migration on all salmon and steelhead streams.

To accomplish this goal, we need:

- ✓ Solutions based on treating the causes of erosion and sediment delivery
- ✓ Low impact solutions that protect water quality
- ✓ Low cost, effective solutions
- ✓ Permanent, low maintenance solutions

INTRODUCTION

Watersheds and streams have a natural background rate of erosion that can be substantially increased by human activities. Delivery of eroded sediment to stream systems occurs through various transport processes that operate in all watersheds. Natural erosion and sediment delivery varies from relatively low amounts in stable watersheds underlain by resistant rock types, to comparatively high amounts in watersheds that have soft rock types that erode more easily. During large storm events or extremely wet winters, mass wasting or landsliding, large-scale gully erosion, stream crossing failure, and stream bank erosion are more likely to occur. Between large storm events or during poor water years, erosion rates are generally lower and overall sediment delivery is low, although sediment may still enter the stream from various erosion processes, particularly associated with road and inboard ditch drainage practices.

Native anadromous salmonids have evolved and successfully adapted through eons of time to changing stream habitat conditions produced by storms, floods and natural geologic events within this dynamic environment. However, excessive man-caused sediment delivery can combine with natural sediment production and delivery to streams to cause both impacts to water quality, as well as deleterious effects on anadromous salmonids by filling in pool habitat and embedding spawning substrate. Roads are often singled out in the sediment assessment process and in water quality investigations for

several reasons. Roads are typically a common and disproportionately significant source of accelerated sediment delivery in managed watersheds. Fortunately, most significant and common erosion problems occurring along roads can be predicted and cost-effectively prevented or treated.

EROSION AND SEDIMENT DELIVERY

Roads accelerate the natural background rate of erosion. They are subject to failures and severe erosion during large, infrequent storms, as well as chronic surface erosion every time it rains and runoff occurs. Three processes are responsible for most erosion from roads:

- *Chronic surface erosion* from bare soil areas including unpaved road beds, turnouts, road ditches, and road cutbanks – any bare soil is subject to surface erosion during rainfall and runoff events;
- *Fluvial erosion*, including gullying, erosion of stream crossings and stream bank erosion, that results in the direct delivery of eroded sediment to stream channels;
- *Mass wasting or landsliding* on road cutbanks and fill slopes, which may deliver sediment to a stream, but almost always interferes with traffic flow and public safety.

A portion of this eroded sediment is delivered to stream channels, either directly when a stream bank collapses into a stream, or indirectly when eroded sediment is carried by runoff through ditches, drains or gullies before being discharged into a stream channel (Figure 1). Eroded sediment that is not delivered to a stream is either permanently stored, or stored temporarily until the next storm takes it away and delivers it to a stream.

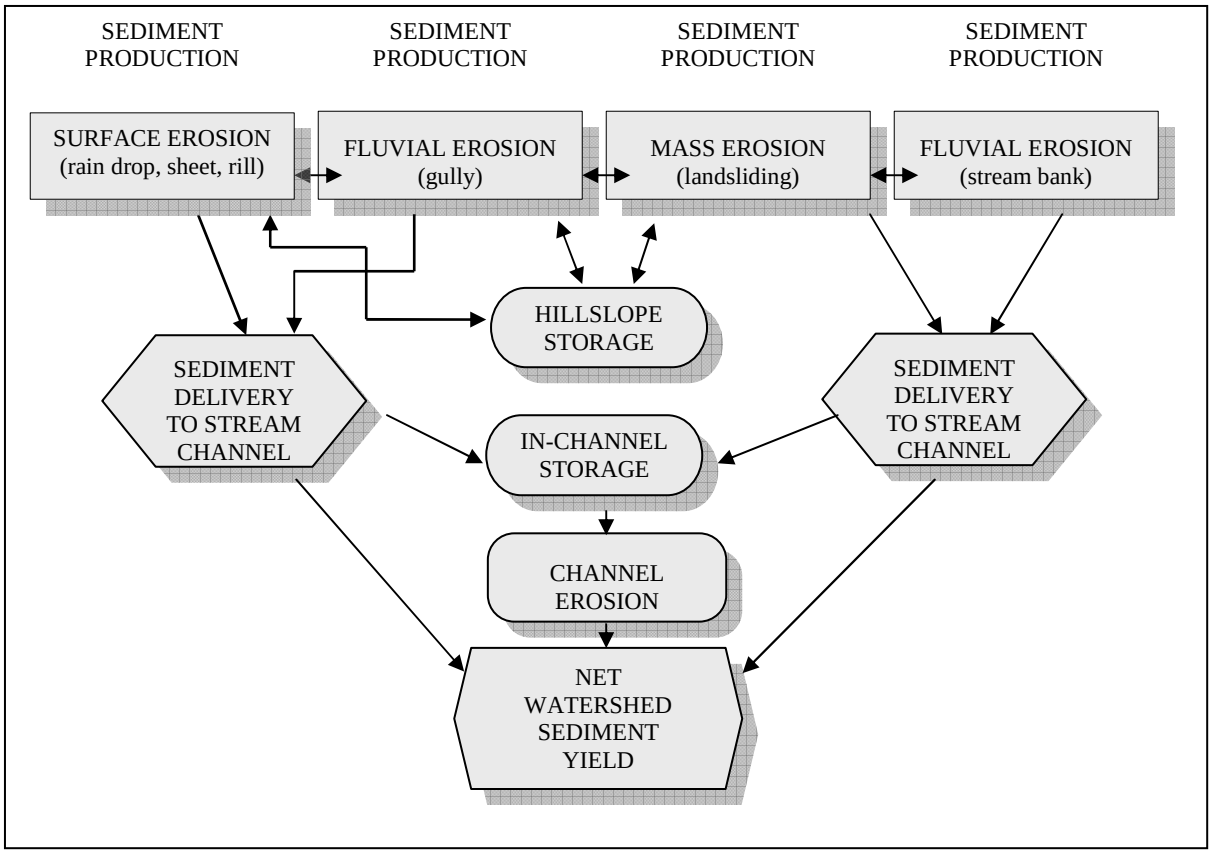


Figure 5.1 Flow chart of erosion and sediment delivery to stream channels.

Recognizing and understanding which of these erosion processes is occurring at a given location is crucial to designing the appropriate treatment or corrective measures. Once sediment is delivered to a stream, even the smallest of streams, it is seldom retrievable. Any sediment originating from county maintained roads effects water quality and aquatic habitat. Erosion prevention and control of sediment delivery must take place along the road, before eroded sediment gets delivered to a stream channel.

Of all the erosion processes in a watershed, road-related erosion is often the most easily identified and treated. Successful treatments for erosion prevention and erosion control along county roads should be designed to address the erosion process (surface erosion, fluvial erosion, or mass wasting). Not every source of sediment can be completely eliminated or prevented, but much of it can be. The choice should be among the most effective and cost-effective methods for reducing the risk of erosion or reducing the volume of eroded sediment that is delivered to streams.

Surface Erosion

Surface erosion results from raindrop impact and un-channeled water flowing over bare soil during and after rainstorms. Exposed soil is a common feature along roads, and anywhere there is bare soil there will be surface erosion. This includes cutbanks, ditches,

turnouts and unpaved sections of road. Although it is a chronic process, the more intense the rainfall and the greater the runoff, the more surface erosion occurs. Surface erosion turns into sediment delivery when the runoff discharges into a stream channel, often through rills or small gullies, or directly through road ditches.

Sediment Control Principles for Surface Erosion

- Keep bare soil to an absolute minimum when conducting land use activities. This is the single most effective method for preventing land use related surface erosion.
- Mulch or revegetate bare soil adjacent to stream channels, or other flow transport paths, to the break-in-slope near those areas. Mulching is the single most effective and cost-effective method for controlling surface erosion.
- Keep runoff from bare soil areas well dispersed. Dispersing runoff keeps sediment on-site and prevents sediment delivery to streams.
- Direct any concentrated runoff from bare soil areas into natural buffers of vegetation or to gentler sloping areas where sediment can settle out.
- Prevent rills by breaking large or long bare areas up into smaller patches that can be effectively drained before rills can develop.
- Disconnect and disperse flow paths, including roadside ditches, which might otherwise deliver fine sediment to stream channels. This prevents most sediment delivery.

Fluvial Erosion

Definition - Fluvial erosion includes gullying and stream bank erosion. Gullies, eroding channels greater than 1 ft^2 in cross section, form when concentrated runoff scours and erodes soil along its path. Along county roads, gullies are commonly found where road surface runoff has been collected and then discharged on adjacent hillslopes, where "shot-gun" culverts discharge onto erodible fill slopes, or where stream crossing culverts have plugged and overtopped.

Gullies are most commonly located below the outlets of ditch relief culverts, berm drains and below berm breaks; at shotgun culverts; on stream crossing fill slopes; and where runoff from upslope private properties flow over the road cut slope. The largest gullies often form when a stream-crossing culvert plugs and flow overtops the road. During large, infrequent storms and floods, stream crossings commonly fail in the following ways:

- Overtopping, which may occur when a culvert plugs, or its capacity is exceeded and water flows over the road and gullies the outside fillslope;
- Stream diversions occur when a culvert plugs or exceeds capacity and the stream flow goes down the road, instead of over-topping the stream crossing fill;

Rate of erosion - The amount of erosion that occurs is a combined function of the flow volume or flow velocity and soil erodibility. All else equal, the greater the flow the

greater the gullying or bank erosion. Similarly, the more erodible the soil type the more soil loss will occur. Fine grained granular soils like silt and sand are most likely to erode; and rocky soils and bedrock are the least likely to erode.

Gullies usually form during large storm events, but they can also be a chronic source of sediment where gullies gradually increase in size or stream banks continue to erode during small and moderate runoff events. The large storm events usually trigger greatly increased fluvial erosion, as new gullies form and existing gullies enlarge.

Sediment delivery - Fluvial erosion is usually a very efficient sediment delivery mechanism. The larger a gully system, the more likely the eroded sediment will be delivered directly to a stream channel. Fluvial erosion rates can vary greatly between watersheds, depending on soil types, land use and land management practices. Finally, even gullies that have been stable for years can serve as efficient conduits for fine sediment delivered from other sources, such as road surfaces and ditches. Gullies are like conveyor belts; any sediment delivered to a gully system from another sediment source such as road surface runoff or cut bank erosion, is likely to deliver to a stream channel somewhere down slope.

Sediment Control Principles for Fluvial Erosion

- Prevent gullies by dispersing runoff from road surfaces, ditches and construction sites, by correctly designing, installing and maintaining drainage structures (e.g., road shape, rolling dips, culverts, etc.) and by keeping streams in their natural channels. No single point of discharge from a road or other disturbed area should carry sufficient flow to create gullies. If gullies continue to develop, additional drainage structures are needed to further disperse the runoff.
- Direct any concentrated runoff from bare soil areas, such as road surfaces, into natural buffers of vegetation, or to areas where sediment can settle out of the runoff.
- Dewater active gullies to prevent their enlargement and to reduce their capacity for sediment transport.
- Dewater old gullies, even if they are not actively eroding, so they no longer carry fine sediment to streams.
- When dewatering is not possible, options include channel armoring and grade control structures. However, these specialized erosion control techniques are more costly and less effective than prevention and dewatering gullies. Channel armoring and grade control structures typically require specific design, proper installation, and a commitment to maintenance.

Mass Wasting

Definition - On county roads, the two most common types of landslides are fill slope failures along the outer half of a road built on steep slopes, and cutbank failures where

the natural hillslope has been undercut by road construction. Where roads are unstable, it is usually because of poor construction or maintenance practices (e.g., the use of uncompacted fills, fills containing organic debris or sidecast spoil disposal) or because of the location where they are built (e.g., steep slopes, unstable geologic materials or soils, or undercutting by stream bank erosion). Unstable roads are most commonly located on steep hillslope areas, and on soils or geologic materials that are regionally know to be unstable. Roads, especially wide roads, increase the frequency of landsliding by undercutting hill slopes, sidecasting poorly compacted fill onto steep slopes, and discharging road runoff onto potentially unstable slopes.

Rate of erosion – In many watersheds in California, mass wasting is a very important process of episodic (storm-triggered) sediment production and delivery to streams. Bigger storms are noted for increasing numbers of landslides, and this is especially true along roads. Some unstable fill slopes and cut banks fail all at once, while others show signs of instability for years before suddenly sliding. Signs of unstable road fillslope include cracks and scarps in the roadbed, and leaning trees on the fill slope. Signs of cutbank instability include leaning trees, scarps and the occurrence of failures, slumps and gullies that deposit material on the roadbed. These signs can be used to predict the location of road failures and to implement preventive treatments.

Sediment delivery - Landsliding creates sediment delivery when material slides into a stream channel. Some types of landslides are efficient at delivering sediment to streams while others rarely result in sediment delivery. Factors affecting direct sediment delivery from fill slope landslides include proximity to a stream, slope steepness, slope shape, moisture content, and soil composition. Road cutbank landslides are notoriously frequent where roads cross steep hillslopes, but typically lack major amounts of sediment delivery unless they are large enough to pass over the road and continue downslope. In contrast, road fill-slope failures are less frequent but result in direct sediment delivery when they are located close to a stream channel. Very few landslides deliver all their material to a stream. Some sediment is usually stored on the hillslope before reaching the stream.

<u>Sediment Control Principles for Mass Wasting</u>

- In general, the smaller the landslide, the more easily it can be prevented or controlled. In contrast, larger management-related landslides may be preventable, but they are very expensive to control once they begin sliding.
- Prevent accelerated landsliding by avoiding, minimizing or eliminating future sidecasting on steep or streamside hillslopes.
- Divert surface runoff and subsurface drainage to stable sites away from steep, unstable or potentially unstable slopes.
- Small fill slope landslides are often effectively prevented or controlled by direct excavation of all or most of the potentially unstable material. This is often the most effective and cost-effective technique for preventing road-related fill slope landsliding. If the roadbed is too narrow, move the road into the cutbank (cheapest) or rebuild the road with a structurally reinforced fill (most expensive).

- Control sediment delivery from some medium and large size fill slope landslides by excavating and removing material at the head of the slide. Removal of mass from the top of a slide may unload the slide sufficiently to stabilize the remaining mass. The amount of unloading required is a technical question that requires professional analysis, and the outcome of the unloading is not a certainty. A trained engineer or geologist should be consulted.
- The most cost-effective sediment control treatment for large, uncontrollable landslides is often direct excavation and removal of slide material poised for delivery to a stream. This is the one-for-one rule where every cubic yard of material removed is a cubic yard not delivered to a stream by continued landsliding. This technique reduces sediment delivery but does not prevent or control landslide movement.
- Sediment delivery from most cutbank landslides is not great, unless they are very large. Excavate landslide debris that is deposited on the road or in the ditch and haul it to a stable disposal site.
- Large, old landslide scars are ugly but the main process is often surface erosion and gullying of the surface. These processes are often difficult and costly to control due to the extremely steep slopes and harsh site growing conditions.
- Revegetation is a valid long-term restoration technique for unstable and potentially unstable slopes, but revegetation is sometimes very difficult and the benefits will take decades to occur

"BIG THREE" COUNTY ROAD MAINTENANCE AND DESIGN PROBLEMS

Public roads, especially county roads, are unique and at an inherent disadvantage in meeting today's water quality objectives. They were usually designed and constructed many decades ago, and many are located in riparian zones so close to streams that water quality impacts cannot be avoided. They were often built to follow early private road alignments, for convenience and to minimize construction costs. Water quality protection was not a consideration. Although elements of poor location cannot be easily addressed, as there is little or no realistic opportunity to alter their current alignment or location, design deficiencies can be solved through a program of gradual upgrading and long-term maintenance activities.

In spite of their inherent and inherited problems, many county roads have significant and correctable deficiencies in three of the most common sources of road-related water quality impacts. These are related to elements of 1) road surface drainage, 2) stream crossings, and 3) slope stability.

1) Road Surface Drainage Design

Standard drainage engineering practice calls for the collection, concentration and rapid discharge of road runoff into natural stream channels. This is the way roads have been

historically designed. County roads often have long ditches that are hydrologically connected to nearby stream channels. That is, they carry surface runoff and fine sediment in ditches and these ditches discharge the flow into stream channels, either directly or through points of connectivity such as ditch relief culverts and gullies. This design facilitated the classic engineering approach to road surface drainage, but also kept costs to a minimum, in that few ditch relief culverts were required.

Four types of road features contribute to the continuing problem of "hydrologic connectivity" and its impacts on water quality. These include features or structures that collect and concentrate road surface runoff, and structures that then deliver the runoff and fine sediment to stream channels. These collecting and delivering road drainage structures are the very things that can be redesigned and modified to reduce water quality impacts from county roads while still satisfying requirements for public safety.

- ✓ *Road surface shape* (i.e. insloped, outsloped or crowned) determines whether all or a portion of the runoff, including sediment and chemical pollutants originating from the road right-of-way, are delivered to inboard ditches and stream channels or dispersed onto the adjacent hillslopes. (See Figure 5.2) Most county roads are paved, and this limits the amount of surface erosion that occurs throughout the road system. However, cutbanks, turnouts, ditches and many private drives are not surfaced, and they contribute storm runoff and eroded fine sediment to the road's surface drainage system, and ultimately to local stream channels.

- ✓ *Inboard ditches* are designed to collect and deliver road run-off and road and cutbank derived sediment directly to ditch relief culverts or road-stream crossings. This has been classical engineering design of road surface drainage systems. Problems with inboard ditches are plentiful, and include erosion and down-cutting within the ditch, plugging of ditch relief culverts, alteration of natural hillslope drainage patterns, collection of emergent groundwater, and increased volume and velocity of runoff in both the ditches and adjacent stream channels. In more urbanized areas road drainage can deliver pollution from private driveways, as well as yard treatments such as fertilizers, insecticides and herbicides.

- ✓ *Cross-road drainage structures* such as ditch relief culverts often collect and discharge sufficient water to create gullies on hillslopes below the road. Likewise, water rapidly discharged from road ditches into natural drainage channels can increase a channel's normal water load and force the channel to adjust by eroding its banks.

- ✓ *Berms* created along the outside edge of many county roads can retain and concentrate runoff over long road distances, similar to a ditch. Infrequent or inadequate berm breaches can cause the creation of hillslope gullies or deliver road-derived sediment and pollutants directly to stream channels.

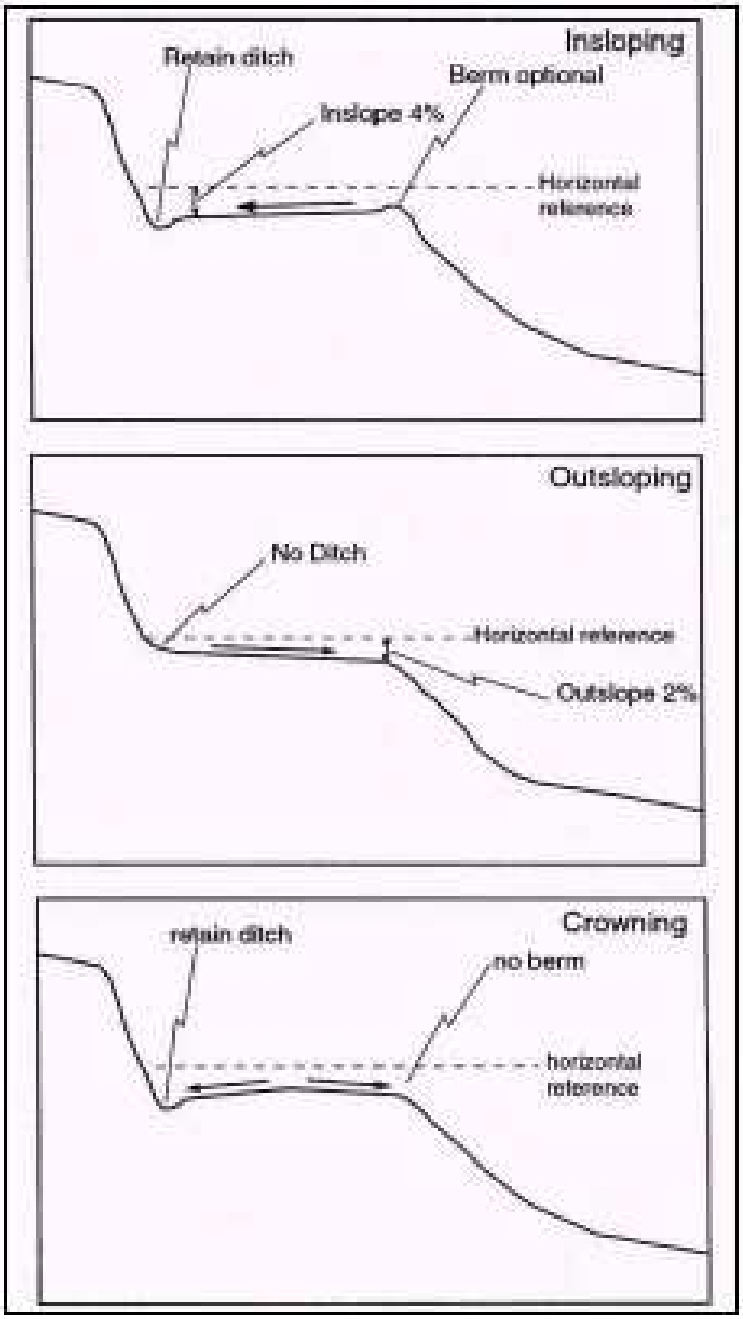


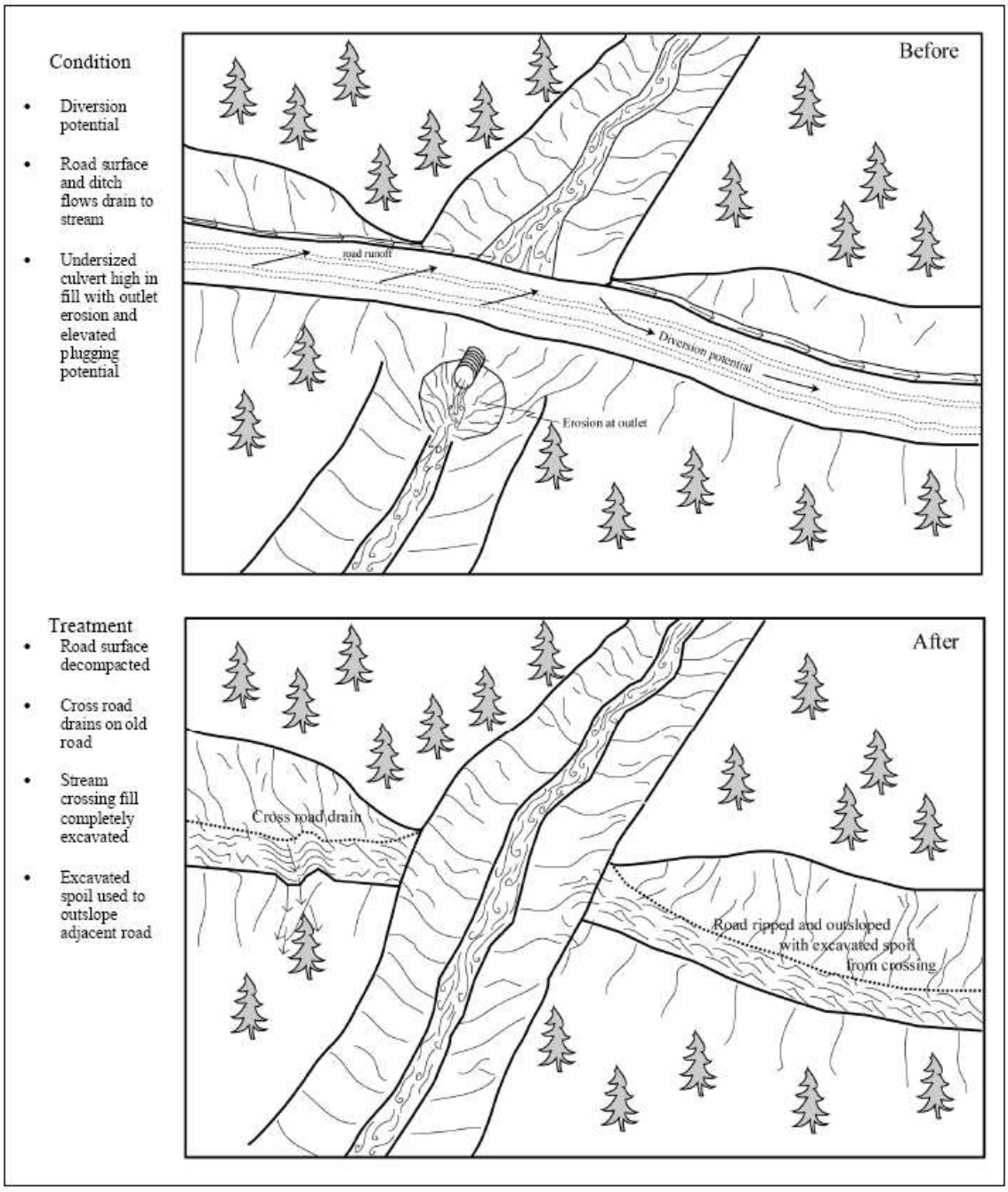
Figure 5.2 Utilizing road shape to reduce surface runoff. California Salmonid Stream Habitat Restoration Manual Chapter X. CDFG 2002.

2) Stream Crossing Design

Most existing stream crossings on county roads, especially culverted crossings, were built decades ago, and many exhibit serious deficiencies that impact or threaten water quality and aquatic resources, including listed salmon species.

- ✓ *Culverts* are the weak-points in most road systems, and many county roads have culverts that are significantly under-designed for today's standards. The most important culvert design deficiency is with *sizing*. Only a small percentage of culverts are sized to pass the 100-year design flow that is the current standard across California's wild lands. In addition, culverts that are undersized are more likely to fail by *plugging* with organic debris and sediment than by overtopping by flood flows. Most county road stream crossing culverts have not been designed to accommodate (or pass) organic debris and heavy sediment loads. Finally, culverts installed decades ago were often set high in the fill, not at the natural channel grade, and out-of-line with the natural channel. *Misalignment* encourages culvert plugging, increases maintenance requirements and can result in severe outlet erosion where shotgun culverts discharge onto unprotected fillslopes.
- ✓ *Stream diversion potential* is a design flaw in many culverted stream crossings on county roads, and elsewhere. When a culvert plugs, or its capacity is exceeded during a flood event, flood waters can only go two places: 1) across the road, over the fillslope and back into the natural stream channel, or 2) down the road and into another culvert or onto an adjacent hillslope. On average, the diverted stream is much more likely to cause severe off-site erosion, property damage and water quality impacts. Stream diversions can lead to inboard ditch erosion, additional stream crossing failures or diversions where diverted streamflow overwhelms culverts down the road, erosion and enlargement of natural stream channel dimensions, severe hillslope gully erosion, or it can trigger off-site road fillslope and hillslope landsliding.
- ✓ *Fish passage* is a critical stream crossing design consideration that must be considered today. Because of their location, county roads often parallel and cross streams that are, or once were, used by anadromous salmon and trout for spawning or rearing. Until recently, culvert and stream crossing designs did not consider fish passage requirements, let along the needs for passage at all stages of the salmon's life cycle. By not considering this design element in their original construction or in subsequent culvert replacements, many stream crossings on county roads are currently barriers to fish passage.

Figure 5-3. Upgraded stream crossing to retain runoff in channel of origin and minimize sediment input to stream. (California Salmonid Stream Habitat Restoration Manual Chapter X. CDFG 2002).



3. Slope Stability Design

Landslides are usually triggered by storms and floods. They episodically contribute sediment to stream channels via fill failures (directly) or indirectly through cutbank landslide cleanup and other spoil management or road maintenance practices. Historically, landslide prevention work has been designed and undertaken to keep roads open, and not with the explicit goal of water quality protection. Similarly, until recently spoil management was a maintenance practice designed and conducted to keep roads clear, and not as a tool to protect and maintain water quality and fish habitat. Design standards and maintenance practices for county roads now need to actively consider water quality protection when identifying and treating potential fill failures and when planning and conducting spoils disposal from cutbank landslides.

- ✓ Fillslopes exhibiting tension cracks or scarps along the outer half of a county road, even when paved, frequently forecast future landslides that can deliver sediment to nearby streams below the road, especially on very steep slopes. Water focused improperly onto fillslopes by ditch relief culverts or berm breaches may further destabilize the road edge and cause erosion below the road shoulder. Some roads are so close to streams that the fillslope encroaches on the stream and fill failures are quickly delivered to the channel.
- ✓ *Cutbank* slope failures are unpredictable yet common along county roads. They deposit most of the slide material on the road prism and in the inboard ditch. As slope failures, cutbank slides usually deliver low volumes of material to streams, except for minor surface and gully erosion of the slide deposit washing fine sediment into inboard ditches and then into streams. The major concern with cutbank slides is spoil disposal: how and where is the slide material disposed.
- ✓ *Spoil disposal* from all landslide and related maintenance and clean-up activities is a severe concern with most county road systems, as county road management actions must be confined to the road right-of-way. Standards for spoil disposal have gone from free sidecasting prior to about 1985, regardless of location, to today's near total prohibition on sidecasting of spoil materials, even though such sidecasting may not threaten water quality.

PRINCIPLES FOR REDESIGNING AND TREATING COUNTY ROADS FOR WATER QUALITY PROTECTION

In this section we propose a three-pronged process, called "storm-proofing," for redesigning and treating County roads to lessen their impact on water quality, while still meeting transportation and safety objectives. This approach is complemented by a series of principles that can be used to identify, prescribe, prioritize and implement road-upgrading techniques. Storm-proofing consists of specific road upgrading and maintenance practices designed to lower the frequency and magnitude of stream crossing and road fillslope failures, and to reduce both episodic and chronic sediment delivery.

County roads are sometimes poorly located in relation to water quality. Designing for better locations is generally not a practical solution to road-related water quality problems, because property lines and rights-of-way are legally fixed. With few exceptions, such as road alignments through public lands, County roads will remain where they are currently located. For this reason, the main tools that are available to protect water quality include specific practices designed to make roads more resilient to infrequent, large storms and erosion, and to reduce their chronic discharge of fine sediment and turbid runoff.

Storm-Proofing County Roads

The vast majority of County roads were constructed many decades ago with very different design and construction standards than are in effect today. Historic designs included long ditches discharging storm runoff and fine sediment directly to streams; stream crossings with short, undersized culverts, diversion potentials and high plugging potential; stream crossings that are barriers to fish migration; fillslopes that are susceptible to slope failure; and uncontrolled spoil disposal practices. Those days are gone, and they have been replaced with standards that meet transportation needs while protecting water quality.

The fundamental design components of a storm-proofed county road are simple in concept, and there are a number of alternative methods or practices that can be used to achieve these objectives:

Storm-proofing road surface drainage

- Roads are hydrologically "disconnected" from the natural stream channel network; this includes disconnecting current discharge sites by installing additional drainage structures or features such as ditch relief culverts, road shaping, berm removal, and rolling dips.
- Typically no more than 150 feet of road or ditch should drain directly to any stream crossing.
- Road surface and ditch drainage structures are installed frequently enough such that gullies do not form below the road and those with gullies are dewatered.

Storm-proofing stream crossings

- Drainage structures (culverts, fords, bridges, etc) are designed to accommodate the 100-year peak flow, including floating debris and sediment.
- Culverts are designed to have a low plugging potential.
- Stream crossings do not have a diversion potential.
- Culverts are bedded at or near the natural channel grade, and in alignment with the natural channel.
- Shotgun culvert outlets are fitted with downspouts or energy dissipation.
- Culvert inlets, outlet and bottom are in open and sound condition.
- Crossings of Class 1 streams accommodate adult and juvenile fish passage.

- Bridges do not significantly restrict channel capacity for the 100-year flood flow.

Storm-proofing unstable fill slopes

- Slope failures that threaten sediment delivery are treated to prevent landsliding or minimize sediment delivery when a failure does occur.
- Small, unstable fillslopes that would deliver are excavated or structurally stabilized so they do not fail during storms.
- Larger unstable fillslopes with potential to deliver are stabilized by buttressing, retaining, partial excavation, reconstruction, or by other means.
- Excavated spoil is stored in a location that is stable and will not deliver eroded sediment to a stream.

A STRATEGY FOR IMPLEMENTING CHANGE

A three-step process can be used for prescribing and conducting storm-proofing on County roads. The steps include:

- Identifying problems and prescribing treatments
- Prioritizing proposed erosion prevention activities (to take advantage of limited funds)
- Implementing upgrading work

A forward-looking sediment inventory, one that identifies treatable sites of future erosion and sediment delivery, is first conducted along a County road system. This inventory utilizes field assessments that are based on logical, standardized, science-based observations, measurements, and deductive reasoning (CDFG, 2004). The goal of this uniform data collection and resultant inventory is to deliver a storm-proofing and road upgrading plan that:

- Identifies the nature and magnitude of the erosion and sediment delivery problems;
- Provides quantified risk assessment data;
- Estimates the volume of sediment that could be prevented from delivery to streams;
- Develops a prioritized list of treatment prescriptions and associated cost estimates.

Data analysis is performed when all the inventory information has been collected, properly entered in the database and cleaned. The use of a database allows for rapid data analysis, cost analysis, and prioritization. Data tables developed for the restoration plan contain summary information regarding the number of sites recommended for treatment, erosion potential, treatment immediacy (priority), potential sediment savings, recommended treatments, excavation volumes, estimated heavy equipment and labor hours and costs.

After prescribing treatments and evaluating costs (for access and treatment), employ cost-effectiveness calculations and other criteria to prioritize all the inventoried sites for actual treatment. The cost-effectiveness of treating a restoration work site is defined as the average amount of money spent to prevent one cubic yard of sediment from entering or being delivered to the stream system (Weaver and Sonnevil, 1984). Cost-effectiveness is determined by dividing the cost ($) of accessing and treating a site, or group of sites, by the volume of sediment prevented from being delivered to local stream channels. Use cost-effectiveness as a tool to prioritize potential treatment sites throughout a watershed or along a road network. The key elements in determining cost-effectiveness are a fair and accurate estimate of future sediment delivery (in the absence of treatment) and a reasonable estimate of treatment costs.

Once they are prescribed and prioritized, and funding has been secured, storm-proofing projects are implemented. For water quality and fisheries protection, the goal of upgrading County roads is to minimize the contributions of fine sediment from roads and ditches to stream channels, as well as to minimize the risk of episodic erosion and sediment delivery when storms and floods occur. The most important of these include upgrading stream crossings for the 100-year storm event, prevention of culvert plugging and failure, elimination of stream diversion potential, removal of unstable sidecast and fill materials from steep slopes, and the application of drainage techniques to improve dispersion of road surface runoff. The assessment plan will define which are the most critical and most cost-effective projects to undertake first.

Principles of Storm-Proofing Implementation

Below are six fundamental road assessment and treatment principles, which if observed, will go far in protecting water quality and stream habitat. Although ensuring that roads are open and safe to the traveling public remains each county's number one priority, water quality and habitat goals are concurrently achievable.

These principles are straightforward and sometime obvious, but many are not systematically or routinely applied. Most principles are simple procedures or ways of thinking about and seeing road-related problems in a new light, and formulating long-term solutions. Developing these thoughts and supporting these principles through in-house training, education, field trips, and implementation practices will encourage managers and field maintenance staff to think about ways they can achieve both goals. Conducting road storm-proofing requires both recognition of problems and solutions, as well as a long term commitment to gradually chip away at prioritized projects, and to seek needed funding, in a process that will likely be measured in decades, not years. Getting everyone "on the same page," thinking in the same way, is the first step in this process.

<u>Principle #1. Treat causes, not symptoms</u> – Learn to recognize the true cause of erosion and attack the cause, not the symptom, of erosion and sediment delivery.

The only way to solve a problem is to treat its cause. If the cause of culvert failures, stream diversions, fillslope failures and road connectivity are not addressed, water quality degradation and road failures will continue to occur.

For example, repeatedly cleaning undersized culverts of accumulated sediment and debris is treating the symptom of the problem. The cause of the problem is that the culvert is not properly designed to effectively handle woody debris or heavy sediment loads, and treating the cause would entail the installation of a larger culvert or a debris barrier. Another example would be the treatment of gullying below a ditch relief culvert or berm drain outlet. Armoring the slope or gully to prevent continued erosion on the hillslope would be a symptomatic treatment, whereas reducing the volume of flow to the culvert or berm drain, by installing additional drainage structures along the road, would address the cause of the problem.

In order to begin the process of truly correcting causes and lowering the risk of future erosion and sediment delivery, many counties in coastal California have undertaken comprehensive inventories and assessments along county roads. These include the counties of Trinity, Del Norte, Humboldt, Mendocino, Sonoma, Marin, San Mateo, Santa Cruz and Monterey. The assessments have focused on both chronic and episodic sediment sources utilizing Fish and Game approved road assessment, erosion control, and storm-proofing protocols (CDFG, 2004, Chapter 10) as well as culvert inventories to evaluate and correct fish passage (CDFG, 2003, Chapter 9).

These approved approaches provide county managers and engineers with a prioritized "action plan" which defines which stream crossing sites or road reaches pose a higher risk of ongoing or future sediment delivery to streams and impacts to water quality. Likewise, the methods provide a systematic method for identifying and correcting County stream crossings that restrict or prevent fish passage. These procedures allow county staff to evaluate the extent and magnitude of the sediment production risk or fish passage problems, and serves as a long term planning tool for identifying and prioritizing road storm-proofing and upgrading activities, and correcting fish passage problems.

<u>Principle #2. Fix problems, don't apply band aides</u> - Changing things that don't work is the only way to improve road performance and protect water quality - if you don't change things, reoccurring problems will reoccur.

The only sure way to improve the response or behavior of a road and prevent water quality problems is to change site conditions so that they are less susceptible to failure. For example, cleaning plugged culverts during a winter storm does not solve the problem of a high plugging potential. In contrast, culvert plugging potential can be permanently reduced by the installation of a larger culvert sized to pass the 100-year flood flow, a debris trash rack upstream from the culvert inlet or a flared inlet.

<u>Principle #3. Be forward-looking and use prevention strategies</u> - It's generally more effective and less expensive to prevent erosion than to control, repair or potentially pay fines for road damage and sedimentation.

Once erosion gets started, it can be very costly, or sometimes impossible, to control. A "properly designed and upgraded" road or construction site saves money in the long run, needing less short and long term maintenance while avoiding catastrophic failures and expensive repairs. Once sediment is introduced to a stream channel, it can rarely be efficiently removed from the channel. Both state and federal agencies with responsibility to enforce the Clean Water Act and the Endangered Species Act are increasingly looking at county road practices and activities that impact water quality. Water quality violation can result in large fines that should be viewed as part of the cost of not preventing erosion. Consequently, every effort should be made to recognize where sediment is being delivered to any stream, and develop a treatment prescription that either prevents future sediment delivery or minimizes the volume of sediment delivery.

<u>Principle #4 – Expect and anticipate floods</u> – Apply practices and install structures that have been designed to withstand 100-year flood events.

Large magnitude winter storms create the most havoc with road systems. Don't design your roads to "get by" during the average winter, and don't guess at what needs to be done to storm-proof your road. Don't replace what's already there by the same thing or by what you might have available in the culvert yard simply because you have the correct size. Similarly, if a stream-crossing culvert is undersized and is to be replaced, don't guess what size culvert should be installed. Conduct road assessments in advance and then consult and use these assessments in the normal course of road upgrading and maintenance work. It is important that road supervisors know how to use and apply these plans. Such foresight and planning will minimize future stream crossing failures, prevent stream diversions and reduce the number and size of road fill failures.

<u>Principle #5. Disconnect and disperse runoff</u> - Disperse road and ditch runoff frequently to prevent gullying and to disconnect road surface runoff and ditch flow from natural stream channels.

Chronic erosion and sediment delivery from roads impacts stream channels every year. In order to disperse (not collect) roadbed runoff on unsurfaced roads, converting insloped and flat roadbed shapes on unpaved roads to outsloped or crowned road beds, or frequently "roll" the road shape to provide for regular drainage. Likewise, install frequent drainage structures (rolling dips, ditch relief culverts, berm breaks) along roadbeds and inboard ditches to disperse road runoff.

<u>Principal #6 – Think and act "holistically" and long-term</u> - Envision how your project will function in the first storm, and in the "big" storm; recognize ways you can anticipate and avoid potential negative impacts or future problems while

increasing resource protection resulting from road upgrading and road maintenance practices.

- Predicting performance - Envision project performance and how your project will function in the first storm, and in the "big" storm. Don't just do things because you've always done it that way. Always consider the unintentional effects and impact of your work. Envision your project or maintenance work as it responds to heavy winter rainfall and runoff events; where will runoff go and how much will occur? See your work through the "eyes" of a raindrop and a rivulet of runoff during the first winter storm, and through the "eyes" of the fish in the stream that may receive that runoff.

- Riparian protection - The riparian zone is the land and vegetation adjacent to lakes, watercourse, estuaries, and wetland areas. Protecting and restoring healthy riparian zones is the best defense for maintaining a healthy stream. The plants in the riparian zone create cool water temperature, supply large wood needed for fish habitat, and filtrate sediment and pollution before it reaches the stream. They also provide stream bank and hillslope stability, help with channel stability and promote high quality fish and wildlife habitat.

- Vegetation and revegetation - Protect and retain existing vegetative cover. Plant cover provides your cheapest form of effective and long-term erosion control. Native grasses, shrubs and trees help stabilize cut and fill slopes. Make sure a revegetation plan is included as a final element of all road-upgrading projects, especially those involving vegetation removal. A vegetation management plan should address the removal of invasive non-natives.

- Fish passage - When replacing or upgrading stream crossings on salmon and steelhead bearing streams your project needs to provide for fish passage. No stream crossings should block the upstream or downstream migration of salmon and steelhead at all life stages. Monitor structures for performance during the winter season. Consult with a qualified fisheries biologist or engineer who is trained in evaluating and implementing fish passage projects.

- Maintenance monitoring - Monitor conditions, record and report your observations to appropriate division supervisors. Prioritize your response to problems to prevent more serious failures and sediment problems . Develop a "maintenance-monitoring" system for recording problems and tracking maintenance performed at sites; and keep these records in an electronic database. Over the years, as personnel come and go, this record will become your invaluable institutional memory of the County road system. Storm inspections, repairs, and maintenance monitoring are critically important tools to prevent serious damage and resource.

- The county road system was developed over the past 150 years based on public transportation needs. Some road sections are poorly located from both transportation and water quality perspectives. Often, county transportation planners or road engineers may not be aware of recurring problems on a road. It is crucial that maintenance departments promptly alert engineering or planning departments about significant problems and their impact on watercourses, so that alternatives may be considered. Maintenance monitoring is a tool to help accomplish this. Balancing the public's need for safe and open roads with the environment's need for clean water and healthy streams is challenging but not impossible. Remember: the public also needs clean water and healthy streams.

For further reference on protecting aquatic habitat while conducting road and culvert related restoration projects, see the Department of Fish and Game Salmonid Stream Habitat Restoration Manual, Chapters IX and X. Flosi et al, 2002.

5.2 PAVED ROAD SURFACES

DESCRIPTION

Paved road maintenance provides a safe roadway surface for the traveling public and prevents further roadway deterioration or failure. Repair activities include: pothole and square cut patching; replacing base and surfacing; repaving; extending pavement edge; paving graveled shoulder; crack sealing; overlay; chip seal; slurry seal; pavement marking; traffic channelization; addition of traffic control features and removal of excess material for disposal or recycling.

ENVIRONMENTAL CONCERNS

The major risks during paved road surface maintenance are:

- ✓ Discharge of the following materials into a stream channel, stormwater drainage system or riparian area:
  - o Sediment, asphalt concrete binder, liquid asphalt, asphalt concrete (AC), asphalt emulsion, sealant material, Portland cement concrete (PCC), concrete rinse water, concrete grindings and cuttings, concrete waste and diesel oil
- ✓ Harm to riparian vegetation.

BMP OBJECTIVES

- ✓ Minimize road-related materials entering storm drain inlets and watercourses.
- ✓ Reduce sediment entering storm drain inlets and watercourses.
- ✓ Encourage recycling of excess road maintenance materials.

BEST MANAGEMENT PRACTICES

GENERAL

1) Inspect all road and drainage facilities after a 25-year storm event. Report to road managers locations of road surfaces, drainage features, cutslopes and fillslopes that appear to be failing and contributing sediment to streams in order to prioritize maintenance or repair. Standardize and document reports

2) Regularly inspect equipment for leaks, damage and oil or grease buildup before starting work, and regularly in the field. Use non-organophostate hydraulic fluid. Place drip pans under any equipment needing emergency service or repair in the field. Except in emergencies, always take equipment and vehicles to a repair facility for maintenance.

3) Set up work area to minimize environmental impacts:
   - o Identify riparian areas (areas adjacent to watercourses) and keep equipment out of them.

- Designate areas for parking, fueling and minor equipment maintenance (during and after shifts) where pollutants will not be discharged to watercourses or storm drains.
- Park paving equipment over drip pans or absorbent materials.

4) Identify storm drain inlets, manholes, and watercourses before beginning work. If there is any risk of discharge of sediment or road-related material, protect storm drains with appropriate Erosion Control and Sediment Management BMPs. Make sure any wash water is contained locally, and that none is discharged into the storm drain or watercourses.

5) Make sure personnel are trained to respond appropriately to spills. Carry a spill kit for immediate cleanup of any spills related to equipment failure (see *Appendix A*-Planning and Prevention BMPs: Small Spill Kit). Do not hose down the work area or pour any materials down drains.

6) Dispose of all excess materials from paved road maintenance activities at designated sites consistent with spoil disposal and stockpile requirements for various materials (see *Chapter 7.3 Spoils Handling and Disposal*). Recycle excess materials.

SEASONAL CONCERNS

1) Perform routine maintenance during the dry season. Avoid working in wet conditions or during the wet season (October 15-April 15), except for emergencies such as pothole patching, since rain and flooding greatly increase the risk of pollutant runoff.

SPOILS AND SIDECASTING (See *Chapter 7.3- Spoils Handling and Disposal.*)

2) Avoid sidecasting of soil in all cases where it could be delivered into a watercourse, riparian area, roadside ditch or storm drain. Do not sidecast outside of the County right-of-way, without landowner's permission. In some instances, under the following guidelines (See Table below), sidecasting is allowable given remote distances from spoils storage sites. In these cases, the setback distance required depends on slope and vegetation. The presence of vegetation helps to slow the travel of sediment downslope, so good judgment is needed to assess the situation. *Do not sidecast at all* if the slope is sparsely vegetated and it appears that sediment will travel with rain runoff into a stream or estuary system, even if setback distances are applied. On slopes of 5:1 (20% gradient) or less, sidecasting is allowed beyond 150 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On 2:1 slopes (50%) or less, sidecasting is allowed beyond 300 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On slopes greater than 2:1, typically sidecasting is *not allowed at all*, however there may be rare instances on slopes greater than 2:1 where sidecasting is acceptable given very long distances from waterbodies and good vegetative cover. Seek advice from local fisheries agency staff when in doubt. Avoid concentrating sidecasting repeatedly in the same place. Never sidecast large amounts of soil from major landslides.

SLOPE GRADIENT	DISTANCE FROM WATERCOURSE, STREAM CROSSING, RIPARIAN AREA, ROADSIDE DITCH, STORM DRAIN	SIDECASTING RULE
Any slope	Appears that sediment will travel with rainwater into watercourse.	Not allowed
5:1 (20%) or less	150 feet or more	Allowed using good judgment
2:1 (50%) or less	300 feet or more	Allowed using good judgment
Greater than 5:1 (50%)	Vegetated slope long distance from watercourse	Allowed
Greater than 5:1 (50%)	Sparsely vegetated slope and it appears that sediment will travel with rain into watercourse	Not allowed

3) Temporary spoils stockpiles should be located in areas that are relatively level; relatively free of vegetation and away from streams and wetlands areas. The primary concern is to keep stockpiled materials from eroding into stream or wetland systems. Apply erosion control BMPs when needed. Do not place temporary spoils piles at the top of unstable slopes or at the edges of slopes where water will carry sediment into watercourses. Remove temporary stockpiles to permanent disposal locations before the rainy season. If emergency work is conducted during the rainy season, remove stockpile as soon as feasible and before the next rain storm.

BERMS (See *5.5- Shoulder Maintenance*.)

4) Do not leave loose soil piled in berms alongside the road or ditch. Loose or exposed soil berms are erodible and readily flushed into waterways and storm drains.

5) If any berm is left in place for public safety it must be compacted and stabilized with seeding or asphalt. Frequent well placed breaks in the berms are necessary to allow water to drain from road, preserving the natural drainage pattern of the slope.

ROAD DRAINAGE (See *5.1-Road Treatment and Design Principles and 5.6- Drainage Systems* for specifications.)

6) Note areas of natural cross drainage. Document in writing any significant changes to drainage patterns resulting from road surface maintenance and report to County Engineering or Planning.

7) On problem roads, look for opportunities to reconstruct the road to improve and maintain natural drainage patterns; for example, add rolling dips, critical dips and/or additional cross drains. (See *5.1-Road Treatment and Design Principles*).

BMP TOOLBOX

Planning and Prevention BMPs
- ✓ Seasonal Planning
- ✓ Small Spill Kit

Road Drainage
- ✓ Ditch Relief Culvert
- ✓ Rolling Dip
- ✓ Outsloping
- ✓ Critical Dip

Erosion Control BMPs
- ✓ Blankets/Geotextile Fabrics
- ✓ Mulching
- ✓ Planting
- ✓ Plastic Covering
- ✓ Seeding

Sediment Control BMPs
- ✓ Coir Log/Straw Roll
- ✓ Storm Drain Inlet Protection
- ✓ Silt Mat/Vegetated Grassy Swale
- ✓ Sand Bag
- ✓ Silt Fence
- ✓ Siltation Pond/Settling Pond

* Note: Some of these are temporary measures that need to be removed upon completion of work and replaced with more permanent structures. See Appendix A for details on removal.

PERMITS

5.2 PAVED ROAD SURFACES	
Activity or Condition	**Required permit or limitation**
Replacement of road base or surfacing next to sensitive habitats	Consult with CDFG or NOAA Fisheries as appropriate.

5.3 UNPAVED ROAD SURFACES

DESCRIPTION

Good maintenance practices on unpaved road surfaces prevents roadway erosion, deterioration or failure; helps with sediment and dust control, and provides a safe roadway surface for the traveling public. Unpaved road maintenance includes grading, repairing, or maintaining unpaved road surfaces. See *5.4 -Shoulder Maintenance* for best road design and drainage engineering techniques to use to prevent erosion and protect salmon and aquatic habitat.

ENVIRONMENTAL CONCERNS

- ✓ Discharge of sediment or dust abatement chemicals into a stream or a stormwater drainage system.
- ✓ Harm to fish and aquatic life as a result of pumping water from streams for dust abatement.
- ✓ Concentrated runoff leading to erosion.

BMP OBJECTIVES

- ✓ Preserve or improve surface drainage in the vicinity of the road.
- ✓ Disconnect road drainage features from watershed hydrology.
- ✓ Make sure drainage is self-maintaining.
- ✓ Minimize amount of road-related sediment that gets into watercourses.
- ✓ Prevent dust abatement chemicals from getting into watercourses or riparian areas.

BEST MANAGEMENT PRACTICES

SEASONAL CONCERNS

1) Perform routine road surface maintenance during the dry season. Avoid working in wet conditions and during the wet season (October 15- April 15), except for emergencies. Disturbed soil combined with rainfall, greatly increase the risk of exposed sediment runoff into streams.

2) Inspect roads and associated drainage facilities for signs of erosion or deterioration at least twice annually with at least one inspection during or after first storm events of the season with additional follow-up for severe storm events. Inspect all road and drainage facilities after a 25-year storm event. Report locations of road surfaces, drainage features, cutslopes and fillslopes that appear to be failing and contributing sediment to streams in order to prioritize maintenance or repair. Standardize and document reports.

SURFACE GRADING

3) In general, maintain unpaved roads to obtain a less erosive running surface and to minimize the need for frequent surface grading. Blade and compact a smooth surface and compact loose soils as needed.

4) Crown or slope the road to avoid ponding or concentration of runoff. Outslope all roads where possible and safe, consulting with County Engineering on specifications. (See *5.1 - Road Treatment and Design Principles.*)

5) Repair rutting/failing areas, if needed.

SPOILS AND SIDECASTING (See Chapter 7.3- Spoils Handling and Disposal.)

6) Avoid sidecasting of soil in all cases where it could be delivered into a watercourse, riparian area, roadside ditch or storm drain. Do not sidecast outside of the County right-of-way, without landowner's permission. In some instances, under the following guidelines (See Table below), sidecasting is allowable given remote distances from spoils storage sites. In these cases, the setback distance required depends on slope and vegetation. The presence of vegetation helps to slow the travel of sediment downslope, so good judgment is needed to assess the situation. *Do not sidecast at all* if the slope is sparsely vegetated and it appears that sediment will travel with rain runoff into a stream or estuary system, even if setback distances are applied. On slopes of 5:1 (20% gradient) or less, sidecasting is allowed beyond 150 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On 2:1 slopes (50%) or less, sidecasting is allowed beyond 300 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On slopes greater than 2:1, typically sidecasting is *not allowed at all*, however there may be rare instances on slopes greater than 2:1 where sidecasting is acceptable given very long distances from waterbodies and good vegetative cover. Seek advice from local fisheries agency staff when in doubt. Avoid concentrating sidecasting repeatedly in the same place. Never sidecast large amounts of soil from major landslides.

7) Temporary spoils stockpiles should be located in areas that are relatively level; relatively free of vegetation and away from streams and wetlands areas. The primary concern is to keep stockpiled materials from eroding into stream or wetland systems. Apply erosion control BMPs when needed. Do not place temporary spoils piles at the top of unstable slopes or at the edges of slopes where water will carry sediment into watercourses. Remove temporary stockpiles to permanent disposal locations before the rainy season. If emergency work is conducted during the rainy season, remove stockpile as soon as feasible and before the next rain storm.

SLOPE GRADIENT	DISTANCE FROM WATERCOURSE, STREAM CROSSING, RIPARIAN AREA, ROADSIDE DITCH, STORM DRAIN	SIDECASTING RULE
Any slope	Appears that sediment will travel with rainwater into watercourse.	Not allowed
5:1 (20%) or less	150 feet or more	Allowed using good judgment
2:1 (50%) or less	300 feet or more	Allowed using good judgment
Greater than 5:1 (50%)	Vegetated slope long distance from watercourse	Allowed
Greater than 5:1 (50%)	Sparsely vegetated slope and it appears that sediment will travel with rain into watercourse	Not allowed

BERMS (See *5.5- Shoulder Maintenance*.)

8) Do not leave loose soil piled in berms alongside the road or ditch. Loose or exposed soil berms are erodible and readily flushed into waterways and storm drains.

9) If any berm is left in place for public safety reasons (see Chapter 5-5, BMP 5) it must be compacted and stabilized with seeding or asphalt. Frequent well placed breaks in the berms are necessary to allow water to drain from road, preserving the natural drainage pattern of the slope.

ROAD DRAINAGE (See *5.1-Road Treatment and Design Principles and 5.6- Drainage Systems* for specifications.)

10) Note areas of natural cross drainage. Document in writing any significant changes to drainage patterns resulting from road surface maintenance and report to County Engineering or Planning for approval.

11) On problem roads, look for opportunities to reconstruct the road to improve and maintain natural drainage patterns; for example, add rolling dips, emergency water bars and additional cross drains. (See *5.2-Road Treatment and Design Principles*).

DUST CONTROL (See *Appendix C- Dust Palliative Application Guidelines*.)

12) Do not apply chemical dust palliatives during rain or immediately before anticipated rain. Approved dust control agents are preferred over water drafting and application.

13) Follow manufacturer's recommendations when applying chemical dust palliatives. Do not apply chemical or petroleum-based palliatives where they may enter a stream or watercourse unless specifically approved for such use

14) Dispose of excess dust abatement materials at designated sites (see *Chapter 9.4 – Maintenance Facilities- Waste Handling, Storage, and Disposal*).

15) Make sure personnel are trained to respond appropriately to spills during use of chemical dust palliatives. Carry a spill kit for prompt cleanup (see *Appendix A* - Planning and Prevention BMPs: Small Spill Kit),using appropriate procedures. Do not hose down the work area or pour any materials down drains.

WATER DRAFTING (See *Appendix C-Technical References, Water Drafting Guidelines.*)

16) Notify Department of Fish and Game, before drafting water from streams or other waterbodies for dust control or moisture conditioning, DFG permits drafting if certain basic protectionary conditions are in place. If a work site is to be temporarily dewatered by pumping, intakes should be completely screened with wire mesh not larger than 5 millimeters to prevent amphibians from entering the pump system.

17) Appendix C contains both *NOAA Fisheries Water Drafting Specifications* and *DFG Guidelines for Temporary Water Drafting*. The requirements and specifications are detailed and can be found in both of these documents- a helpful resource when preparing permit applications and working with agency staff.

18) Check appropriative water rights for stream that is used for drafting, set by the Division of Water Rights: http://www.waterrights.ca.gov/)

BMP TOOLBOX

Planning and Prevention BMPs

- ✓ Seasonal Planning
- ✓ Small Spill Kit

Road Drainage

- ✓ Ditch Relief Culvert
- ✓ Rolling Dip
- ✓ Outsloping
- ✓ Critical Dip

Erosion Control BMPs

- ✓ Blankets/Geotextile Fabrics
- ✓ Mulching

- ✓ Planting
- ✓ Plastic Covering
- ✓ Seeding

Sediment Control BMPs
- ✓ Coir Log/Straw Roll
- ✓ Storm Drain Inlet Protection
- ✓ Silt Mat/Vegetated Grassy Swale
- ✓ Sand Bag
- ✓ Silt Fence
- ✓ Siltation Pond/Settling Pond

* Note: Some of these are temporary measures that need to be removed upon completion of work and replaced with more permanent structures. See Appendix A for details on removal.

PERMITS

5.3 UNPAVED ROAD SURFACES	
Activity or Condition	**Required permit or limitation**
In a Coastal Zone, conducting unpaved road maintenance activities below the high tide line.	Coastal Zone Development Permit or Coastal Development Exception from County Planning or the California Coastal Commission
Diverting or obstructing flow from streams or watercourses (including water drafting for dust control or moisture conditioning)	Fish and Game Code Section 1600 requires: • formal notification to DFG • 1602 Standard Streambed Alteration Agreement (with DFG's recommended protectionary steps) if DFG determines it is needed. http://www.dfg.ca.gov/1600/qa1.html
Any activities covered by local regulations	Local permits
Use of serpentine rock and asbestos-containing aggregate for unpaved surfacing.	This use is prohibited by California Air Resources Board air quality rules. To ensure the aggregate is asbestos-free, outside contractors that resize and/or crush rock must have MSHA (Mining Safety and Health Administration) 46 Identification number.

5.4 SHOULDER MAINTENANCE

DESCRIPTION

Areas adjacent to surfaced and unsurfaced roads require maintenance to provide a usable area for vehicles to pull off the traveled way, prevent the loss of lateral road support, the deterioration or failure of the edge of road surfaces, and to maintain roadside drainage patterns. Shoulder maintenance activities include shoulder blading and rebuilding, and smoothing ruts.

ENVIRONMENTAL CONCERNS

- ✓ Delivery of sediment from grading activities or improper disposal of spoils into streams or storm water drains.
- ✓ Damage to vegetation that provides erosion control on slopes.
- ✓ Harm to riparian areas and rare plant populations.

BMP OBJECIVES

- ✓ Reduce amount of sediment and debris entering streams or storm drains.

BEST MANAGEMENT PRACTICES

1) Perform routine maintenance during the dry season, between April 15th and Oct 15th. If emergency work must be performed during the rainy season, perform work during dry weather.

2) Avoid disturbance of vegetation outside the essential shoulder area, especially near ditches, streams or watercourses. These vegetated areas help filter sediment from water run-off into ditches or streams and helps prevent erosion.

3) Avoid sidecasting of soil in all cases where it could be delivered into a watercourse, riparian area, roadside ditch or storm drain. Do not sidecast outside of the County right-of-way, without landowner's permission. In some instances, under the following guidelines (See Table below), sidecasting is allowable given remote distances from spoils storage sites. In these cases, the setback distance required depends on slope and vegetation. The presence of vegetation helps to slow the travel of sediment downslope, so good judgment is needed to assess the situation. *Do not sidecast at all* if the slope is sparsely vegetated and it appears that sediment will travel with rain runoff into a stream or estuary system, even if setback distances are applied. On slopes of 5:1 (20% gradient) or less, sidecasting is allowed beyond 150 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On 2:1 slopes (50%) or less, sidecasting is allowed beyond 300 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On slopes greater than 2:1, typically sidecasting is *not*

allowed at all, however there may be rare instances on slopes greater than 2:1 where sidecasting is acceptable given very long distances from waterbodies and good vegetative cover. Seek advice from local fisheries agency staff when in doubt. Avoid concentrating sidecasting repeatedly in the same place. Never sidecast large amounts of soil from major landslides.

SLOPE GRADIENT	DISTANCE FROM WATERCOURSE, STREAM CROSSING, RIPARIAN AREA, ROADSIDE DITCH, STORM DRAIN	SIDECASTING RULE
Any slope	Appears that sediment will travel with rainwater into watercourse.	Not allowed
5:1 (20%) or less	150 feet or more	Allowed using good judgment
2:1 (50%) or less	300 feet or more	Allowed using good judgment
Greater than 5:1 (50%)	Vegetated slope long distance from watercourse	Allowed
Greater than 5:1 (50%)	Sparsely vegetated slope and it appears that sediment will travel with rain into watercourse	Not allowed

4) Except as provided in #5 below, do not leave loose soil piled in berms alongside the road or ditch. Loose or exposed soil berms are erodible and readily flushed into waterways and storm drains. Remove excess berm material before the rainy season. If placed in emergency during the rainy season, remove as soon as possible before the next rain. Dispose of all excess materials from shoulder maintenance activities in appropriate spoil disposal sites. (see *Chapter 7.3-: Spoils Handling and Disposal*).

5) Berms are used in some places for traffic delineation or public safety (i.e. line of sight along soft shoulders with steep drop-offs). If any berm is left in place it must be kept to a minimum height and be compacted and stabilized with native seeding or asphalt. Use Erosion Control BMPs to stabilize berms that are being left in place for road delineation.

6) Frequent well-placed breaks in the berms are necessary to allow water to drain from road and back into its original channel, preserving the natural drainage pattern of the slope. Check the areas breached to make sure they are stable. If erosion occurs at berm breaching areas, or the seeding is not in yet and rains are approaching, apply Erosion Control BMPs directly.

7) Stabilize disturbed or bare soils along cutslopes and fillslopes with Erosion Control BMPs. If not otherwise recycled, asphalt concrete pieces and pavement grindings may be

used in embankments and road shoulders when these materials are placed where they will not enter watercourses or storm drains. Do not place recycled road materials in the stream bank.

8) Report to County Engineering the locations of cutslopes and fillslopes that appear to be failing or contributing significant amounts of sediment to streams so that maintenance/repair may be prioritized.

BMP TOOLBOX

Planning and Prevention BMPs

- ✓ Seasonal Planning
- ✓ Small Spill Kit

Erosion Control BMPs

- ✓ Mulching
- ✓ Planting
- ✓ Seeding

Sediment Control BMPs

- ✓ Storm Drain Inlet Protection
- ✓ Silt Mat/Vegetated Grassy Swale
- ✓ Sand Bag

* Note: Some of these are temporary measures that need to be removed upon completion of work and replaced with more permanent structures. See Appendix A for details on removal.

PERMITS

5. 4 SHOULDER MAINTENANCE	
Activity or Condition	**Required permit or limitation**
Any re-grading in sensitive habitat areas	Consult with CDFG or NOAA

5.5 ROADSIDE DITCHES

DESCRIPTION

Roadside ditches carry runoff to designated outfall locations. They are periodically cleaned, reshaped, or stabilized. Ditch maintenance activities include: shoulder blading and rebuilding to correct rutting; reshaping of ditches to maintain the flowline and centerline or to improve the carrying capacity; mowing; and removal of weeds and built-up materials to maintain proper grade or capacity. Follow-up activities include hauling and disposal of excess soil, debris or vegetation to an appropriate spoils disposal location.

Although ditches are considered utilitarian, built for the purpose of draining water from roads, they may contain wetland vegetation and may be classified as "jurisdictional wetlands or Waters of the U.S. Additionally, if a natural drainage channel that is a "Water of the U.S." (e.g. an ephemeral stream) flows into drainage ditch, the ditch thereby becomes a Water of the U.S. Examples of Waters of the U.S. include tidal drainage ditches and ditches through wetlands.

ENVIRONMENTAL CONCERNS

- ✓ Delivery of sediment related to ditch maintenance to streams or watercourses from:
  - runoff that flows into the ditch
  - erosion within the ditch itself
  - erosion adjacent to the road *or*
  - road failure due to a plugged ditch or ditch relief culvert
- ✓ Excessive erosion or stream channel changes due to concentrated water runoff from a ditch into a watercourse, often exceeding the channel's normal carrying capacity.
- ✓ Harm to aquatic habitat during ditch maintenance.
- ✓ Loss of wetland vegetation.
- ✓ Disposal of spoils and debris from ditch maintenance where materials may enter a waterway.

BMP OBJECIVES

- ✓ Avoid sediment delivery from ditches into connected watercourses.
- ✓ Disconnect drainage ditches from stream channels to reduce potential for sediment delivery and stream channel changes.
- ✓ Stabilize bare soils after maintenance.
- ✓ For unpaved roads, eliminate ditches and ditch relief culverts utilizing outsloping with rolling dips, wherever possible.

BEST MANAGEMENT PRACTICES

1) Schedule ditch activity in dry conditions. Avoid working in wet conditions or the wet season, except for emergencies. Due to direct proximity and connectivity, rain and flooding greatly increase the risk of sediment and pollutant runoff.

2) Grade ditches only when necessary to keep the ditchline free flowing and restore capacity. Unnecessary mechanical grading can cause excess erosion, undermine banks, and expose the toe of the cutslope to erosion or slope failure.

3) Avoid removing more grass and vegetation than necessary.

    - To control vegetation (rather than remove it entirely), use methods like mowing or weed-whacking when feasible. Vegetation prevents scour and filters out sediment.

    - Whenever feasible, maintain a buffer of vegetation between the ditch and the road. This helps filter sediment from runoff and can be accomplished by using a steeper angle on the grader blade.

    - Avoid harming existing vegetation on the cutbank above the ditch to reduce erosion and prevent slope failure.

4) Stabilize bare soils after maintenance. Ground disturbance activities within drainage ways have a high potential for causing sediment discharges. To reduce or prevent erosion in retained ditches:

    - rip-rap with appropriate sized rock
    - cover crop
    - apply well-anchored matting or geofabric (e.g. as ditch lining)
    - apply a hardened surface such as asphaltic cement or concrete

5) When "pulling" a ditch (mechanically grading and removing fine sediment), avoid spreading ditch spoils across or into the surface rock of the road or shoulder. Consider removing sediment and debris using vacuum trucks as an alternative.

6) Dispose of all materials from ditch cleaning at designated sites or acceptable roadside areas (see *Chapter 7.3 - Spoils Handling and Disposal* regarding acceptable disposal of excess materials).

7) Avoid sidecasting of soil in all cases where it could be delivered into a watercourse, riparian area, roadside ditch or storm drain. Do not sidecast outside of the County right-of-way, without landowner's permission. In some instances, under the following guidelines (See Table below), sidecasting is allowable given remote distances from spoils storage sites. In these cases, the setback distance required depends on slope and vegetation. The presence of vegetation helps to slow the travel of sediment downslope,

so good judgment is needed to assess the situation. *Do not sidecast at all* if the slope is sparsely vegetated and it appears that sediment will travel with rain runoff into a stream or estuary system, even if setback distances are applied. On slopes of 5:1 (20% gradient) or less, sidecasting is allowed beyond 150 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On 2:1 slopes (50%) or less, sidecasting is allowed beyond 300 feet of a watercourse, stream crossing, riparian area, roadside ditch or storm drain. On slopes greater than 2:1, typically sidecasting is *not allowed at all*, however there may be rare instances on slopes greater than 2:1 where sidecasting is acceptable given very long distances from waterbodies and good vegetative cover. Seek advice from local fisheries agency staff when in doubt. Avoid concentrating sidecasting repeatedly in the same place. Never sidecast large amounts of soil from major landslides.

SLOPE GRADIENT	DISTANCE FROM WATERCOURSE, STREAM CROSSING, RIPARIAN AREA, ROADSIDE DITCH, STORM DRAIN	SIDECASTING RULE
Any slope	Appears that sediment will travel with rainwater into watercourse.	Not allowed
5:1 (20%) or less	150 feet or more	Allowed using good judgment
2:1 (50%) or less	300 feet or more	Allowed using good judgment
Greater than 5:1 (20%)	Vegetated slope long distance from watercourse	Allowed
Greater than 5:1 (20%)	Sparsely vegetated slope and it appears that sediment will travel with rain into watercourse	Not allowed

8) To the extent practical, employ proper cross drain designs and spacing to retain water in its drainage of origin. See *5.6 - Drainage Systems* for recommended minimum drainage spacing for different soil types.

9) When constructing or reconstructing a ditch, work with designs for outlet locations and terrain, that avoid directly dumping ditch water into surface waters, when practical. If not practical, implement Sediment Management BMPs such as check dams, sand and gravel bag barriers and other acceptable techniques to trap sediment before it reaches a stream. Remove temporary BMPs and replace with permanent BMPs as soon as practical

10) Be alert for abnormal ditch water (e.g. summer months or high flow during winter months), which may be indicative of other issues. Try to find the source of the water first.

There may be an adjacent spring exposed in the bank cut and thus have biological resources that need addressing or a failed ditch relief culvert upslope that needs fixing.

11) Implement routine maintenance for sediment trapping BMPS to ensure they maintain their function. Initially, check BMPs after each storm event. If BMPs are performing adequately, reduce frequency of checks to annually or after major (e.g., 10-year) storm events.

12) For ditches with ongoing sedimentation problems, it may be more cost-effective and environmentally less damaging to implement upslope erosion control BMPs to reduce sediment delivery into ditches, rather than conducting seasonal ditch "pulling". Sediment traps are another alternative.

BMP TOOLBOX

Planning and Prevention BMPs
- ✓ Seasonal Planning
- ✓ Small Spill Kit

Culvert BMPs
- ✓ Culvert Hydraulics - Diagram
- ✓ Culvert Plugging - Diagram
- ✓ Energy Dissipater
- ✓ Culvert Inlet Sediment Trap

Road Drainage
- ✓ Ditch Relief Culvert

Sediment Control BMPs
- ✓ Storm Drain Inlet Protection
- ✓ Silt Mat/Vegetated Grassy Swale
- ✓ Siltation Pond/Settling Pond

Water Management BMPs
- ✓ Sandbag

* Note: Some of these are temporary measures that need to be removed upon completion of work and replaced with more permanent structures. See Appendix A for details on removal.

PERMITS

5.5 ROADSIDE DITCHES	
Activity or Condition	**Required permit or limitation**
Reshaping of ditch to other than original dimensions and configuration if: • ditch itself is a Water of the U.S. • a natural drainage channel that is a "Water of the U.S." (e.g. an ephemeral stream) flows into drainage ditch; the ditch thereby becomes a Water of the U.S. Examples of Waters of the U.S.: • Tidal drainage ditches and ditches through wetlands • An ephemeral stream – triggers this permit requirement if it has an Ordinary High Water Mark (OHWM) as defined in 33 CFR 328.3(e)]	(If in doubt as to whether permit is required, consult with COE.) CWA 404 permit; specifically, the COE's Nationwide Permit 41, "Reshaping Existing Drainage Ditches". This permit is subject to the following conditions: • Ditch must be returned to its original dimensions and configuration • Design capacity or area drained cannot be expanded • Centerline of reshaped ditch must be essentially in the same location as existing ditch's centerline • County must notify COE if portion reshaped is greater than 500 feet in length **Note:** This permit does *not* authorize reconstruction of drainage ditches that have become ineffective through lack of regular maintenance. CWA 401 Water Quality Certification permit from the RWQCB (always required with 404 permit)
Cleaning only (including removal of sediment, debris and vegetation), without reshaping. A ditch that only collects rainfall off the road is not jurisdictional water, and permitting is not required for any maintenance	Exempt from CWA 404 permit process; cleaning is considered maintenance only. However, the ditch must maintain its original dimensions and configuration.
In a Coastal Zone: • Any work subject to review under Section 1601 of the Fish and Game Code ***and/or*** • Excavation or disposal of fill is outside of the roadway prism	Coastal development permit (Other than listed activities, ditch maintenance work is exempt from this permit requirement.)

5.6 DRAINAGE SYSTEMS

DESCRIPTION

Drainage system maintenance includes inspection, repair or replacement of components: including retention facilities, pollution control devices, manholes, catch basins, inlets, vaults, drains, and cross drains. For the purpose of this manual, culverts and crossings constructed in natural stream channels are discussed separately in *Chapter 6 –Working In or Near Stream Streams*. Ditch maintenance is also discussed separately in *5.5 - Roadside Ditches*.

While these structures are not naturally occurring watercourses, streams or wetlands, some storm or surface water runoff facilities become wetlands, or were wetlands prior to their conversion, and are regulated as "jurisdictional wetlands" or Waters of the State. (See *Chapter 6 – Working In Or Near Streams*).

ENVIRONMENTAL CONCERNS

- ✓ Discharge of sediment or debris to streams or watercourses.
- ✓ Water pollution from leakage of petroleum products from equipment used for maintenance.
- ✓ Plugging that results in stream crossing diversion.
- ✓ Excessive erosion resulting from alteration of natural hydrologic patterns.
- ✓ Increased peak flows due to runoff from impermeable surfaces.

BMP OBJECTIVES

- ✓ Minimize road-related sedimentation.
- ✓ Reduce sedimentation to watercourses.
- ✓ Reduce stormwater pollution.
- ✓ Preserve or improve surface drainage characteristics in the vicinity of the road.

BEST MANAGEMENT PRACTICES

1) Perform routine maintenance and repairs during the dry season whenever possible. If work must be performed during the rainy season, perform work during dry weather. Report erosion problems to county engineers for repairs.

2) Stabilize disturbed or bare soils around work areas with Erosion Control BMPs. Stabilize bare soils after maintenance. Ground disturbance activities within drainage ways have a high potential for causing sediment discharges. Implement Sediment Control BMPs at drainage system features as necessary during maintenance to reduce downstream discharge of sediment.

3) Inspect critical and problem culverts, drain inlets, and detention facilities annually before the rainy season (prior to October 15th), and after the first major rainfall event (2 year event), when feasible. Inspect suspected problematic culverts as necessary after that, depending on intensity and frequency of rain events.

4) Crews should determine the possible presence of California red-legged frogs, Santa Cruz long-toed salamanders (Santa Cruz/Monterey), and San Francisco garter snakes (northern Santa Cruz/San Mateo) before removing vegetation from drainage ditches.). Additionally, where practicable, the Counties should remove vegetation by hand and with the use of small hand tools.

5) When vegetation removal or reduction is necessary, dispose of waste according to county standards (see *Chapter 8- Vegetation Management*).

6) If using herbicides close to the "normal" start of the rainy season or in early springtime, use only aquatic approved formulations (e.g. Rodeo/Aquamaster with Agridex or LI-700 surfactant, not Round-Up). Timing, rate and volume of spraying should be included in a schedule for herbicide treatment. See Chapter 8-Vegetation Management for details and when in doubt, contact your County Agricultural Commissioner's office.

7) Look for opportunities to restore natural drainage patterns. Install culverts or rolling dips to retain water in its drainage of origin, which will decrease the potential for erosion downstream. On problem roads, look for opportunities to reconstruct the road segment to improve and maintain natural drainage patterns; for example, add rolling dips, emergency water bars and additional cross drains. (See *5.1- Road Treatment and Design Principles*).

8) The recommended minimum diameter for all new culverts, including cross drains, but exclusive of driveway culverts, is 18 inches. Often, small diameter culverts (12 inches or less) plug with debris, causing significant road damage. They are also difficult to clean out. In addition, all culverts on anadromous fish bearing steams should be sized for the 100-year storm event and then upsized to accommodate sediment and debris transport volume (See Chapters *5.1- Road Treatment and Design Principles* and *6.2- Culvert Cleaning, Repair and Replacement).*

9) Implement energy dissipation BMPs at cross drain outlets to prevent erosion. Discharges from cross drains onto road fill or other erosive areas often cause significant erosion and slope failure. Make sure that newly-installed cross drains are properly designed to minimize erosion problems. Where erosion is already occurring, work to halt and reverse it with appropriate erosion control BMPs.

10) Clean cross drains as needed; including clearing vegetation and sediment immediately upslope or downslope of the drain if needed. Consider removing sediment and debris using vacuum trucks as an alternative, where applicable.

SEDIMENT BASINS, SILTATION PONDS AND SEDIMENT TRAPS

11) Monitor accumulation of sediment in the sediment basins or siltation ponds. Manage water release from ponds to maximize sediment retention and eventual removal. Develop and implement a routine maintenance schedule for cleaning sediment trapping BMPs to ensure they maintain their function. Keep structures clear of litter and debris and dispose of appropriately.

12) If function of the system is compromised by sediment accumulation and removal of sediment is warranted, dispose of appropriately (see *Chapter 7.3 - Spoils Handling and Disposal).*

BMP TOOLBOX

Planning and Prevention BMPs
- ✓ Seasonal Planning
- ✓ Small Spill Kit

Culvert BMPs
- ✓ Culvert Hydraulics Diagram
- ✓ Culvert Plugging Diagram
- ✓ Energy Dissipater
- ✓ Culvert Inlet Sediment Trap

Road Drainage
- ✓ Ditch Relief Culverts

Erosion Control BMPs
- ✓ Blankets/Geotextile Fabrics
- ✓ Coir Log/Straw Rolls
- ✓ Mulching
- ✓ Planting
- ✓ Plastic Covering
- ✓ Rock Breast Wall
- ✓ Hydroseeding
- ✓ Surface Roughening & Soil Tracking
- ✓ Stepped or Terraced Slope

Sediment Control BMPs
- ✓ Storm Drain Inlet Protection
- ✓ Silt Mat/Vegetated Grassy Swale
- ✓ Silt Fence
- ✓ Siltation Pond/Settling Pond
- ✓ Turbidity Curtain

Water Management BMPs
✓ Sand Bag

* Note: Some of these are temporary measures that need to be removed upon completion of work and replaced with more permanent structures. See Appendix A for details on removal.

PERMITS

5.6 DRAINAGE SYSTEMS	
Activity or Condition	**Required permit or limitation**
• Drainage system feature being worked on is in a ditch that qualifies as a Water of the U.S, ***and*** • activity alters the shape or configuration of the ditch or drainage feature. If drainage system has temporary measures, such as a coffer dam (BMP), a 404 permit is required if fill is being placed within the ordinary high water mark. (See discussion regarding permit applicability in 5.5- *Roadside Ditches*.)	• CWA Section 404 permit • CWA 401 Water Quality Certification permit from RWQCB (required with CWA 404 permit)
• Cleaning only (including removal of sediment, debris and vegetation), with no reshaping of ditch.	• Cleaning is considered maintenance only and is always exempt from the CWA 404 permit process; however, the ditch must maintain its original dimensions and configuration.
• In a Coastal Zone, drainage system maintenance work	Exempt from a Coastal Development Permit unless: • subject to review under Section 1600 of the Fish and Game Code, ***or*** excavation or disposal of fill is outside of the roadway prism. Coastal Development Permit is needed in stated cases
• Any work covered by local regulations.	Consult local agencies about additional local permits.

5.7 STREET SURFACE CLEANING

DESCRIPTION

Street cleaning activities are performed to provide a safe roadway surface for the public and to keep sediment and debris from accumulating on the roadway or in the gutters and getting washed into watercourses via stormdrains. Street cleaning typically consists of sweeping with pickup sweeper units and to a lesser extent power brooms and washing with water trucks.

ENVIRONMENTAL CONCERNS

- ✓ Discharge of the following materials into the storm water drainage system or watercourses:
  - o Litter and debris
  - o Equipment wash water
  - o Sediment and pollutants from the road surface

BMP OBJECTIVES

- ✓ Reduce amount of sediment, organics, chemicals, and debris entering watercourses.
- ✓ Reduce potential for airborne emissions from sweeping operations.

BEST MANAGEMENT PRACTICES

1) Control sweeper speed to minimize airborne particulates and remove the maximum amount of debris.

2) Use the water spray system on the sweeper to reduce dust generation.
Prioritize use of pickup sweepers in sensitive areas (e.g., near watercourses) or when large amounts of debris/sediment are present.

3) Adjust the brooms frequently to maximize the efficiency of sweeping operations.
After pickup sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

4) Street sweepings are often contaminated with petroleum hydrocarbons and heavy metals including lead, copper, and zinc. **Do not compost sweepings!**

5) Watch for the presence of potential hazardous materials so that these can be properly collected and the possibility of spills is reduced.

6) Clean sweepers in a maintenance yard or an approved area to capture solid materials.

7) Make sure personnel are trained to respond appropriately to hazardous materials that may be encountered and spills that may occur during street cleaning. Carry a spill kit for prompt cleanup of spills (Appendix A - Small Spill Kit BMP), and clean up spills of petroleum products immediately using the appropriate procedures. Notify County Engineering immediately regarding other spills, so that appropriate notification and response may be made. Do not hose down the work area or pour any materials down drains.

8) Increase frequency of pickup sweeping as practical.

9) When washing down pavement, employ *Erosion Control and Sediment Management BMPs* in adjacent roadside ditches if wash water can reach streams or storm drain systems.

BMP TOOLBOX

Planning and Prevention BMPs
- ✓ Seasonal Planning
- ✓ Small Spill Kit

Sediment Control BMPs
- ✓ Storm Drain Inlet Protection

PERMITS

5.7 STREET CLEANING	
Activity or Condition	**Required permit or limitation**
Street cleaning in general	Addressed as part of the County's NPDES General Storm Water Management Permit.

5.8 CONCRETE WORK

DESCRIPTION

Maintenance and repair of concrete surfaces, such as bridges, concrete roadways, sidewalks, driveways, parking lots, and curb and gutter sections are performed to provide a safe roadway for the traveling public; maintain safe pedestrian access; and maintain proper functioning drainage features. Concrete work includes: concrete removal, crack sealing, concrete grinding, saw cutting, replacement of removed sections and installation of new structures.

ENVIRONMENTAL CONCERNS

- ✓ Discharge of the following materials into the storm water drainage system or watercourses:
  - o Portland cement concrete (PCC), concrete or cement rinse water, concrete grindings and cuttings, sediment, form release agents.

BMP OBJECTIVES

- ✓ Eliminate run-off of pollutants from maintenance/repair area.
- ✓ Eliminate discharge of sediment to streams and watercourses.
- ✓ Eliminate discharge of concrete debris or rubble resulting from concrete repair work into creeks or waterways. Dispose of debris appropriately.

BEST MANAGEMENT PRACTICES

1) Inspect equipment for leaks or damage prior to performing concrete work. Perform maintenance at designated repair facilities.

2) Prior to concrete work, identify storm drain inlets, manholes, and watercourses. Protect storm drains with appropriate Sediment Management BMPs.

3) Designate areas to be used for concrete washout and perform washout only in properly constructed containments. When washing equipment or vehicles to remove cement or concrete residue, use only as much water as is needed so that rinse water can be properly contained. For example, use a positive shutoff on the washout hose. Construct the washout area in accordance with the Concrete Washout BMP.

4) Follow these procedures for concrete mixing on site.
   - o Ensure that contractors who fuel and operate cement mixing operations on site have an adequate spill plan and materials for spill containment.
   - o Avoid mixing excess amounts of fresh concrete or cement on site.
   - o Establish mixing plants outside of riparian corridors or near watercourses.
   - o Dry and wet materials should be stored away from waterways and storm drains and should be covered and contained to prevent runoff from rainfall.

5) Remove concrete grindings, rubble, and debris from the site for proper disposal and do not discharge into drain inlets, the storm water drainage system or watercourses.

6) Contain coolant water from concrete cutting and do not discharge into drain inlets, the storm water drainage system or watercourses.

7) When fresh concrete may be exposed to water, (e.g. rainy weather work), use concrete sealants that are approved by the California Department of Fish and Game for this purpose.

8) For the duration of concrete work, make inspections an ongoing practice.
   - o After rainfall events, inspect drainage protection measures. In the case of an extended storm, inspect at least once per day. If the protection measures are subjected to non-stormwater flows, inspect daily
   - o Inspect inlet protection to prevent water from backing up. If back-up occurs, the protection needs to be replaced with an alternative device.
   - o Monitor the concrete wash-out, waste storage and disposal sites and on-site procedures at least weekly.
   - o Make sure employees and contractors are following pollution control measures.

BMP TOOLBOX

Planning and Prevention BMPs
- ✓ Seasonal Planning
- ✓ Small Spill Kit

Sediment Control BMPs
- ✓ Containment of Concrete Pours
- ✓ Concrete Washout
- ✓ Storm Drain Inlet Protection
- ✓ Sedimentation Trap/Sump

Water Management BMPs
- ✓ Sand Bag

PERMITS

5.8 CONCRETE WORK

Activity or Condition	Required permit or limitation
Concrete work in streams and on stream banks	• U.S. Army Corps of Engineers 404 Permit • Regional Water Quality Control Board 401 Water Quality Certification • California Department of Fish and Game Streambed Alteration Agreement DFG 1602 • NOAA Fisheries Service consultation
Temporary concrete batch plant	• May need County Use Permit

5.9 SNOW AND ICE CONTROL

DESCRIPTION

Road maintenance crews are responsible for sanding, de-icing, and plowing operations during periods of freezing weather. Snow and ice removal is necessary to provide a safe roadway surface for the traveling public. Materials used include sand and sometimes salt.

ENVIRONMENTAL CONCERNS

- ✓ Discharge of sediment (sand and cinders) and de-icing agents into the watercourse or storm water drains.
- ✓ Impacts of particulates from sand and cinders on air quality.
- ✓ Degradation of stream water quality by increased dissolved solids (salts).
- ✓ Salt damage to trees or other vegetation adjacent to a road or in a location affected by runoff.

BMP OBJECTIVES

- ✓ Reduce road-related sediment (including sand and cinders) discharge to sensitive areas and watercourses.
- ✓ Minimize impacts from application of salts and de-icing/anti-icing chemicals.

BEST MANAGEMENT PRACTICES

1) Minimize use of salt by reducing salt to sand ratios to the maximum extent feasible.

2) Use road abrasives that have been washed, screened, or graded to reduce silt and clay content.

3) Remove sand and salts from road immediately after snow and ice has melted, if practical and advisable from a safety perspective.

4) Plow snow into areas that allow vegetation to filter and contain sand.

5) Prioritize clean up efforts to aquatic habitat areas once road safety hazard due to snow and ice is gone.

6) Prioritize clean up areas without sediment collection systems.

BMP TOOLBOX

Sediment Management BMPs
- ✓ Storm Drain Inlet Protection
- ✓ Sedimentation Trap/Sump
- ✓ Siltation Pond/Settling Pond
- ✓ Sweeping

Planning and Prevention BMPs
- ✓ Seasonal Planning
- ✓ Small Spill Kit

PERMITS

5.9 SNOW AND ICE CONTROL	
Activity or Condition	**Required permit or limitation**
Sanding	None
Chemical use	May need to be addressed as part of the County's NPDES General Storm Water Management Permit