Serene Lakes Erosion Control
and
Water Quality Guidelines
Sierra Lakes County Water District

BACKGROUND

Every lake, in one way or another, is considered to be a "dying" lake - in other words, is trying to become a meadow. All lakes are slowly filling up with dead plant life, soil and sediment. This process is called eutrophication. The key to controlling eutrophication is to slow the "dying" process. High mountain lakes are naturally made up of runoff water which is low in nutrients because of the natural vegetative cover which protects soils and stabilizes stream flow; however, as vegetation is cleared and development occurs, erosion and runoff can increase dramatically. Eroded sediments and increased runoff associated with development and construction are major contributors of nutrients into the Serene Lakes.

A study of the Serene Lakes clearly cites the need for control of sedimentation and nutrient loading in the lakes in order to protect our water quality and to preserve our beautiful lakes.

SITE DEVELOPMENT

The disturbance of a site during and after construction can result in 10 to 2,000 times more erosion than the rate before the site was disturbed. Most runoff can be controlled and erosion prevented through fairly simple planning if erosion control measures and techniques are implemented concurrently with construction. The key elements of erosion control center around reducing runoff from the development site, stabilizing disturbed soils and preserving vegetation. Erosion control measures and techniques generally try to imitate the hydrologic processes of a natural watershed thereby trapping sediment and nutrients on the site.

FERTILIZATION

Another enemy of mountain lakes, although not widely used in our area, is fertilizers. Fertilizers used in landscaping or gardening can eventually work their way into the Serene Lakes and cause nutrient loading which speeds up the eutrophication process. Fertilizers can be a significant source of nitrogen and phosphorus. Algae thrive on these elements. The proper use of fertilizers is very important and can help curb this source of food for algae. For example, planting a lawn which requires fertilization may not be good for our lakes.

EROSION CONTROL

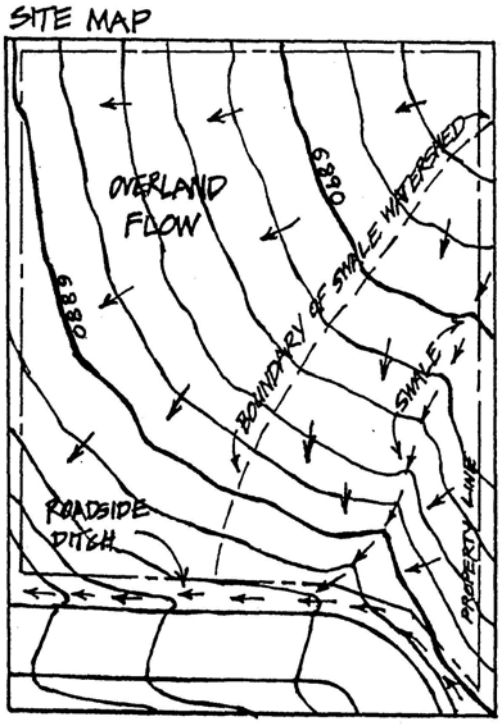
Implementation of proper erosion control measures and fertilizer use will decrease the overall watershed runoff and nutrient load and will help to stabilize eutrophication in the Serene Lakes.
Please carefully read and utilize the contents of this "Serene Lakes Guide for Erosion Control and Water Quality". If you should have any questions, please feel free to contact District Operations at 530-426-7802.

SITE PLANNING

Step One — Identify the physical features of your site

Topography and drainage

The first step in site planning is to identify the physical constraints of your site. You should start with a good topographic map of your property and adjacent areas. The map should show elevation contour lines at an interval sufficient for determining drainage patterns. ***Draining is the key to erosion control planning*** You need to know which way water will flow across your property.



On your site map identify points where runoff will enter and leave your property. Your map should show any upslope area that will contribute significant runoff to your site. It should also show critical nearby areas that may be affected by runoff from your property such as creeks, dwellings, streets or Serene Lakes itself.

Think about how runoff will travel across your site from top to bottom. Will it cross in a well-defined channel or will it flow overland? Bear in mind that when vegetation is removed, water will tend to concentrate and form rills and gullies.

Perform the above drainage analysis for your site as it exists before development. After development plans have been prepared, you will need to re-examine the drainage pattern for changes.

Slope

Identify steep slopes. As slopes become steeper they have more potential to erode and many of the techniques to control erosion become less efficient. Slopes greater than 30% have a high erosion hazard while slopes less than *15%* have only a slight hazard.

Vegetation

Evaluation of the existing vegetation on the development site should include mapping the trees and shrubs. Preservation of healthy and desirable vegetation will help to prevent erosion and enhance water quality. The use of native vegetation in development planning can reduce the need for other more costly permanent erosion control and become an integral part of future landscaping.

Step Two — Locate buildings and driveways to minimize land disturbance

Develop a preliminary site plan that minimizes land disturbance and takes into account the site's physical constraints (identified in Step One). Try to apply the following guidelines:

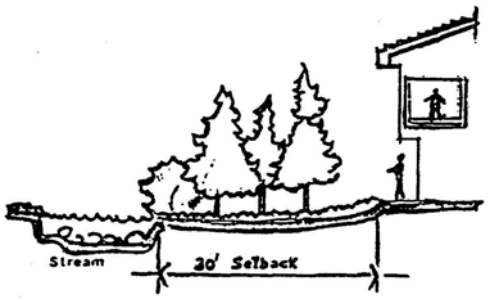
Minimize earth movement

Fit development to the terrain. Design and locate houses, garages, and driveways to minimize cuts and fills. Cutting into slopes not only makes them steeper and thus more erodible, but may damage important root systems. Placing fill on slopes creates loose soil prone to erosion and covers root system infiltration areas.

Stepped foundations, staggered floor levels and stairs or walkway entrances also reduce slope cutting and erosion potential.

Stream Set Backs

Keep structures and construction activities away from stream channels and wetlands. The standard set back of 30 feet provides a buffer between construction activities and the active water course. This buffer helps to maintain the stream channel integrity and can cleanse runoff water due to the stripping effect of the vegetation. Maintaining the natural vegetative cover is an essential element in creating an effective stream buffer zone. In some eases, the buffer zone will exceed the standard 30 feet set back because of the actual flood plain boundaries.



Keep disturbed areas small

Minimize vegetation removal. Preserving trees and other natural ground cover will help maintain site stability and reduce erosion control costs. Locate driveways and buildings to minimize the need for site clearing. For example, route your driveway around existing trees rather than where trees are growing.

Align driveways along slope contours

Locate your driveway parallel to slope contours rather than straight up and down slope. Runoff down long or steep driveways tends to channelize and can cut deep gullies, both along the driveway and off-site. Make driveways narrow to minimize cuts, fills and impervious surfaces.

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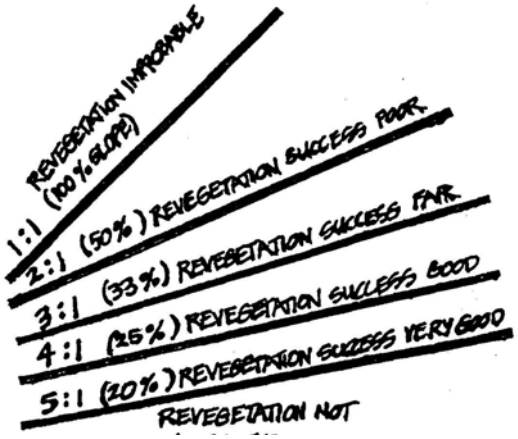
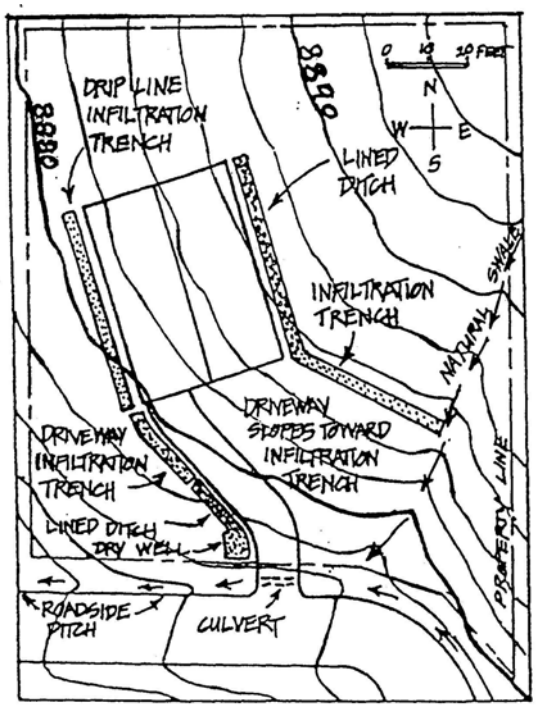
Avoid steep slopes

Confine construction activities to the least critical parts of your site. Once these areas are disturbed by construction, the resulting erosion may be very difficult to stop.

Erosion potential is closely related to slope steepness and slope length. The longer and steeper a slope is, the greater the erosion potential. Water flowing down long, steep slopes builds momentum and carves rills and gullies into the hillside.

In addition, vegetation has a much more difficult time getting established on steep slopes. On cut slopes steeper than three horizontal to one vertical (3:1), you'll have fair success in establishing vegetation unless you use physical slope stabilization measures.



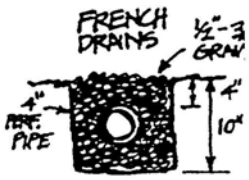


Step Three - Preparation of erosion and runoff control plans

After you have evaluated the location of structures, parking and roads, it is a good idea to prepare a plan to control runoff and prevent erosion. Attention should be paid to control measures suitable during construction and those which are to remain because of their necessity to the life of the development. While it *is* good to sketch these plans out, it gcnex1ly is not required.

Developers of steep or sensitive lands should prepare comprehensive plans for drainage and runoff control, erosion protection and revegetation as a preliminary element of development planning. In some areas these types of plans as well as a narrative describing the land disturbing activities must be completed before development is permitted.

Large scale developments where several acres of land are involved and construction is to last over a few years, a detailed temporary as well as permanent erosion and runoff control plan should be prepared.



PRINCIPLES OF EROSION and SEDIMENT CONTROL

1. Time grading and construction to minimize soil exposure during periods of snowmelt and rainy periods.

In the Sierras the period of spring snowmelt results in saturated soil **conditions** and the highest volume of natural runoff. The late summer thunderstorms result in high intensity runoff. Both of these hydrologic events cause erosion of unstable or disturbed soils.

Therefore, it is best to avoid these periods for major grading or earth moving activities. The construction plan should incorporate into the building schedule the major grading work and earth moving during the early summer or late fall.

2. Retain and protect natural vegetation.

Natural vegetation is the most efficient form of erosion control. In the harsh mountain climate it is difficult to re-establish vegetation.

For this reason, you should strip only the area required for construction. Stage grading so that only the portion of the site that can be constructed in one year is cleared of vegetation.

Vegetation is a desirable form of erosion control because it keeps soil in place and maintains an attractive, natural-looking landscape. Vegetation reduces erosion by:

absorbing raindrop impact
reducing runoff velocity
reducing runoff volume by increasing infiltration into the soil

Revegetate cleared areas as soon as possible after gading. Keep all vehicle traffic out of areas that have been revegetatcd.

3. Seed and mulch.cleared areas.

After grading is completed, seed and mulch the denuded areas according to the procedures outlined on page 7. The mulch will protect the soil until the vegetation gets established. The vegetation will prevent erosion in future years. Grass provides the best short-term protection. After construction is completed, you can replace the grass with the desired long-term vegetation as part of the landscaping around your house.

4. Infiltrate runoff from impervious surfaces.

On undisturbed land much of the rainwater and snowmelt seeps into the ground. Roofs, paved walkways and driveways, and packed soil are impervious to infiltration. Runoff from these surfaces greatly increases erosion potential. Locate infiltration trenches below roof eaves and along driveways and parking areas. If a roof drip line or driveway is on a steep slope, install a lined ditch to route the runoff to a dry well or to an infiltration trench located along a slope contour. Install these permanent infiltration systems after construction is completed.

5. Minimize length and steepness of slopes.

Long or steep exposed slopes (or roadways) have high erosion potential. To shorten runoff pathways down long or steep slopes, construct barriers, such as straw bale dikes, across the slope. These barriers intercept runoff before it can reach an erosive velocity and divert it.
Align roadways along slope contours to minimize steepness.

6. Keep runoff velocities low.

The energy of flowing water dramatically increases as velocity increases. If velocity doubles, the erosive energy quadruples, and the water can move particles 64 times as large. Velocities can be kept low by:

keeping flow volumes low (such as by preserving site vegetation or by dividing runoff into several channels rather than one)
constructing flow barriers at frequent intervals
lining channels with rough materials, such as rocks

7. Protect drainageways and outlets from increased flows.

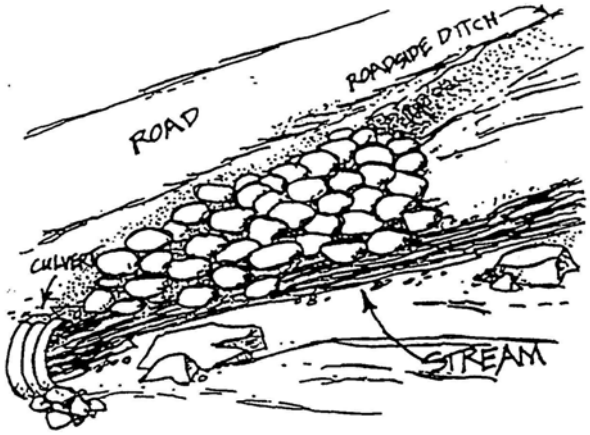
Development changes the characteristics of runoff. When land is paved or vegetation is removed and soil is compacted by construction traffic, the volume of runoff increases. Runoff flowing over hard or smooth surfaces such as packed earth or pavement increases in

velocity. Grading may cause runoff to concentrate in a single channel instead of being dispersed over a broad area. These changes in runoff can cause channel erosion unless protect ion measures are installed. Common forms of channel protection are:

linings (gravel, concrete, asphalt)
pipes or culverts
outlet protectors (such *as* rock aprons)

8. Trap sediment on site

Some erosion during construction is unavoidable. Sediment-laden runoff must be detained on-site so that the soil particles can settle out before the runoff reaches a stream, someone else's property or Serene Lakes. Use any of the following control measures to keep sediment from leaving your site:



straw bales or pine needles
filter fences
wattles are <u>preferred</u>

TEMPORARY CONTROL MEASURES

Revegetation

The primary purpose of revegetation is erosion control. Grass provides the best protection for the first few years. Grasses germinate and grow quickly and provide a fast and complete ground cover. Trees and shrubs are effective for long terrn erosion control, but grasses are needed for initial soil protection until the slower *growing* trees and shrubs become well established. Decorative "landscaping" with trees and shrubs can be done later. The harshness of the mountain climate and the steepness of the terrain make it difficult for plants to become established. The steeper the slope, the more difficult it is. You will have the greatest chance of success with revegetation if you keep the angle of disturbed slopes to a minimum.

Seed Types to Use:

The following grass seed mixes are nearly all sites in the Tahoe Basin. species from each group and combine.

Seed Type	Minimum Seeding Rate (lbs. 1000 sq. ft.)
Group 1	
Sod—forming Wheatgrass: 'Luna' pubescent, 'Topar' pubescent, or 'Oahe' intermediate	.6
Group 2	
Bunchgr ass: Potomac orchardgrass Sherman big bluegrass or crested wheatgrass	.6

All of the above plants are perennial grasses. The Soil Conservation Service, U.S. Forest Service, TRPA and your local nurseries may provide information on these and other suitable plant types.

When to plant

The time of planting depends on whether or not you. irrigate. If you choose to irrigate, you must continue irrigating until the grass is well established.

If you do not irrigate:

(a) Plant seeds as late as possible in the fall but before the ground is frozen and before snowfall. October and November are generally

good months to seed. Seeds planted too early in the fall may germinate with fall rains and the young seedlings can then be killed by frost. *Or,*
(b) Plant seeds in April or May as soon as possible after snowmelt. June is generally too late, since there probably will not be enough rain to germinate the seed and allow the plants to grow to a size that can survive the summer dry period.

If you do irrigate:

Plant seeds as soon as possible after grading is completed and the area can be closed to vehicle traffic. During the germination period (at least the first 2 weeks), irrigate often enough to keep the seedbed moist. You may have to water more than once per day. Water with a fine spray to avoid washing away seeds and soil. Water only long enough to moisten the first 2" of soil. You can discontinue irrigating when the grass is about 6" tall.

How to apply seed

Before you can revegetate an area, you must first roughen or loosen the soil surface so that seeds can get a foothold in it. Use a dirt rake or tiller. Broadcast the seed by hand or with a "belly grinder." Rake the soil after seeding to cover the seeds with ¼"-½" of soil. You can seed a typical lot in less than an hour.

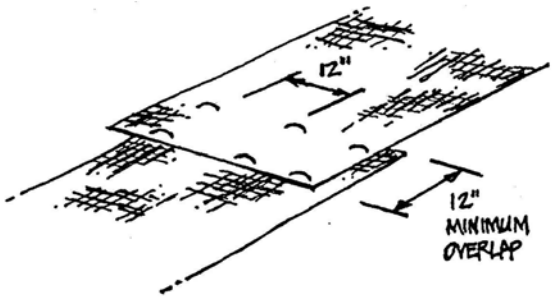
Fertilizing

Apply *5* lbs./l000 sq. ft. of 16-20-0 fertilizer with 15% sulfur (ammonium phosphate sulfate) at the time of seeding. Reapply once per year in the spring until the soil is well protected with grass. Do **not** over- fertilize. Excess fertilizer will wash away and can pollute downstream water resources.

Mulching

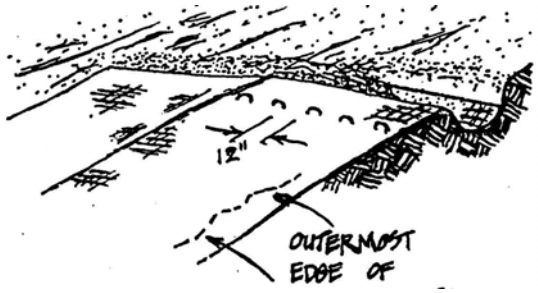
Mulch is essential for revegetation success. Mulch protects bare soil from erosion until new vegetation grows large enough to do the job. It also holds seed and fertilizer in place, keeps soil moist and shades seedlings— all helping to become established.
Straw is the best mulch material. Apply I bale of straw per 1,000 sq. ft. Distribute the straw evenly so that it forms a layer 1" to 2" thick. Soil should still be visible through the straw mat. If you apply too much mulch, it may produce a mat too dense for seedlings to penetrate.
Anchor the straw by punching it into the soil every 1' to 2' with a dull, round-nosed shovel (to avoid cutting the straw) or by covering it with netting (jute, plastic mesh, woven paper, or chicken wire). Fasten the netting to the ground with wire staples as shown on page 8. Because the soils in many areas are quite hard, you may have to use netting to anchor the straw.

Wood fibers, wood chips and pine needles are other usable mulch materials. Wood fiber mulch is applied hydraulically in a slurry that also contains the seed and fertilizer. It is suitable for use on steep slopes or large areas and must be applied by a contractor. (The application rate for wood fiber mulch is 3,000 lbs./acre.) Wood chips and pine needles can protect the soil from erosion, but they also inhibit plant growth. They can only be used where a grass cover is not desired. Apply wood chips so that the soil is completely covered. Apply pine needles in a layer 2" to 3" thick. You can save the pine needles from graded areas on your property to use as a mulch later, but you will probably have to supplement them with wood chips to achieve an adequate ground cover.



Slope netting

Netting is often used to hold mulch in place on steeper slopes. Netting can be used by itself to protect seeds and soils from washing away during watering or rain storms.



How to install slope netting

Materials

Jute, excelsior, fiberglass or plastic netting (Do not use plastic sheeting or filter fabric.)
• Wire staples. No. 11 gauge or heavier, 6" to 10" long (Use longer staples on loose soils.)

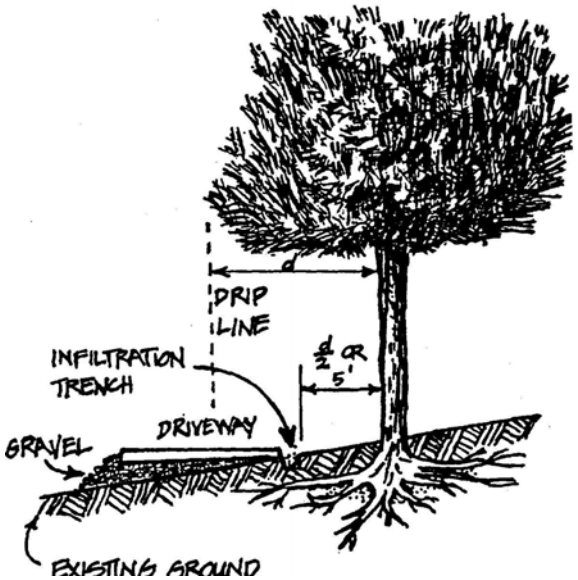
Installation procedure

1. Starting above the mulched *area,* bury top end of strip of material in a trench at least 4" deep.
2. Fill trench with soil and tamp firmly. Fasten with a row of staples 12" apart.
3. Overlap lower end of uphill strip over next strip at least 12" and secure with staples 12" apart.
4. Continue adding strips of material until entire mulched area is covered. Overlap sides of strip at least 4" and staple as shown.

Tree protection

Trees and other native vegetation must be protected against construction damage. Protect vegetation by following these guidelines:

1. Do not nail boards, filter fabric or anything else to trees.
2. Grading, paving or placing fill within a tree's drip Line is not allowed except when all of the following are met:
(a) encroachment is only on one side of tree, (b) encroachment is no closer than *5'* from the trunk or no more than ½ the distance between the drip line and the trunk,
(c) a drainage system that allows air and water to circulate through the root zone is placed under all fills over 1' deep within the drip line,
(d) care is taken not to cut tree roots unnecessarily or to compact the soil around them.
3. Remove low tree limbs that are likely to be broken by construction activities. Cut the limb flush to the trunk or main branch. Paint cut or damaged limbs, trunks or roots with a good grade of tree paint.

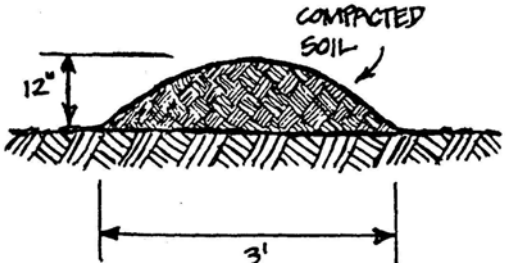


Berms and ditches

A berm is a temporary ridge of compacted soil. A ditch is a small drainageway. Both of these structures have similar purposes.
Where to use berms and ditches

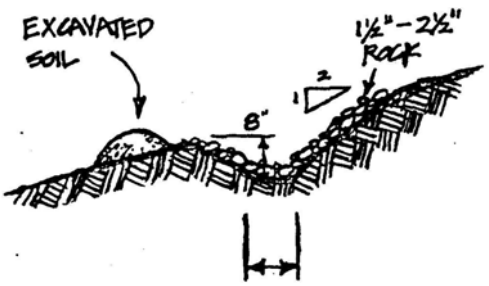
Above disturbed slopes
Around graded areas (to keep clean runoff out and to contain sediment-laden runoff within)
Along slope benches

The most common use of berms and ditches is to divert upland runoff away from exposed soil to a protected outlet (such as an infiltration trench, storm drain or stable channel). When a berm or ditch is used to contain runoff from a disturbed area, you must route the sediment-laden water to a sediment trapping device (see pages *9* to 11)



Berm construction procedure

2. Compact the channel by tamping or rolling.
3. Line temporary ditches with rock, filter fabric, plastic sheeting or jute netting. Do not construct a
temporary ditch at a slope exceeding 15%.
4. Line permanent ditches with rock, asphalt or concrete. Install a rock lining as shown here. Do not install a rock lining on a ditch steeper than 15% slope.
5. Install an outlet protector or infiltration system at the end of the ditch.

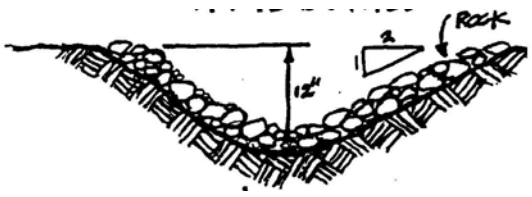


Ditch construction procedure

1. If the drainage area to the ditch is ¼ acre or less, dig the channel 8" deep. If the drainage area is 34 acre to 2 acres, dig the channel 12" deep. Deposit the excavated soil where it will not wash into a drainageway (such as on the downhill side of the ditch).

Maintenance tips

Inspect dikes and ditches before each storm.



Recompact loose soil.
Fill gaps and low spots (such as tire tracks across a dike).

If an unlined channel is eroding, line it with a suitable material.
Repair damaged linings immediately.

Sediment barriers

Sediment barriers are temporary structures that slow runoff and trap small amounts of sediment. Sediment barriers can be built with:

filter fabric attached to a wire fence

Where to use sediment barriers

Below small disturbed areas.
At the base of exposed slopes.
Along streets, curbs and property lines (below disturbed areas).
I. Deposit a ridge of soil about 18" high with a shovel or backhoe.
2. Compact the soil by rolling or tamping until it has the dimensions shown.

Maintenance tips

Inspect periodically and after each storm. Replace damaged bales; re-anchor displaced ones.
Clean out the sediment before it reaches the top of the bales.
Deposit the sediment where it will not enter a drainageway.
How to construct a filter fence

Materials

Filter Fabric

42" wide
tensile strength 120 lbs.
Equivalent Opening Size 70

• Posts

5' long (mm.)
4" x 4" wood or
1.3 *lbs.Ift.* steel

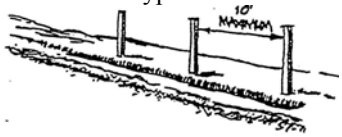
• Wire Mesh

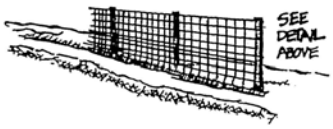
42" wide
6" mesh (max.)
14-gauge wire (mm.)

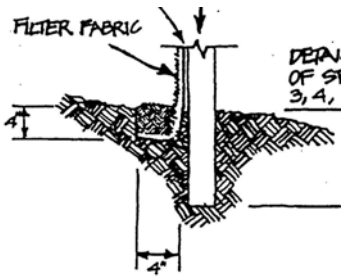
Staples (for wood posts)
heavy duty
1" long (mm.)

• Wire (for steel posts).

Note: Some types of filter fence have stakes included and do not require all the above materials.

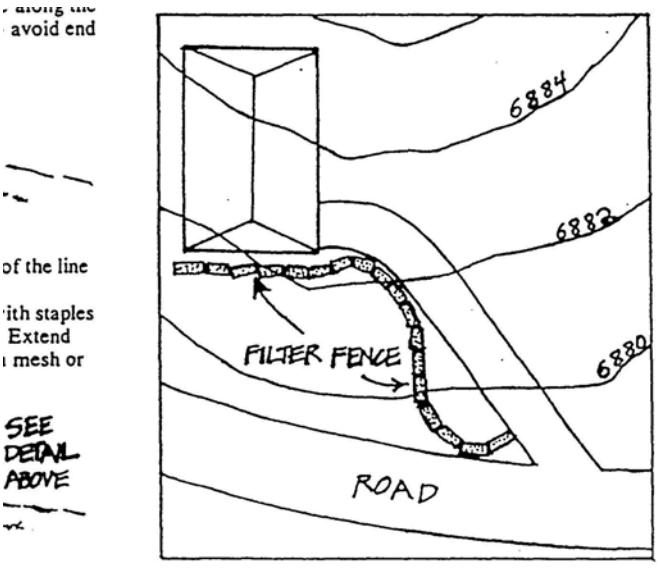




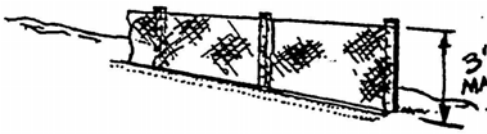


Installation procedure

1. Space posts no more than 10' apart and drive them at lease 1' into the ground. Align the fence along the slope contour, curving it slightly uphill to avoid end runs.



2.. Dig a 4" x 4" trench along the uphill side of the line of posts.
3. Fasten wire mesh to uphill side of posts with staples (on wood posts) or wire (on steel posts). Extend mesh to bottom of trench. (Do not attach mesh or fabric to trees.)
4. Fasten filter fabric to uphill side of posts with staples or wire. Extend fabric 8" into trench.
Note: The fabric should not extend more than 3' above the ground. Cut filter fabric from a continuous roll to avoid having joints. Where joints are necessary, splice the fabric only at a post, with at least a 6" overlap, and fasten both ends securely to the post.
5. Backfill trench and compact the soil.



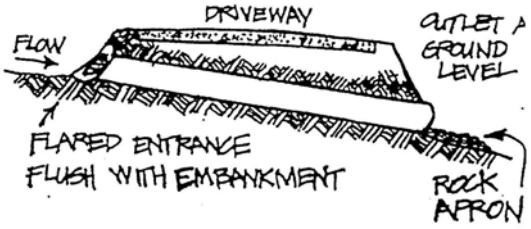
Winterizing your site

Often, during the course of construction, straw bales are broken or knocked out of place, filter fences are knocked over and drainage

ditches are blocked or filled. Before the winter season these erosion control measures must be repaired and functioning properly. All grading and excavation work should be completed by September 1st. At that time, all building sites must be winterized.
To winterize a building site adequately, all loose fill material should be protected
from erosion. Remove loose material ar rocks from the road and from drainage ditches or gutters. Gravel or pave driveways and access roads before the grading season ends.
Where slope stabilization is necessa as a permanent erosion control measure, it must be installed before the winter season to prevent undue erosion.

PERMANENT CONTROL MEASURES

Driveway and parking area stabilization

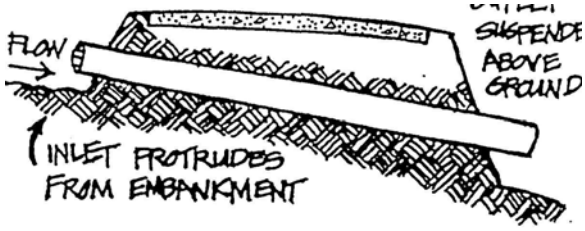


As soon as driveways and parking areas are graded, pave them or cover them with gravel to prevent soil erosion. Spread a 4" layer of W' to ¾" gravel over these areas.

Culverts

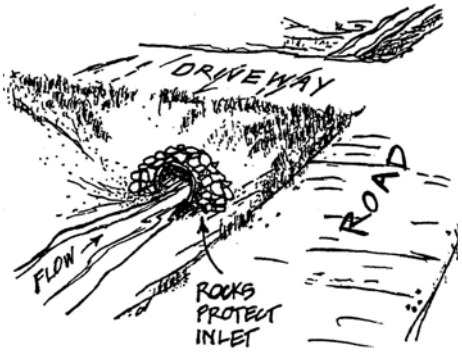
Size culverts to handle the peak flow during a heavy storm. Generally, the county engineer or public works department will size the culvert necessary for installation in roadside ditches along public roads. Where sizing requirements are not provided, use, as a rule-of-thumb, a culvert with twice the cross-sectional area of the channel draining into it. The extra capacity is needed because of flow efficiency loss at the culvert's inlet. If you must construct a driveway and culvert across a roadside ditch, it is best to have a civil engineer design the culvert and its outlet protector.

Inlets



Erosion frequently occurs at culvert entrances. It is best to install a culvert with its inlet flush to the embankment. The edge of the pipe should be rounded or flared to improve flow into it. Place rocks or sandbags around the inlet to prevent scour.

The pictures here show a good installation top, and a poor one bottom.



Outlets

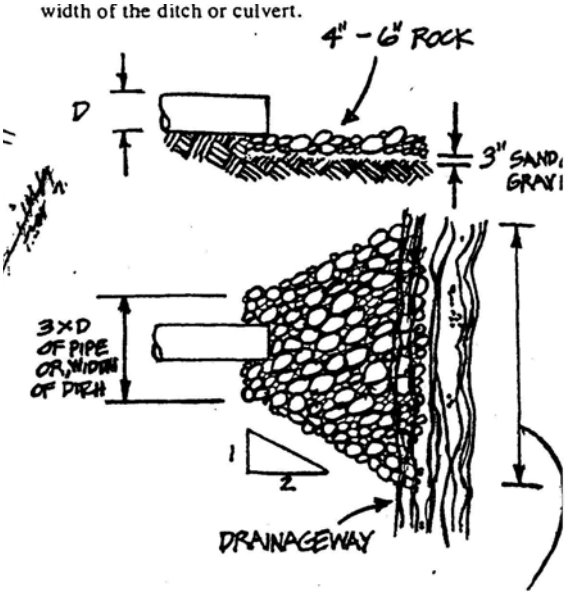
Install a culvert with its outlet at ground level, not suspended above the ground. A culvert must discharge to a stable drainageway. Because culverts generally cause flow velocities to increase, outlet protection is usually needed. Install a rock apron below the outlet as shown below.

Outlet protectors

An outlet protector, such as a rock apron, is a device for absorbing the energy of water discharging from a pipe or channel.

Where to use outlet protectors

— Below culverts.
I Below sediment trap outlets.
S Where a steep or paved channel drains into an unlined or natural drainageway



How to construct a rock apron outlet protector

Note: The following description applies to a ditch or culvert discharging at the side of a drainageway. The ditch or culvert should end at the top of the bank of this drainageway.
1. Place a 3" layer of sand or gravel in a trapezoidal- shaped apron from the ditch or culvert to the middle
of the drainageway. The apron width at a ditch should be as wide as the ditch. The apron width at a culvert should be 3 times the culvert's diameter. The apron should flare out at a ratio of 1' sideways for each 2' of length until the apron is 5 times the width of the ditch or culvert.

2. Place a layer of 4” to 6” rocks on top of the apron. The top of the finished apron should be at the same level as the inflowing ditch or culvert and should slope at the existing grade.

Maintenance

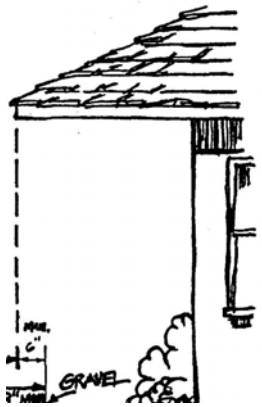
Inspect outlets during or after each storm.
Replace dislodged stones with larger ones.
Enlarge the apron if erosion is occurring around its edges.
Note: If you are constructing a driveway and culvert across a natural drainageway, have a civil engineer design the culvert and its outlet protector.

Infiltration systems

An infiltration system is a device used to percolate runoff into the soil. A typical system is a rock-filled trench or basin (called a dry well). You should infiltrate runoff from all impervious surfaces, including roof tops, driveways and areas where the soil has been packed down.

Where to use infiltration systems

Below roof drip lines
Along driveways and walkways
Along dikes and ditches
Below sediment trap outlets
On flat or gently-sloping ground



The capacity of infiltration trenches decreases as the slope of the trench increases. Infiltration should not be used on slopes steeper than 15%. Where a roof drip line or driveway exceeds 15% slope, install a paved ditch or French drain to convey the runoff to a dry well or lateral infiltration trench located along a slope contour. A French drain is a trench containing a perforated pipe surrounded by gravel.

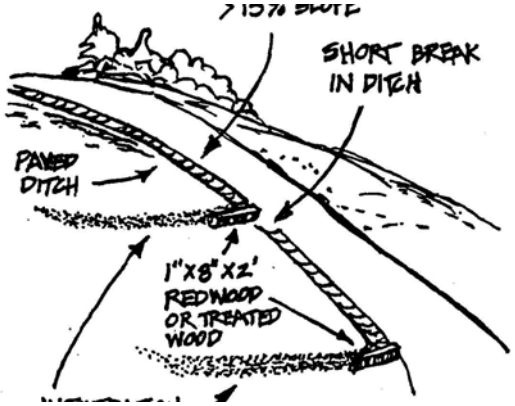
Where water dripping from a roof will fall on a slope above a house’s foundation, install a French drain to convey the roof drip to an infiltration system away from the house (see Sample Permanent Drainage Plan, page 4). The French drain will prevent waterfrom seeping under the foundation and weakening it. ;1
Where an infiltration system is located below a disturbed area, install a sediment barrier to remove the soil before it reaches the system. Removing sediment from the runoff will increase the efficiency of the infiltration system and reduce maintenance costs.

Sizing an infiltration system

The size of the infiltration system depends on soil permeability and runoff area. The system must be able to infiltrate 2.0” of precipitation per hour (the peak hour of the 25-year storm in the Summit area). If you have hired an architect or engineer to prepare the plans for your house, he or she can calculate the size of the. infiltration system needed.

How to construct a roof drip line infiltration trench

1. Dig a trench of the required size along the roof drip line as shown. Allow 3” extra width for the border boards.
2. Add the border boards (which are optional) and gravel to fill the trench to ground level.
Note: Roof runoff collected by a gutter and downspout system should be discharged to an infiltration trench or dry well.
Maintenance tip
Clean out accumulated sediment and debris when the trench fails to infiltrate storm runoff.



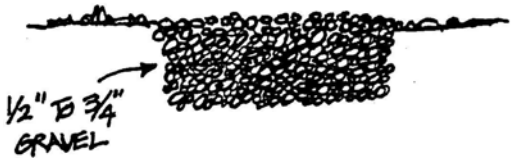
How to construct a driveway infiltration trench

1. Grade the driveway with a *l%-5%* slope towards the trench.
2. If the driveway slope is less than *15%,* size and construct a trench along the low side of the driveway as described under “How to Construct a Roof Drip Line Infiltration Trench.”

3. If the driveway slope is 15% or more, install a paved ditch or French drain along the low side of the driveway and route the runoff to lateral infiltration trenches located along slope contours or to dry wells located in more level areas. Install a 2' long 1" x 8" redwood or treated wood board between each section of ditch to prevent runoff from continuing downslope.
4. See page 14 for information on sizing lateral infiltration trenches and dry wells.

Note:
Do not install lateral infiltration trenches on fill slopes steeper than 4 horizontal to I vertical (4:1).
Do not locate a driveway on top of an infiltration trench.
Avoid placing infiltration trenches where their construction will damage tree roots.

How to construct a dry well



1. Determine the required dry well size as described on page 14.
2. Dig a basin of the required size and fill it with gravel. You may want to cover the top of the dry well with a shallow layer of sand or wood chips to create a more pleasing appearance.

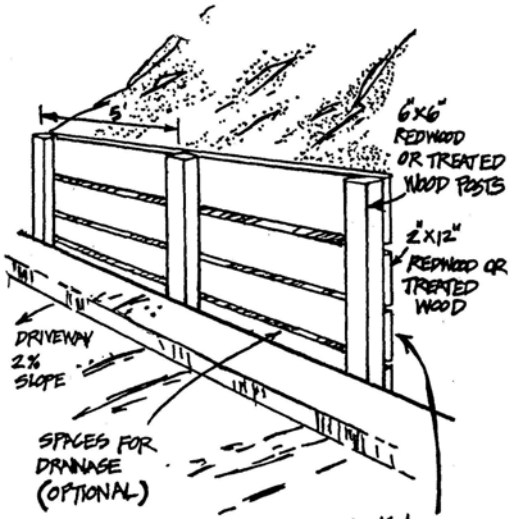
Maintenance tip
Clean out accumulated sediment and debris when the dry well fails to infiltrate storm runoff.

Slope stabilization

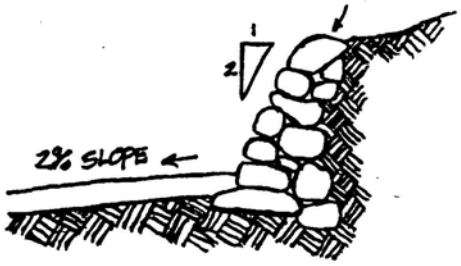
Riprapping is the use of cobble-size rock, generally 6"-lO" in size, placed closely together on disturbed soils to prevent erosion. Rock riprap is generally the most effective erosion control device for slopes greater than 30%. It can also be used on less steep slopes and works well with seeding. Concrete can be used to fill in between the rocks to hold the riprap securely in place — a common practice on steep slopes.

Retaining walls

Slopes that are Cut for building or driveway construction are sometimes so steep that vegetation or riprapping alone cannot adequately protect them. Runoff from these oversteepened slopes often erodes the toe of the slope, causing continued slope slippage. Retaining walls prevent toe erosion and slope slippage. They can be constructed using:
rocks redwood or treated wood
rock-filled baskets (gabions) railroad ties concrete
steel



Where to use retaining walls
At the base of steep slope cuts where erosion **or** slippage may occur.



How to construct a native rock retaining wall

Note: Any retaining wall over 3' high should be designed and installed by a professional.
1. Remove all large rocks from the eroding slope and stockpile on site.
2. Dig a footing trench along the toe of the slope.
3. Place the largest rocks in the trench with their longest axes perpendicular to the slope.
4. Stack rocks layer-by-layer on top of the footing so that each rock has a solid bearing on the rocks below it. The face of the wall may vary from vertical to a ½:l slope.
5. Fill the space behind the rock wall with left-over soil excavated from the site.
6. Slope the ground at the base of the wall at a 2% grade away from the wall and stabilize it with vegetation or mulch. If a driveway is located at the base of the wall, pave it up to the wall or install a curb.

Maintenance tips

• Inspect periodically for erosion, slippage or soil sloughing. Repair as needed.

How to construct a wood retaining wall

Note: Any retaining wall over 3’ high should be designed and installed by a professional.

Materials

Redwood, cedar or treated wood are acceptable materials for wood retaining walls.

1. Set 6” x 6” wood posts into concrete foundations at least 2’ into ground. Space the posts *5’* apart.
2. Nail 2” x 12” wood planks to the upsiope side of posts. Leave a small vertical space between planks to allow drainage at the base of the wall and between planks.

You may want to backfill the space behind the wall with surplus soil from excavations.

3. Slope the ground at base of the wall at a 2% grade away from the wall and stabilize it with vegetation or mulch. If a driveway is located at the base of the wall, pave it up to the wall or install a curb.

Revegetation

Re-establishment of vegetation is probably the most important long term erosion measure. Revegetation done in conjunction with other control measures is extremely effective in erosion control and generally is the least costly of all techniques.

Protection of the existing native vegetation is most desirable, but, when that is not possible, reestablishment of vegetation is important. Native species require less water and fertilizer especially after the vegetation is established. The procedures for revegetating described on pages 6 and 7 are applicable for permanent revegetation of disturbed areas.

A landscape plan should be included as part of the permanent erosion control plan for a building site. In this area, shrubs and trees are the most desirable vegetation for permanent erosion control. While grasses can be effective as permanent vegetation, they generally require more maintenance and watering.

Wattle **Installation Diagrams**