University of Nevada
Cooperative Extension

How to Install Residential Scale Best Management Practices (BMPs) in the Lake Tahoe Basin

Manual for Building and Landscape Professionals

By the BMP Retrofit Partners

CM-11-02

The BMP Retrofit Partners

Who are we and what do we do?

The Contractors Workshop is organized and sponsored by the following partner agencies who are tasked with implementing BMPs on private property in the Lake Tahoe Basin through their respective programs:

- Natural Resources Conservation Service (NRCS)

  NRCS Natural Resources Conservation Service

- Tahoe Regional Planning Agency (TRPA)

  TAHOE REGIONAL PLANNING AGENCY | LAKE TAHOE ENVIRONMENTAL IMPROVEMENT PROGRAM

- University of Nevada Cooperative Extension (UNCE)

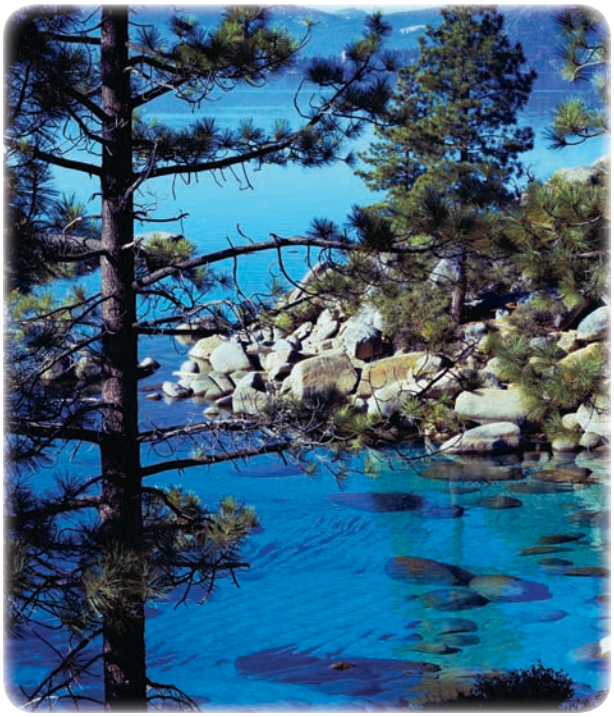
  University of Nevada Cooperative Extension

- Tahoe Resource Conservation District (TRCD)

  TAHOE RESOURCE CONSERVATION DISTRICT

- Nevada Tahoe Conservation District (NTCD)

  Nevada Tahoe Conservation District



FOR MORE INFORMATION AND A FREE BMP EVALUATION, CONTACT ONE OF THE AGENCIES LISTED BELOW:

For information on soil properties:

USDA Natural Resources Conservation Service (NRCS)
870 Emerald Bay Road, Suite 109, Box 3,
South Lake Tahoe, CA 96150
Phone: (530) 543-1501, Ext. 102
http://www.ca.nrcs.gov

For commercial & multi-family properties in Nevada and California:

Tahoe Regional Planning Agency
Stormwater Management Program
P.O. Box 5310, 128 Market Street, Stateline, NV 89449-5310
Phone: (775) 588-4547, Ext. 202
Fax: (775) 588-4527
e-mail: bmp@trpa.org
http://www.trpa.org

Education/Outreach Training:

University of Nevada Cooperative Extension
P.O. Box 3912, 855 Alder Avenue, Suite 106, Incline Village, NV 89452-8208
Phone: (775) 832-4150
Fax: (775) 832-4139
e-mail: cobournj@unce.unr.edu
http://www.unce.unr.edu

For residential properties in California:

Tahoe Resource Conservation District
Backyard Conservation Program
870 Emerald Bay Road, Suite 108
South Lake Tahoe, CA 96150
Phone: (530) 543-1501, Ext. 113
Fax: (530) 543-1660
e-mail: info@tahoercd.org
http://www.tahoercd.org

For residential properties in Nevada:

Nevada Tahoe Conservation District
Backyard Conservation Program
P.O. Box 915, 400 Dorla Court, Zephyr Cove, NV 89448
Hotline: (775) 586-1610, Ext. 28
Fax: (775) 586-1612
e-mail: bcp@ntcd.org
http://www.ntcd.org

How to Install Residential Scale Best Management Practices (BMPs) in the Lake Tahoe Basin

Manual for Building and Landscape Professionals

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Tahoe Resource Conservation District
USDA Natural Resources Conservation Service
Tahoe Regional Planning Agency's Stormwater Management Program
University of Nevada Cooperative Extension

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Chapter 1

Introduction to Lake Tahoe's BMP Retrofit Program

Most property owners at Lake Tahoe are aware that all developed properties there must have Best Management Practices (BMPs) installed. Older structures must be retrofitted with BMPs. Many property owners have contacted the Tahoe Regional Planning Agency (TRPA) and the conservation districts to receive a free BMP Site Evaluation in order to learn which BMPs need to be installed on their properties. Once the property owner receives the completed BMP Site Evaluation in the mail, changes and improvements in the landscape, driveway and parking areas often need to be made.

This manual is intended to help the landscape designer, contractor, engineer and landscaper interpret the BMP Site Evaluation and learn how BMPs need to be installed and maintained in order to meet TRPA requirements. The primary audience for this manual is the contractor, architect, engineer and landscape designer installing BMPs on developed reisdential parcels. Some homeowners may also be able to use it as a do-it-yourself manual.

Best Management Practices (BMPs) for water quality: The basics

Before going into the specific details about residential BMPs, the basic terms and rationale for best management practices will be explained.

Storm runoff brings a plume of sediment and nutrients into the lake from a tributary stream.

Lake Tahoe is suffering from pollution that comes from human disturbances and urbanization in the surrounding watershed, also called the Lake Tahoe Basin. This water pollution is called "nonpoint source pollution," because it comes from many diffuse sources rather than a clearly identifiable point such as the waste discharge pipe of a factory or wastewater treatment plant. In fact, there are no waste pipes permitted to discharge into any water body in the Tahoe Basin.

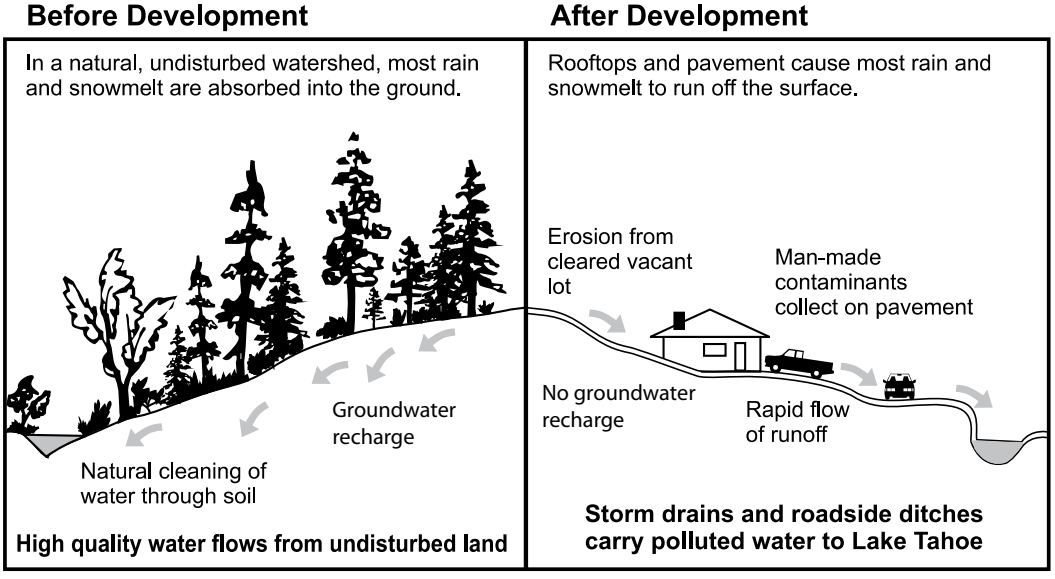
The world-famous clarity of Lake Tahoe has declined considerably over the past 40 years, from 102 feet in 1968 to 68 feet in 2009. Scientists say that to prevent further loss in lake clarity, we must greatly decrease the pollution from our landscapes, roads and construction activities. **This kind of nonpoint source pollution is commonly known as urban stormwater or urban runoff.**

The pollutants that do the greatest harm to Lake Tahoe's clarity are nutrients and fine particles of sediment. Recent research shows that 72 percent of Tahoe's worst pollutant, fine sediment, comes from urban runoff, including soil eroding from developed properties. Once in the lake, nutrients fuel algal growth, and fine sediments remain suspended in the water, reducing its clarity. For more information about the pollutants of concern and their sources in the Lake Tahoe Basin, go to: http://ndep.nv.gov/bwqp/file/LTTMDL_Final_v20.pdf.

Best Management Practices are methods to help developed properties function more like natural, undisturbed forest and meadowland. Water that is conveyed to a lake by an undisturbed watershed is usually quite pure, because the watershed's soils and plants act as a natural water purification system. The **BMP Site Evaluation** provides methods to mimic natural conditions by infiltrating water from rooftops and pavement (also called impervious coverage) into the soil instead of letting it leave the property as runoff. No private property runoff is allowed to enter the street storm drain system.

BMPs are so useful for protecting water quality that TRPA requires their implementation on all developed properties in the Tahoe Basin.

In many undisturbed forests, more than 95 percent of rain and snowmelt soaks into the ground. Pavement, rooftops and other hard surfaces cause water to run off the surface rapidly, carrying soil particles and other contaminants into nearby streams and eventually into the lake.



BMPs are required

The Tahoe Regional Planning Agency has been charged by the U.S. Congress to establish regulations that will prevent the continued decline of Tahoe's water quality. The requirements for the BMP Retrofit Program are codified into law in the TRPA Code of Ordinances. Implementation of BMPs as recommended by a BMP Site Evaluation is required of all Tahoe Basin landowners to meet the TRPA BMP Ordinance. Because priority watershed deadlines have passed, all property owners who are out of compliance are required to install BMPs as soon as possible. TRPA has begun enforcement activity on all property types in California and Nevada.

Within TRPA, the Erosion Control Team has been formed specifically to help property owners meet their BMP retrofit requirements. You can call them or any of the other agencies listed on the back cover for assistance.

How to use this manual

This manual should be used with a completed BMP Site Evaluation and the University of Nevada Cooperative Extension's *Home Landscaping Guide for Lake Tahoe and Vicinity.* That book is a broad reference guide about conservation which can be used to look up specific topics not covered in this manual, such as the TRPA's recommended plant list (Chapter 7 of the *Guide*).

Types of BMPs described in this manual

The second chapter describes Temporary BMPs, which must be installed and maintained on all construction sites and during large-scale BMP retrofit projects. The following two chapters describe BMPs for Paved Driveways (Chapter 3) and Runoff and Infiltration (Chapter 4). The site evaluator will make recommendations for infiltrating the volume of runoff that would result from a rainstorm that produces an inch of rainfall in one hour (the 20-year/1 hour storm). Unless the site has shallow soils or high groundwater, the property owner must implement BMPs to capture and infiltrate the runoff generated by all impervious surfaces with either a naturally vegetated area or an infiltration system where the runoff can soak into the soil. Even clean runoff leaving the property can overload roadside ditches and stream channels, causing erosion and sedimentation downstream.

Chapters 5 and 6 describe BMPs for Slope Stabilization and Vegetation and Mulch. If the property has steep, unvegetated slopes or bare soil areas, these areas must be treated to prevent soil erosion and to encourage the water that falls there to soak into the ground rather than running off.

Chapter 7 provides information about monitoring and maintenance to ensure that the BMPs installed continue to work effectively, and Chapter 8 describes permitting requirements for BMP retrofit work.

There are agencies to help you

Representatives from five local agencies have formed a coalition in order to help you implement BMPs on residential properties. These agencies are listed below:

- The Nevada Tahoe Conservation District (Nevada)
- The Tahoe Resource Conservation District (California)
- The USDA Natural Resources Conservation Service
- Tahoe Regional Planning Agency's (TRPA) Stormwater Management Program
- The University of Nevada Cooperative Extension

Please see back cover for contact information for these agencies.

Process to obtain a certificate of BMP completion

To bring a property into compliance with the BMP Retrofit Program and to improve Lake Tahoe's clarity, you can follow these simple steps.

Step 1: BMP site evaluation

Property owners should request a free BMP Site Evaluation by contacting a TRPA-BMP certified contractor, the Nevada Tahoe Conservation District for single-family residence in Nevada, the Tahoe Resource Conservation District for single-family residence in California, and the TRPA Erosion Control Team for multi-family, commercial/ industrial or public service properties. (See phone numbers, back cover.)

Step 2: BMP implementation

The property owner will receive a copy of the completed BMP Site Evaluation in the mail. Property owners are then responsible to install the BMPs either by doing it themselves, or by hiring a qualified contractor to do the work. They can request additional technical assistance from TRPA or one of the Conservation Districts. Site evaluations conducted after May 1, 2009 will expire three years after they were completed. If any site evaluation is more than three years old, please call the agency who conducted the evaluation to see how BMP requirements may have changed. This could save the owner time and money.

An erosion control expert performs a free site evaluation with a homeowner.

Step 3: Certificate of completion (BMP certificate)

When the BMPs are completed, the contractor or the property owner should contact TRPA's Erosion Control Team, their local conservation district, or a TRPA-certified BMP evaluator for a final inspection. If the BMPs have been installed as prescribed and are functioning correctly, the property owner will receive a Certificate of Completion. This signifies that the property is in compliance with the TRPA BMP Retrofit Ordinance. The Certificate will be valid as long as the BMPs are maintained and functional.

Procedures to Prepare for a Final BMP Inspection:

1. Complete the "BMP Final Inspection Checklist" (see appendix I).
2. Provide an ***approved*** site evaluation to the inspector.
3. Be sure to get "significant" or "substantive" changes to a site evaluation approved by the designer or design agency **before** installation.
4. Have photo documentation showing infiltration systems prior to backfill. Place a tape measure in the photo to show the depth, width and length of excavation. Better yet, email the photos to the inspector prior to the appointment.
5. All runoff conveyances must pass a hydraulic test (hose test) to insure connectivity to the infiltration device. Be sure to have a water supply for the hose test.

Scheduling your water quality improvements

Some property owners do not want to implement all BMPs at once due to time and budget limitations. Determining a BMP implementation schedule allows flexibility for the homeowner and allows for phasing of BMP retrofits over time. Use the following priority list to determine what BMPs should be implemented first if the project will be phased over several grading seasons. If requested, be prepared to notify TRPA in writing of your proposed BMP implementation schedule to have it approved.

The TRPA priority order for installation of retrofitting measures:

1. Pave legally established roads, driveways and parking areas;
2. Install drainage conveyances;
3. Stabilize walkways and cut and fill slopes;
4. Vegetate denuded areas; and
5. Treat surface runoff from land coverage.

See **Chapter 2** for temporary BMPs to use during construction.

A note to BMP professionals

The BMP Retrofit Partners have prepared this manual specifically to help you take advantage of a business opportunity in the Tahoe Basin. Since thousands of homeowners will be obtaining BMP Site Evaluations in the next few years, we want to be sure they can get professional help to meet the requirements with a minimum of worry, red tape and needless expense. Our partners offer trainings each spring on the design, implementation and maintenance of effective BMPs. Licensed professionals who satisfactorily complete these trainings and pass the test will be listed each year on a list of BMP-trained Resource Professionals, which is available to property owners. This list states that you have attended the workshop, but it does not "certify" that you are skilled at implementing BMPs, nor does it substitute for a valid contractor's license.

Dirt driveways contribute sediment to Lake Tahoe.

How to interpret BMP site evaluation forms

This section will familiarize you with the BMP site evaluation documents. Please refer to the sample BMP site evaluation forms on pages 7 through 10.

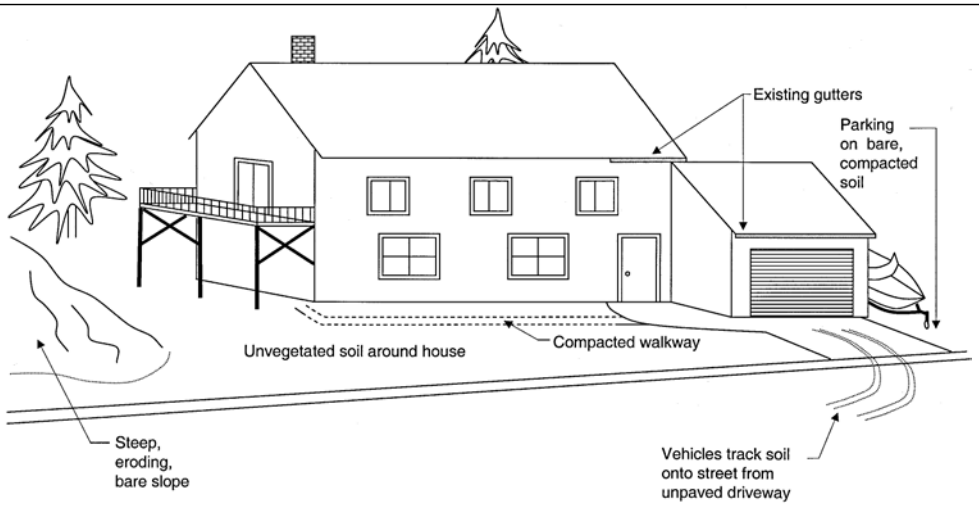
Each evaluation has a diagram, the "site plan," indicating what BMPs are required and where they should be located. Each BMP is assigned a letter of the alphabet (A-F) or a number which shows its location(s) on the site and allows the property owner to find it in the recommended treatment table. Sample recommended treatment forms are shown here for a typical house on three different soil types: rapid soil, moderately permeable soil (5.7"/hr), and "constrained site" (see pages 27 and 34). A separate document, "Attachment 1," gives the owner a brief description of each treatment or BMP. The chapters of this book describe how each type of BMP was designed and should be installed.

Please note:
Property owners should be aware that a BMP site evaluation is NOT a verification of land coverage, land capability or use, nor is it a conceptual approval of any future project not related to the site evaluation.

Soil type

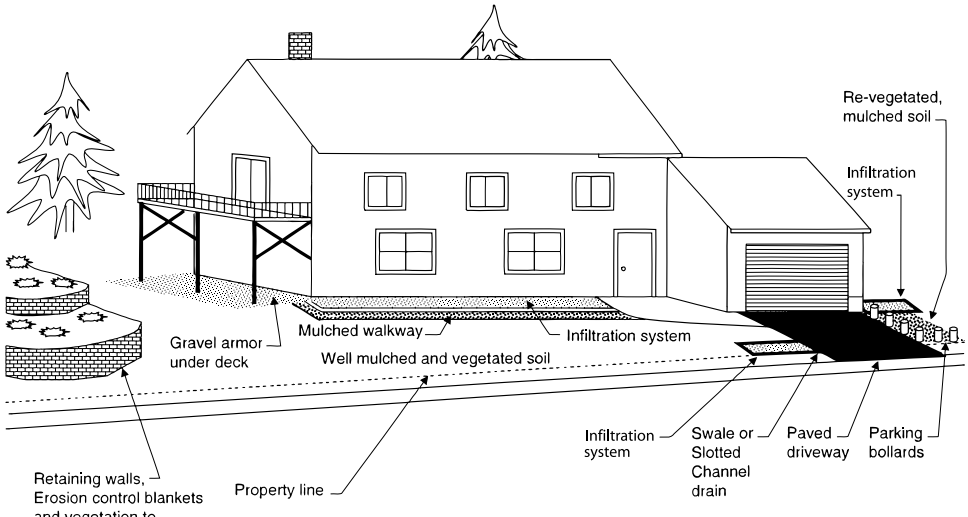
On most BMP site evaluations, you will find the permeability of the soil, measured in inches per hour, presence of drainage problems, if any, and average slope percentage. A "Brief Soil Description" sheet is also attached to most Site Evaluations. The NRCS soil survey is online at http://websoilsurvey.nrcs.usda.gov. Since one goal of BMPs is to infiltrate stormwater runoff into the soil, these factors must be used to correctly design and size the infiltration systems. The examples of BMP Treatment forms on pages 8-10 will give you an idea about how BMPs differ depending on soil type. Note that on "Moderately Permeable Soils," the drip line trenches (B) are excavated, while "Rapid Soil" and "Constrained Sites" have only rock armor on the soil under drip lines. In fact, because of seasonal high ground water and very slow drainage, (and/or shallow bedrock) the sample constrained site on page 10 has only one excavation, of 3 inches (B6), for an energy disipater at the foot of a downspout. (See Chapter 4: Runoff & Infiltration.)

A sketch of a typical property in Lake Tahoe BEFORE implementing BMPs.

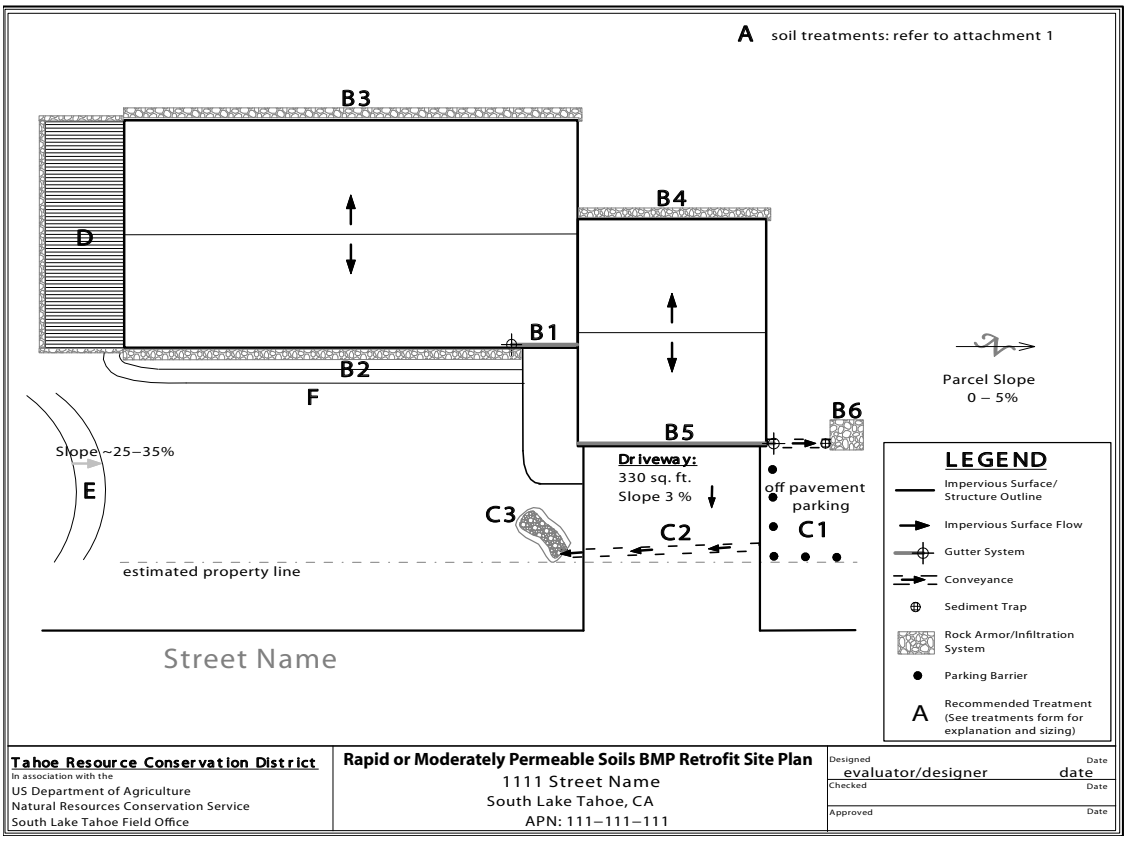


BEFORE IMPLEMENTING BMPS

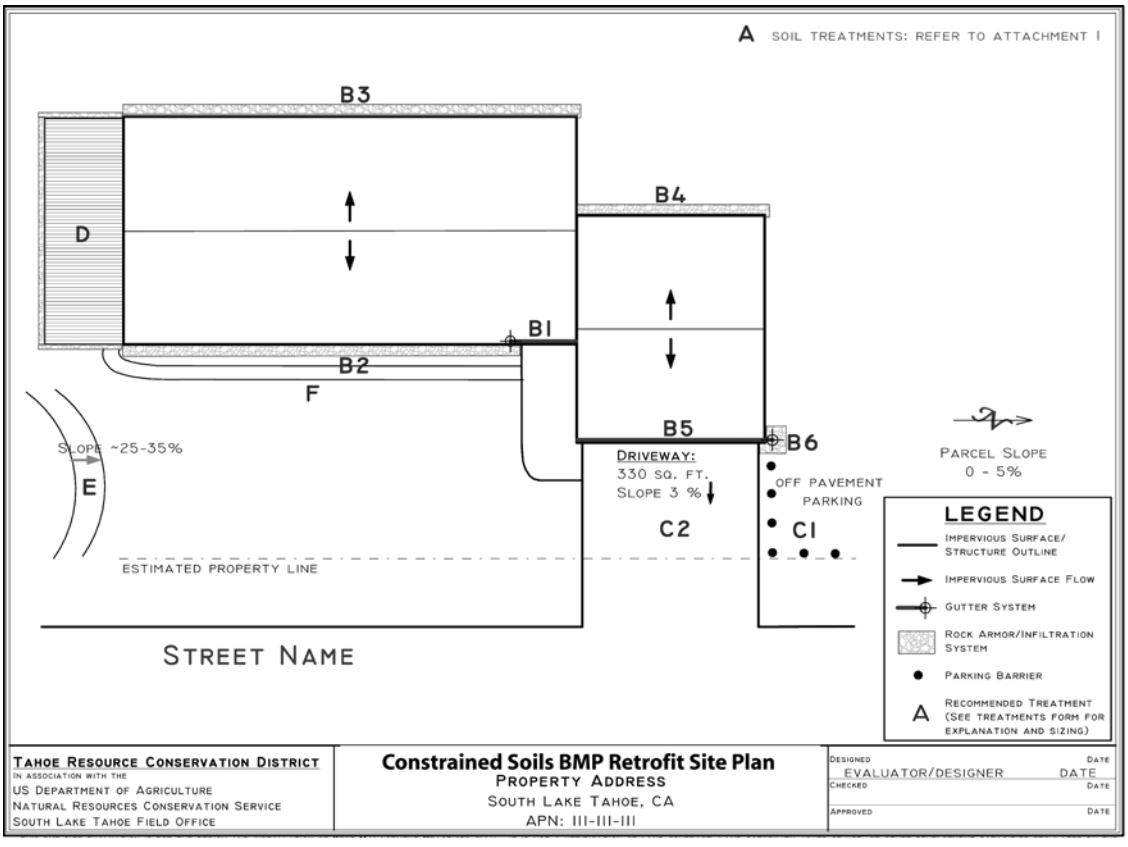
The above property after implementing the BMPs shown on pages 7-10.



AFTER IMPLEMENTING BMPS



Site plan for the evaluations on pages 8 and 9.



Site plan for the evaluation on page 10.

Sample BMP Site Evaluation Form - Rapid Soil Example

TRCD Backyard Conservation Program

Date Printed: 4/5/2010

APN: _____ Property Owner: Name

Physical Address: - 1111 Street Name Community: Y Area County: _____

Mailing Address: _____ City: SOUTH LAKE TAHOE State: CA Zip: 96151

Watershed: UPPER TRUCKEE RIVER 44 Priority: 2 **Compliance Date: 2006**

Site Evaluation Recommended Treatments

Evaluation Date_____
(Site evaluations expire after 3 years.
Call the evaluator to check for possible changes.)

Tahoe Resource Conservation District
(530) 543-1501 ext. 113

Soil Survey Map Data **(RAPID SOIL EXAMPLE)**

Field Measurements: **Permeability Measurement: 12.8"/hr** **Depth 1: 12"**

Infiltration Rate: None measured Hydrophobic Soils? NO Slope (%): 0-25

#	RUNOFF (CF)	TREATMENT	DIMENSIONS	QUANTITY
A		Soil Treatments: Refer to Attachment 1		
B1		Maintain existing conveyance system		
B2	75	Armor bare soil under drip line with 3" layer of drain rock or cobble and boarder system	~52'L x 24"W Reference BMP-009.2	.96 cu yds
B3	75	Armor bare soil under drip line with 3" layer of drain rock or cobble and boarder system	~62'L x 24"W Reference BMP-009.2	1.15 cu yds
B4	31.3	Armor bare soil under drip line with 3" layer of drain rock or cobble and boarder system	~27'L x 18"W Reference BMP-009.2	.35 cu yds
B5		Maintain existing conveyance system		
B6	31.3	Install drain rock infiltration system in conjunction with a sediment trap	~5'L x 4.5'W x 11"D	.75 cu yds
C1		Install parking barriers	Reference BMP-026.1	
C2		Install Swale in driveway with sediment trap (cold-ptach berms not acceptable)		
C3	27.5	Install infiltration basin	Top: 7'L x 5'W; Bottom: 5'L x 24"W x 6"D	
D		Install drain rock under elevated structures (decks/stairs/walkways)	Reference Standard Drawing BMP-010.2	4.41 cu yds
E		Install rock slope protection (riprap), terracing, and/or appropriate vegetation and mulch to stabililize slope		
F		Site Specific treatment. Refer to Attachment 1(BMP Path)		
Total		Total drain rock required for recommended treatments		~7.50 cu yds

Reviewed by: _____ Approved by:_____

Title: _____ Title: _____

This BMP Site Evaluation is for the design and installation of Best Management Practices only. It is not a verification of land coverage, land capability, units of use, or other development capacities regulated by the Tahoe Regional Planning Agency (TRPA), nor is it a conceptual approval of any unrelated future project. These verifications require the submittal of a separate application to the TRPA for review and approval.

Sample BMP Site Evaluation Form - Moderately Permeable Soil Example

TRCD Backyard Conservation Program

Date Printed: 4/5/2010

APN: _____ Property Owner: Name

Physical Address: - 1111 Street Name Community: Y Area County: _____

Mailing Address: _____ City: SOUTH LAKE TAHOE State: CA Zip: 96151

Watershed: UPPER TRUCKEE RIVER 44 Priority: 2 **Compliance Date: 2006**

Site Evaluation Recommended Treatments

Evaluation Date_____

(Site evaluations expire after 3 years.
Call the evaluator to check for possible changes.)

Tahoe Resource Conservation District
(530) 543-1501 ext. 113

Soil Survey Map Data **(MODERATELY PERMEABLE SOIL EXAMPLE)**

Field Measurements Permeability Measurement: 5.7"/hr Depth 1: 12"

Infiltration Rate: None measured Hydrophobic Soils? NO Slope (%): 0-25

#	RUNOFF (CF)	TREATMENT	DIMENSIONS	QUANTITY
A		Soil Treatments: Refer to Attachment 1		
B1	Added to B2	Maintain existing conveyance system		
B2	75	Install drain rock infiltration trench under drip line	~52'L x 30"W x 3"D Reference BMP-001.1	1.20 cu yds
B3	75	Install drain rock infiltration trench under drip line	~62'L x 24"W x 3"D Reference BMP-001.1	1.15 cu yds
B4	31.3	Install drain rock infiltration trench under drip line	~27'L x 24"W x 3"D, Reference BMP-001.2	.50 cu yds
B5		Maintain existing conveyance system		
B6	31.3	Install drain rock infiltration system in conjunction with sediment trap	~5'L x 5'W x 21"D	1.62 cu yds
C2		Install swale in driveway with sediment trap (cold-patch berms not acceptable)		
C3	27.5	Install infiltration basin	Top: 10'L x 4'W Bottom: 8'L x 24"W Depth: 6"	
D		Install drain rock under elevated structures (decks/stairs/walkways)	Reference Standard Drawing BMP-010.2	4.41 cu yds
Total		Total drain rock required for recommended treatments		~9.00 cu yds

Note: The BMP Treatment Forms on pages 8-10 each show examples of recommended BMPs for the same house on differing soil conditions. For ease of comparison, some treatment rows which are same on pages 8-10 have been removed on pages 9 and 10. Notice that the house on soil with a Permeability Measurement of 12.8 inches per hour (Page 8) has smaller infiltration systems, requiring less drain rock, than the house on soil with a permeability rate of 5.7 inches per hour (Page 9). Soils with rapid permeability generally require smaller infiltration systems than those with moderate permeability. You can see this difference in the "Dimensions" and "Quantity" (of drain rock) columns on pages 8 and 9.

The "Constrained Site Example," shown on page 10, has a permeability rate of 1" per hour. This very slow permeability rate places this property in the "Constrained Site" category. In general, these sites have no excavations greater than 3 inches deep. The property owner must complete all BMPs except excavated infiltration systems. (See pages 26-27 and 34).

Sample BMP Site Evaluation Form - Constrained Site Example

TRCD Backyard Conservation Program

Date Printed: 4/5/2010

APN:_____ Property Owner: Name

Physical Address: - 1111 Street Name Community: Y Area County: _____

Mailing Address: _____ City: SOUTH LAKE TAHOE State: CA Zip: 96151

Watershed: UPPER TRUCKEE RIVER 44 Priority: 2 **Compliance Date: 2006**

Site Evaluation Recommended Treatments

Evaluation Date_____
(Site evaluations expire after 3 years.
Call the evaluator to check for possible changes.)

Tahoe Resource Conservation District
(530) 543-1501 ext. 113

Soil Survey Map Data **(CONSTRAINED SITE EXAMPLE)**

Field Measurements: **Permeability Measurement: 1"/hr** **Depth 1: 12"**

Infiltration Rate: None measured Hydrophobic Soils? Don't know Slope (%): 0-25%

#	RUNOFF (CF)	TREATMENT	DIMENSIONS	QUANTITY
A		Soil Treatments: Refer to Attachment 1		
B1		Maintain existing conveyance system		
B2	8.7	Armor bare soil under drip line with 3" layer of drain rock or cobble and boarder system	~52'L x 24"W Reference BMP-009.2	.96 cu yds
B3	10.3	Armor bare soil under drip line with 3" layer of drain rock or cobble and boarder system	~62'L x 24"W Reference BMP-009.2	1.15 cu yds
B4	3.1	Armor bare soil under drip line with 3" layer of drain rock or cobble and boarder system	~27'L x 18"W Reference BMP-009.2	.35 cu yds
B5	0.8	Maintain existing conveyance system		
B6	31.3	Install energy dissipater under downspout	~3'L x 3'W x 3"D	.08 cu yds
C2		Site Constraint - See attached Site Constraint Memorandum		
D		Install drain rock under elevated structures (decks/stairs/walkways)	Reference Standard Drawing BMP-010.2	4.41 cu yds
Total		Total drain rock required for recommended treatments		~7.00 cu yds

Notice that the examples on pages 8-10 have **Field Measurements** entered for soil permeability (See definition, page 31). These rates are made using a Constant Head Permeameter (CHP) by qualified staff. They are measured as "saturated hydraulic conductivity or Ksat. By using the on-site Ksat, BMP designs reflect the on-site soil conditions that are often affected by disturbance and compaction. When there are no entries in the "Field Measurements" for soils, then the default value used is the NRCS mapped rate shown for that soil in the Soil Survey. If a site evaluation calls for an excavated infiltration system, dig the hole first, before other steps such as modifying a driveway. If your test hole shows indicators of shallow groundwater, immovable rock or other barriers, **call the Conservation District that performed the Evaluation before excavating further.** Tell them you need to report a problem with an existing site evaluation, and you may need to get approval for a change.

Chapter 2

Temporary BMPs for Construction Sites

When sediment-laden runoff flows from construction sites and into Lake Tahoe, the nutrients attached to the sediment encourage algal growth. The small or "fine" sediment particles also remain suspended in the lake's water. Both algae and fine sediment reduce Lake Tahoe's clarity. Construction often disturbs large areas of soil and removes vegetation, leaving soil vulnerable to erosion. Therefore, construction sites are required to have temporary Best Management Practices installed BEFORE any disturbance occurs.

What are temporary BMPs?

According to the Tahoe Regional Planning Agency's *Handbook of Best Management Practices*, temporary BMPs are practices and structures used to prevent or minimize erosion and sedimentation before and during construction and until permanent BMPs have been installed. Temporary BMPs must be sized to capture and infiltrate runoff for the 20-year/1-hour storm, which is approximately 1 inch of rainfall in an hour in this area. If properly installed, temporary BMPs can prevent the discharge of degraded runoff water from construction sites.

What is the difference between erosion control and sediment control?

Erosion control, also called sediment source control, includes practices that keep soil particles in place by protecting them from being eroded by water or wind. In this approach, soil is valued as a natural resource that needs protection. (See photo below.)

Sediment control includes practices that try to capture soil particles after they have been picked up by wind or water. These

A great deal of topsoil has been washed away because of a lack of erosion control BMPs.

BMPs usually try to filter or trap sediment out of the water or wind. Sediment control does not treat soil as a natural resource to protect, but instead emphasizes removing it from runoff, then redistributing it on site or disposing of it safely. (See photo of silt fence and fiber roll log below).

Erosion control is generally less expensive than sediment control. Once soil is suspended in water, it is costly and difficult to remove. Also, if you violate surface water discharge standards, you are liable to pay a fine according to federal, state and local laws. Erosion control practices should be "backed-up" by sediment control practices, increasing the protection of the construction site.

The silt fence and fiber roll log will remove sediment from runoff if a rainstorm occurs.

What are the maintenance needs of temporary BMPs?

Temporary BMPs are site-specific, and usually only last one year or one winter season. They require much more maintenance than permanent BMPs. Due to their temporary nature, these practices usually require daily checking, especially during clearing and grading activities. They should also be checked immediately before an impending storm and after the storm has passed. Sediment that accumulates behind temporary BMPs must be removed from the site and disposed of at a TRPA-approved location whenever it accumulates and again upon removal of the BMPs unless TRPA approves allowing the material to be stabilized onsite.

When should I start thinking about BMPs for my construction project?

You should start thinking about BMPs during the planning phase of your project. With proper planning, disturbance to a construction site can be minimized and managed. By staging your construction process carefully, you can reduce how much area you disturb. Additionally, by phasing stages of your project, you can disturb less area at one time, minimizing the threat of serious soil loss.

What temporary BMPs need to be in place BEFORE I start construction?

Temporary Construction Site BMPs

Before you start construction on a project, the following BMPs need to be properly installed and must remain in place until all construction activity is completed and/or until permanent BMPs are installed:

1. Boundary Fencing is temporary fencing used on the construction site to mark the limits of clearing and grading and to define

areas which must be protected. Boundary fencing is normally placed 12 feet from structures in order to minimize disturbed areas, to protect trees and vegetation and to prevent any encroachment in stream environment zones, on steep slopes or in other highly sensitive areas. (See photo at right.)

Boundary fencing around construction sites prevents vehicles and equipment from damaging adjacent vegetation and habitat. This fence is too close to the tree. It should extend as far from the tree as the length of the longest branches (the "dripine").

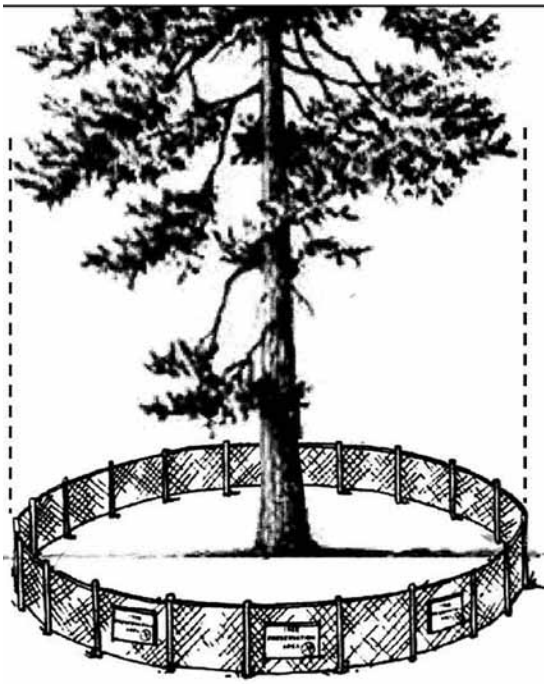
2. Traffic Control is the control of onsite traffic during construction activities, especially during the clearing, grading and excavating phases of site development. Areas where construction vehicles can travel must be well marked with flagging, markers and/or temporary fencing before construction activity begins. This can be combined with boundary fencing. The following guidelines need to be considered:

- Locate construction roads where future roads, driveways, and parking lots will be.
- Store materials and park equipment where permanent parking areas will be.
- Avoid sensitive areas such as steep slopes and stream zones.
- Avoid areas planned as future open space to prevent compaction of soils.
- Keep traffic away from wet soils.
- Use the minimum number of temporary routes to access the construction site.
- Sweep and/or scrape any dirt and mud off public streets at the end of the workday, and store sediment onsite with a temporary sediment barrier.
- Do not allow vehicles to travel over exposed soils when they are muddy.

3. Stabilized Construction Entrance consists of a pad of crushed stone or gravel located at any point where construction traffic enters or leaves the site. This pad reduces the tracking of sediment off of the disturbed site. When necessary, washing of vehicle wheels to remove sediment before leaving the site will be conducted on this type of stabilized crushed stone pad, with an approved sediment barrier in place to trap water and sediment. The entrance pad should consist of 1- to 3-inch diameter, clean, crushed stone or gravel, at least 8 inches deep. The entrance must be maintained, which may require periodic addition of crushed stone or gravel to the surface. If the construction site already has a paved or stabilized entrance that will be used as the only point of ingress and egress, or if trucks and other heavy equipment will not be used onsite, a stabilized construction entrance is not necessary.

4. Protection of Trees and Other Vegetation involves installing temporary fencing or other barriers **along the dripline of tree and other vegetation's branches** to prevent disturbance to the vegetation itself

as well as the root system. Protective fencing for soil and vegetation must be constructed with metal posts, industry standard mesh fencing, and must be at least 4 feet in height, unless an alternative protection method is approved by TRPA. Boards, wire, rope or other materials should not be nailed to trees, and fill materials should not be placed within fenced tree protection areas. Trees and other vegetation outside of the grading limits that are protected by the boundary fencing do not need individual protection. (See photo below.)



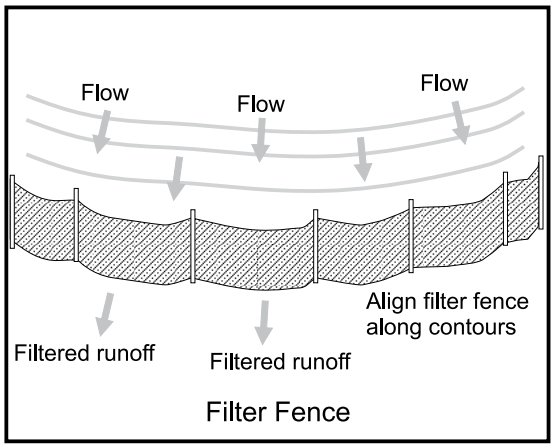
Protective fencing is used to protect the root systems of trees on construction sites. Vegetation fencing is required to extend around the full dripline of the tree.

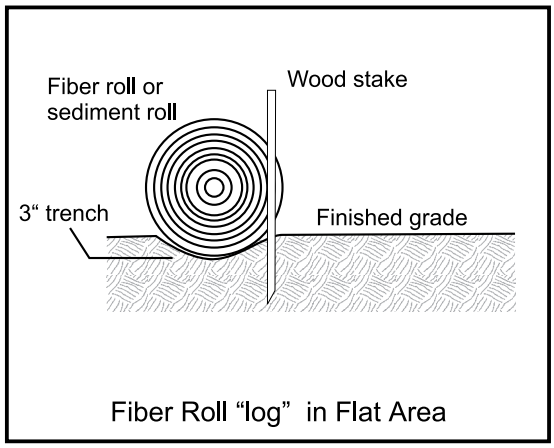
What specific BMPs do I need to use to prevent sediment from leaving the construction site?

Temporary Sediment Barriers are structures constructed to slow runoff and trap small amounts of sediment temporarily. Temporary sediment barriers must be installed around the downhill perimeter of disturbed soil areas. Historically, straw bales have been used as temporary sediment barriers. However, due to their limited ability to effectively trap sediment and the danger of noxious weeds being introduced by their use, they are no longer accepted or permitted for use in the Tahoe Basin. Instead, use **one or more** of the temporary BMPs listed:

1. Fiber Roll Barriers (also called sediment logs) usually consist of milled wood or other natural fibers sewn into a circular weave fabric. Fiber rolls are a good perimeter protection BMP, as long as they are installed properly. Fiber rolls should be installed on the contour line, perpendicular to the slope direction, keyed into a concave trench at least 3 inches deep, and staked securely on both sides of the roll every 12 inches (see diagram next page). When two rolls are installed abutting each other, the ends should create a tight joint to prevent sediment from escaping.

2. Filter Fence consists of a permeable filter fabric material that is keyed into the ground at least 6 inches deep, backfilled with dirt or gravel, and staked along the contour line below the disturbed slope (see diagram next page). The fabric pools the runoff, causing the sediment to be dropped behind the fence while the water slowly filters through the fabric. This BMP is widely used, but unfortunately is often installed improperly and ineffectively (see the Temporary BMP Hall of Shame in Appendix B for examples.) This BMP should never be installed across stream channels or areas of concentrated flow. The ends of the fence should be installed with a turn uphill to create a "J" shape that will pond water.





Two kinds of temporary sediment control BMPs for construction sites

3. Drop Inlet Barriers prevent sediment and debris from entering nearby stormwater conveyance systems by slowing runoff and trapping sediment. Drop inlet barriers are temporary devices including gravelbags and drop inlet filters. These devices are intended for use on a construction area with a curb and drop inlet system only.

Gravelbags are bags made of a permeable fabric and filled with clean (washed) 1- to 3-inch diameter gravel. Historically, sandbags have also been used, but because the fabric bags eventually rip and sand can leak out and become a source of sediment, they are no longer accepted/ permitted. The gravelbags are stacked tightly in a U-shape abutting the curb and intersecting the flow. When installed properly, the bottom of the U-shape is where the runoff will pool. When the construction runoff is trapped in the U-shape, it slows, ponds and settles out sediment. Gravelbags can also be stacked tightly around drop inlets to prevent sediment from entering the drop inlet. Accumulated sediment trapped behind the bags needs to be removed often and disposed of properly. Gravelbags also need to be inspected often to ensure that they are trapping the runoff.

Drop Inlet Filters are various proprietary BMPs designed to capture sediment as it enters a drop inlet and filter it out of the runoff. They are usually designed to fit inside the drop inlet itself, attaching in different ways to the inlet and the grate. Drop inlet filters are used as a secondary line of protection only, and do not preclude the need for other required temporary BMPs on the construction site. Examples of brands of drop inlet filters include: Floguard Fossil Filter, HydroKleen, DrainPac, Ultra-Urban Filter, and S.I.F.T Filter. Please be aware that TRPA and UNCE do not endorse any stormwater products.

An example of tree protection (fence), fiber roll barriers and gravelbags on a construction site in the San Francisco Bay Area.

4. Dust Control is the control of wind-blown soil or other materials from construction sites or soils. Dust control practices are required for all grading activity. There are a variety of methods to control dust, including:

- Sprinkle the exposed soil surface with water as needed to keep the surface moistened to a depth of 2 to 3 inches.
- Mulch the area with 1 to 2 inches of organic mulch.
- Establish a vegetative cover on bare soil surfaces using native and or adapted species.

Vegetation is the most effective practice to stabilize disturbed, bare soils not exposed to construction traffic. Sprinkling is the least effective of the practices for dust control and has to be repeated several times a day. Sprinkling also increases the probability that soil particles will be entrained in water, increasing the need for effective temporary sediment barriers to prevent any sediment-laden water from leaving the site. **Please note: Organic mulch (such as pine needles) is required on all denuded soil for the duration of the soil disturbance except within 5 feet of structures for defensible space.**

This spoil pile should be surrounded by sediment barriers (fiber roll or filter fence) and covered completely by plastic sheeting.

What specific BMPs do I need to use to prevent erosion from bare, exposed soils?

All bare soil areas that are exposed for any amount of time must be stabilized by one or more of the following BMPs:

- Organic Mulch
- Erosion Control Blankets or Geotextiles
- Chemical Mulches and Tackifiers
- Hydromulch and hydroseed
- Inorganic Mulch Rock/Cobble in 5-foot, non-combutible zone

Each of the different stabilization methods have various technical specifications that need to be followed to ensure success. For example, organic mulch is not effective on slopes of more than 3:1, or 33 percent, without vegetating the slope as well or adding bio-technical stabilization methods (see Appendix D). Also, erosion control blankets and geotextiles need to be installed correctly, which involves securing them with staples on the slope and overlapping the materials correctly to prevent runoff from undermining the material. (See Chapter 5)

If you are unfamiliar with the application of chemical mulches, tackifiers, hydromulch and hydroseed, we recommend that you work with an erosion control specialist until you are familiar with the technical aspects of these practices. For more information on slope stabilization, please refer to Chapter 5: Slope Stabilization. Temporary sediment barriers should be installed below the area that is being stabilized by one of these practices.

How do I protect spoil piles on my construction site?

Spoil piles (piles of excavated soil) that remain onsite one day or longer need to be surrounded by properly installed temporary sediment barriers (fiber rolls or filter fence) and must be completely covered by an impermeable fabric. The impermeable fabric must also be placed on spoil piles whenever a storm is impending. This practice will allow rain to flow off of the fabric instead of allowing it to quickly erode the spoil pile. Spoils must be removed from the construction site and disposed of at a TRPA-approved site or may be stabilized onsite if previously approved by TRPA. Spoil piles should not be located in areas prone to erosion or concentrated flows.

Always call before you dig

Before any excavation, **call 811** to get a free site inspection to locate any gas or electric lines beneath the ground surface.

Conclusion

Construction activity has a high potential to pollute our surface waters and ultimately Lake Tahoe with sediment and other construction debris. With some forethought and diligence, this type of pollution can be prevented. When in doubt, contact a BMP professional at the Tahoe Regional Planning Agency's Erosion Control Team at 775-589-5202, who will be happy to come out to your site and discuss appropriate BMPs for your project with you. Remember, you are required to prevent sediment-laden water and wind from leaving your construction site.

Disclaimer

This section does not attempt to discuss all temporary BMPs that may be required or appropriate for construction sites, but rather intends to provide a foundation of basic temporary BMPs that are appropriate in a wide array of situations. For a full collection of BMPs appropriate in the Tahoe Basin, please refer to the *Water Quality Management Plan for the Lake Tahoe Region; Volume II: Handbook of Best Management Practices*, available from the Tahoe Regional Planning Agency. Any brand name products mentioned in this chapter are for informational purposes only, as neither UNCE nor TRPA endorse any stormwater product.

Reference documents:

Erosion and Sediment Control Field Manual, California Regional Water Quality Control Board, San Francisco Bay Region, 1999.

Water Quality Management Plan for the Lake Tahoe Region; Volume II: Handbook of Best Management Practices, Tahoe Regional Planning Agency, 1988. (Check TahoeBMP.org for an updated version by 2011.)

Notes:

Chapter 3

Paved Driveways

Paving a dirt driveway is one of the most beneficial Best Management Practices (BMPs) a homeowner can implement. Bare soil areas serving as driveways are so compacted that water cannot readily soak into the ground. Instead, stormwater will flow off of the compacted soil area and carry sediment away with it. Also, vehicle tires, snow removal and other disturbances carry sediment from unpaved driveways into the street, where it can reach the storm drain system and eventually Lake Tahoe.

Soil erosion and stormwater runoff can be controlled with a properly designed paved driveway with BMPs. Driveways and infiltration systems should be designed to preserve natural vegetation and to blend with the natural landscape.

Rules & regulations regarding driveways

The Tahoe Regional Planning Agency's (TRPA's) Code of Ordinances states, "All roads, driveways and parking areas proposed for year-round use shall be paved." In other words, **any surface designed for vehicular use must be paved, and only that paved area can be used for vehicles**. No vehicular disturbance is allowed on unpaved areas. The use of parking barriers (i.e. boulders, logs, shrubbery, etc.) may be required to restrict vehicles to pavement. (See BMP-026.1, appendix H.)

Parking barriers are helpful to prevent cars from compacting soil outside the designated parking spot.

TRPA's *Handbook of Best Management Practices Volume II* states, "No private property surface runoff is allowed to flow across public rights-of-way and into the street storm drain system." The reason for this rule is that public stormwater projects **are not** designed to handle the quantity of runoff from both public **and** private properties. All property owners are required to infiltrate the volume of a 20-year/1-hour storm, about 1 inch of rainfall in an hour, on their property, before it runs off to public rights-of-way (the street or ditch). **All driveways should be constructed to convey surface runoff to a properly sized infiltration system as described in Chapter 4.**

According to TRPA's Code of Ordinances, "Slopes of driveways shall not exceed the standards of the county or city in whose jurisdiction the driveway is located. Driveways shall not exceed 10 percent slope, unless TRPA finds that construction of a driveway with a 10 percent or less slope would require excessive excavation. The runoff from a steeper driveway shall be infiltrated. In no case shall the driveway exceed 15 percent slope."

According to TRPA's Code of Ordinances, "Driveways serving single family homes shall have a minimum width of 10 feet. Where the single family home includes a garage, the driveway shall be at least as wide as the garage door opening for a distance of fifteen feet from the garage door."

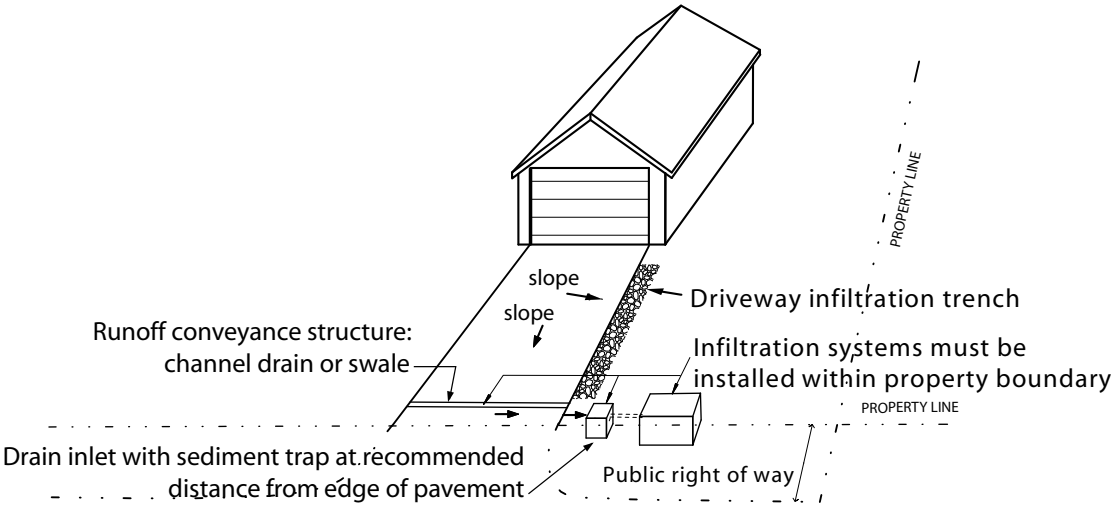
For other residential uses, TRPA's Code of Ordinances states, "Two-way driveways serving residential uses other than single family homes shall have a minimum width of 20 feet and a maximum width of 24 feet. One-way driveways serving other residential uses shall have a minimum width of 10 feet and a maximum width of 12 feet." For additional driveway and public right-of-way encroachment requirements, contact the local jurisdiction.

Permitting process (required for newly paved driveways)

Generally, prior to paving a driveway, two different permits are required, a Paving Permit and an Encroachment Permit from the county or city in whose jurisdiction the driveway is located. Please contact the county or city that the subject property is located in for additional permitting requirements. You can often obtain a permit "over the counter" to pave the minimum allowable parking area. See Chapter 8 for additional information on permitting.

As part of the paving permit process, a BMP site evaluation is required, which is to be performed by a staff member from TRPA, NRCS or one of the Conservation Districts or by a TRPA certified evaluator. A legally existing compacted area (See Chapter 8: Permitting), which has been serving as the driveway, is considered "soft coverage" by TRPA and so may be paved without adding any additional coverage to the property, since the compacted area is already considered coverage. For a driveway to be considered legally existing soft coverage, the driveway must have been established pursuant to TRPA's Code of Ordinances, which states, "Soft coverage must have been used for parking of cars or heavy and repeated pedestrian traffic prior to February 10, 1972." Please remember that only the dimensions of the legally existing soft coverage can be paved. Contact TRPA for clarity on the determination of soft coverage. See **Chapter 8, Permitting,** for more details about required permits.

If a property already has the maximum allowable coverage designated for that site, and legally established soft coverage does



Courtesy of NRCS, NTCD and TRCD

Driveway runoff is diverted by a conveyance structure through a sediment trap and then to an appropriately sized system for storage and infiltration. Rock borders along the edge of the driveway can protect vegetation and prevent soil and nutrients from moving onto the paved surface.

not exist, findings must be made by TRPA to transfer coverage for use as a driveway and to pay an excess coverage mitigation fee. Please contact TRPA's Environmental Review Services Branch and the county or city that the subject property is located in to further investigate establishing a legal driveway.

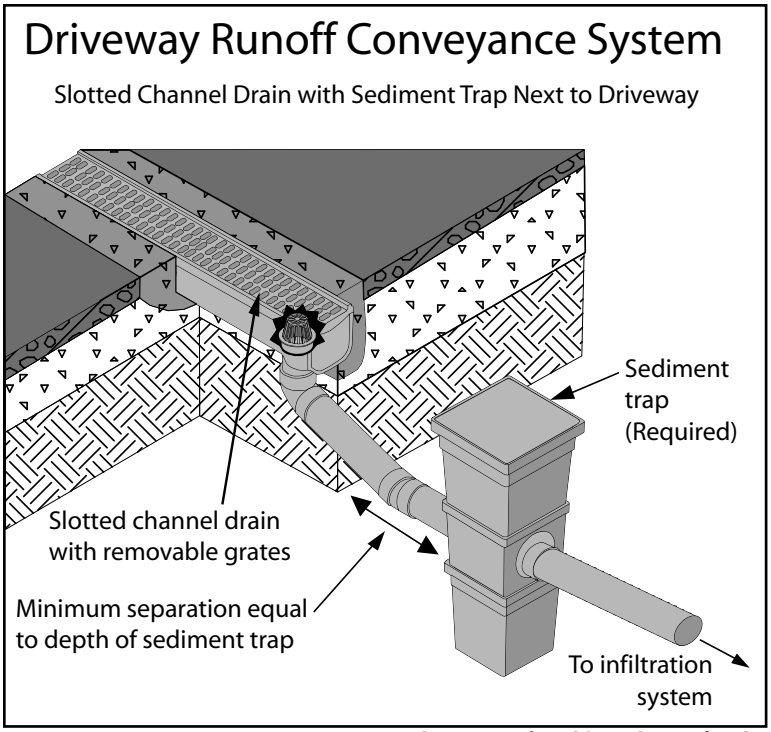
For existing paved driveways that only need to be retrofitted with BMPs, no permit is required, only a BMP site evaluation.

Conveyance and infiltration

In order to meet TRPA's BMP Retrofit requirements, conveyance structures and infiltration systems are often needed on and next to driveways to capture stormwater runoff and infiltrate it into the ground. However, in some cases the existing natural landscape and vegetation is sufficient to infiltrate the required volume of runoff onsite with no erosive effects on the landscape. If the site evaluator makes this determination, the site evaluation will direct the owner to simply maintain existing vegetation.

If recommended, infiltration systems and sediment traps, also described in Chapter 4, should be placed 1 foot away from the edge of the driveway or at a distance equal to the depth of the nearest component, whichever is greater. During installation, the ground supporting the driveway must not be undermined. Filter fabric is recommended along the edge of interlocking paving stone driveways to prevent the movement of sand base material into the infiltration system. Proper compaction of soil and gravel when backfilling is critically important in systems placed next to driveways. Driveway infiltration trenches should not be deeper than 3 inches.

When paving a driveway on a lot with a gradual slope toward the street, it may be possible to slope the pavement toward a shallow (3") infiltration trench on the side.



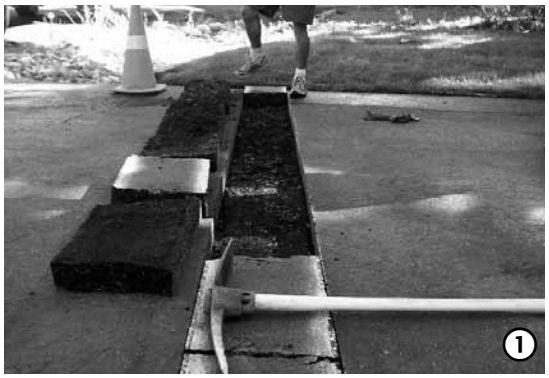
Courtesy of NRCS, NTCD and TRCD

Conveyance of runoff on driveways

Conveyance structures (i.e. slotted channel drains, swales) installed roughly perpendicular to the flow path, **intercept and divert runoff to an infiltration system or vegetated area so it cannot flow into the street storm drain system.** These structures should usually be placed at or as near to the property line as possible to maximize the amount of runoff that is intercepted and infiltrated. Except when approved by the local jurisdiction, conveyance structures are not allowed in public rights-of-way nor should they direct water into public rights-of-way.

Steps for installing slotted drains, channel drains, and trench drains to convey driveway runoff to an infiltration system:

1. Cut the pavement.
2. Install channel drain and pour concrete.
3. Photo document that infiltration system is properly sized and backfilled.
4. Install required sediment trap between the channel drain and the infiltration system.

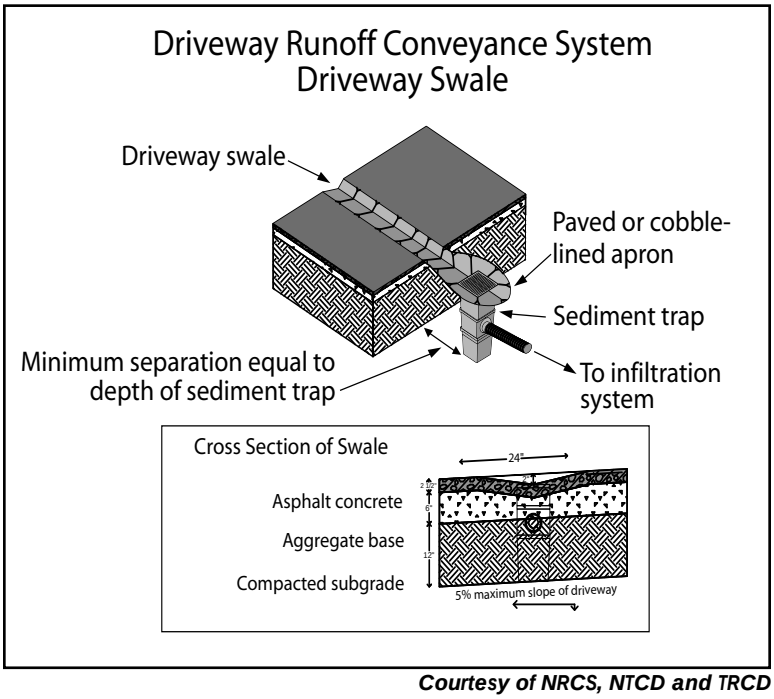


The following are brief descriptions of commonly prescribed conveyance structures for driveways:

1. Slotted drain (Also called trench drains or channel drains):
A grated channel, installed below the surface of the driveway, that transports water to an infiltration system. This is the most effective method of conveyance, but is often the most costly. Properly installed channel drains do not interfere with snow removal. There are several different types of slotted drains that can be installed. Be sure to choose one with removable grates that can be taken off to clean out accumulated debris as needed. Channel drains need a trap to capture sediment before releasing stormwater to the infiltration system. See the diagram and pictures of correctly installed slotted drains on the previous page.

2. Driveway swale:
A wide and shallow linear depression in the pavement that transports water to an infiltration system or vegetation. In order to properly install a swale on an existing driveway, a portion of the driveway must be cut and removed. The repaired pavement is shaped in a concave (V-shaped) form. On slopes greater than 5 percent, swales may not be effective unless installed with a built-up section on the downhill side of the swale. (Removal of a larger section of pavement is required.) Swales installed angling down toward the infiltration system will have a steeper flowline and will carry water more efficiently than swales installed perpendicular to the driveway. Good swale design should consider the potential damage from snow plows. **All changes in elevation need to be gradual.** See the diagram and photos of correctly installed swales (at right).

Driveway swales are valleys in the pavement that collect runoff and convey it to an infiltration system adjacent to the driveway.



Courtesy of NRCS, NTCD and TRCD

Above, view of a driveway with a swale that diverts flow through a sediment trap to an infiltration system for storage and infiltration into the soil.

A note on berms as conveyance structures on driveways

In the past, **berms** were recommended on driveways being retro-fitted. (The term "berm" refers to a linear mound of asphalt placed on a driveway like a speed bump.) Due to field observations of system failures, berms are no longer an acceptable method of conveying driveway runoff to an infiltration system. Berms were sometimes constructed from temporary cold asphalt concrete patch mix. These berms did not last. Even when constructed from asphalt concrete hot mix, berms have been proven to degrade and lose functionality over time. Most failures are caused by snow removal equipment and poor bonding between the berm and the driveway surface. Slotted drains and swales have been observed to function effectively at conveying surface runoff *for the long term*.

Design driveways so runoff flows to infiltration systems

Infiltration is the entry or absorption of water (from precipitation, irrigation or snowmelt) into the soil. An infiltration system provides an area for water storage when the rate of rainfall exceeds the rate of natural infiltration. It stores runoff so that it has time to sink down into the earth. The site's soil type, the volume of runoff generated from the site's impervious surfaces and the amount of open space in the water storage area determine the size of the infiltration system required if vegetation and site characteristics don't allow for adequate natural infiltration. **See Chapter 4, Runoff and Infiltration**, for more information on infiltration and types of infiltration systems.

The site evaluator will determine what type of infiltration system will be required to store and infiltrate the flow captured by the conveyance structure. The infiltration system should be placed slightly downhill of where the flow exits the slotted drain or swale. Obviously, if the infiltration system is placed uphill of the discharge point of the conveyance structure, the infiltration system will not work.

View of a berm on a driveway. Berms are no longer acceptable as conveyance structures.

Planning process for paving an unpaved driveway

A paving contractor has a lot of control over where the flow is directed when a driveway is paved, especially when the property is relatively flat. **It is during the paving planning process that the flow path of the runoff is determined.** By grading the surface prior to paving it, the flow can be directed toward vegetation, off one or both sides of the driveway, or to an infiltration system. It should not be directed out toward the public right-of-way. All installations must pass a **hose test** to prove that the water does not leave the property.

Keep the following in mind before paving a dirt driveway:

- If adequate vegetation on a level area exists onsite to infiltrate the required volume of runoff, and it can be shown that runoff cannot leave the site, then the driveway can be graded – sloped so that flow is directed to that vegetated area.

Below, a hose test is used to prove the water does not leave the property.

- When natural vegetated areas will be used to infiltrate driveway runoff, the driveway should be graded such that flow is dispersed as evenly as possible. This grading will minimize the concentrated energy of the flow and maximize the contact area between the vegetation and runoff.
- If the driveway must be graded such that runoff will enter the public right-of-way, a conveyance structure must be installed as close to the property line as possible to intercept the flow and divert it to an appropriately sized infiltration system.
- In some cases, more than one conveyance structure and infiltration system may be necessary to intercept and infiltrate the runoff flowing from the driveway, particularly when the driveway is very long and/or steep.

Above: View of a driveway with paving stones and a slotted drain. Below: A variety of pervious surfaces can be seen at the South Lake Tahoe Demonstration Garden at Lake Tahoe Community College and the North Lake Tahoe Demonstration Garden at Sierra Nevada College in Incline Village.

Driveway paving options

Concrete and **asphalt** are acceptable paving options at Lake Tahoe. **Paving stones** are aesthetically pleasing and allow a percentage of runoff to infiltrate into the ground, depending on how widely spaced the paving stones are laid, the steepness of the driveway, and the amount of soil compaction that has occurred. Unfortunately, paving stones only allow for a small percentage of infiltration. Thus, in most cases a conveyance structure and an infiltration system is still required on a paving stone driveway. Paving stones are considered hard coverage equivalent to asphalt.

Consider snow removal needs if you are thinking of using paving stones to pave a driveway. While it is possible to remove snow from a paving stone driveway, care must be taken so the driveway is not damaged. Additionally, paving stones are often not allowed in the public right-of-way, so be sure to check with the appropriate agency

before installation. Paving stone driveways will last longer if the edge is stabilized with concrete or other durable products designed to withstand the abuse of snow removal operations.

Permeable paving products

The use of permeable paving products as alternatives to traditional surfaces like asphalt is encouraged because of their ability to infiltrate runoff. Permeable paving surfaces appropriate for driveways include permeable paving blocks, permeable concrete, and permeable asphalt. Again, design the driveway and install the products with snow removal in mind. When installing any type of permeable paving surface, a storage reservoir (permeable subgrade) of crushed stone must be used under the surface, and often constructed with a level bottom, to effectively infiltrate runoff. A traditional subgrade of roadbase and sand does not adequately infiltrate runoff. TRPA requires a redundant infiltration system as well.

Property owners who wish to install permeable products on their driveways should contact TRPA to determine whether the products used and the areas involved are appropriate for these types of driveway surfaces. Landowners and contractors should know that permeable paving products will be counted as land coverage because recommended vegetation cannot grow there.

Unusual circumstances — "problem driveways"

Sometimes, particularly when retrofitting existing paved driveways, obstacles can make it difficult to install conveyance structures and infiltration systems. These obstacles might include:

- High ground water
- Retaining walls
- Steep cut and fill slopes
- Boulders
- Vegetation
- Underground utilities
- Underground heated driveway
- Limited area available for infiltration
- Slow permeability of soil

At left, the pervious pavement is laid on top of a permeable subgrade of gravel. The driveway below has a steep slope and very little space at the foot of the slope for an infiltration system.

Here are some options you may have when faced with these difficult driveway situations:

1. Break up the flow. Install more than one conveyance structure, and utilize surrounding natural infiltration areas that already exist. Opportunities may exist to convey the water by means of a pipe or french drain system to an appropriate infiltration area.
2. Reduce the coverage of the driveway. If some asphalt can be removed, the volume of runoff is reduced, which in turn requires a smaller infiltration system. Also, wherever pavement is removed, effective infiltration areas can be created.
3. Re-slope the driveway. In some cases the driveway may be re-sloped so that the driveway flow is diverted to vegetated areas or areas where infiltration systems can effectively be installed.
4. Contact the county and ask for permission to place an infiltration system in the right of way (encroachment area). On occasion, adjacent landowners may have areas where the flow from the driveway in question can be diverted for infiltration. Obviously, this takes a friendly neighbor, some coordination, and sharing of costs.
5. **Site Constraints**: Opportunities may arise in the future that would allow a homeowner to pay an offsite water quality mitigation fee to be used for water quality projects in the Tahoe basin in situations where the infiltration of stormwater onsite is not economically or physically feasible.

This could qualify as a ***constrained site***. Notify the conservation district or TRPA if, due to high groundwater, shallow bedrock, or underground utilities, infiltration is infeasible. They can issue a ***constraints letter*** and a ***source control certificate***. The property owner still needs to complete source control BMPs on all bare soil areas.

Two options that may require design by a qualified licensed engineer include:

1. Installation of a subpavement infiltration system. If there is no room to infiltrate the driveway runoff, the only option may be to install the infiltration system under the driveway pavement and divert the flow to it for storage.
2. Cut or move the retaining wall. If retaining walls are present on both sides of the driveway, you may have to excavate out an area for the required infiltration system and stabilize the slope behind it. You would be moving the retaining wall back and excavating part of the slope to make room for the infiltration system. If the wall is made of wood, you may be able to cut the wall so that the conveyance structure can divert the flow through it to the infiltration system. Be sure the modification will not jeopardize the integrity of the wall.

Economies of scale

What types of cost savings could there be for homeowners if the paving contractor could pave dirt driveways or retrofit existing paved driveways for whole streets or blocks at a time? There may be a neighborhood or community watershed program in your area. Contact your Conservation District for more information.

Always call USA North at 811 at least 48 hours before you dig.

Notes:

Chapter 4

Runoff and Infiltration

Why are infiltration systems needed?

The purpose of infiltration systems is to prevent erosion by infiltrating stormwater into the soil. This reduces concentrated flow so that it does not overwhelm downstream drainage systems. Increased urban and residential development results in an increase in impervious area. Impervious areas do not allow water to soak into the ground, but rather cause it to run over the ground, collecting and carrying sediments, nutrients and traces of other pollutants to Lake Tahoe. Infiltration systems are installed to reduce the amount and rate of runoff and its erosive force downstream. Infiltration systems are practices that help large volumes of concentrated runoff soak into the ground, where soils, vegetation and plant roots can naturally filter out pollutants.

Impervious areas generate runoff

Impervious surfaces prevent water absorption, and cause water to concentrate as stormwater runoff. Types of impervious surfaces include:

Roofs - Roofs are impervious surfaces that convey water to eaves or gutters.

Basic working definitions

Infiltration:	Entry or absorption of water from precipitation, irrigation or runoff into soil.
Runoff:	The portion of rain or irrigation water failing to infiltrate into soil. Surface runoff is the primary cause of soil erosion and nonpoint source water pollution.
Impervious:	Resistant to penetration by water or plant roots. Impervious surfaces create runoff.
Soil Permeability:	Ease with which water transmits through saturated soil, often expressed as a rate; i.e. inches per hour.
Problem Drainage:	Inability of soil to infiltrate water, due to high water table, heavy clay soil or soil compaction.

Water falling from eaves or gutters without downspouts typically causes erosion and runoff at the "drip lines" below.

Driveways - Driveways are impervious surfaces that, without the aid of a conveyance and infiltration system, often contribute large volumes of runoff to public right-of-ways. Consult Chapter 3 for a more complete discussion of driveways.

Compacted Soils - Soils that have been walked, driven or parked on regularly are usually compacted enough to prevent water from entering the soil. (See Chapter 6 and BMP-026.1, appendix H.)

Raised decks and stairways - Structures that do not have spaces between wood planks create impervious surfaces where water can run off. If there are spaces between planks, water falling through them to the soil below may cause erosion. (See BMP-010.2 and -011.2, appendix H.)

Runoff from paved surfaces can carry fine particles of sediment to Lake Tahoe.

Dog Runs - Paved or not, dog runs become compacted due to concentrated animal traffic and cannot support vegetation.

Patios and Walkways - Runoff from paved patios and walkways can often infiltrate into the adjacent soil if the area is flat and well vegetated or mulched.

Where do we use infiltration systems?

Infiltration systems are often located under roof driplines, under gutter downspouts, at the end of conveyance structures from driveways or adjacent to other impervious surfaces, such as parking areas. Infiltration systems are sized according to soil permeability and volume of surface runoff. (See sample treatment forms on pages 8-10.) **Whenever possible, naturally vegetated level areas should be protected and used for infiltration.** The natural plant-soil complex can usually treat runoff better than any artificial infiltration system. Runoff is stored in the vegetated cover, and root systems promote infiltration.

By infiltrating stormwater into the soil with BMPs, we mimic natural conditions of an undisturbed watershed. As the stormwater travels through the soil, sediment is filtered out and some nutrients may bind to the soil or be taken up by roots. This process helps to purify the water before it reaches Lake Tahoe. However, polluted water from commerical sites can contain high levels of nutrients or toxic substances like gasoline and oil and can contaminate the soil and ground

water. **Stormwater runoff containing toxic substances must be pretreated prior to infiltrating it into the soil.** Stormwater collected on residential sites generally does not require pretreatment devices and can usually be safely infiltrated into the soil. If you are concerned that a property may have contaminated stormwater, contact the Conservation Districts, TRPA, or NRCS for more information.

Maintenance of infiltration systems

It is good to check your BMPs after each storm, in the spring, and just before winter. A visual inspection can determine if the BMPs are functioning properly: run a hose over the system to determine if the water infiltrates or if it overflows and runs off quickly.

By installing a sediment trap upstream of an infiltration system, the life of the infiltration system is prolonged. The extra cost spent installing sumps and clean-outs will be lower than the cost to frequently dig up and clean the entire infiltration system, which is time consuming and labor-intensive.

Systems that are backfilled with gravel should be constructed with maintenance in mind. A simple layer of filter fabric placed near the top of the infiltration trench will catch fine sediments and prevent them from being transported to the rest of the infiltration system. Do not place filter fabric on the bottom of infiltration systems or trenches. (See BMP-060.2 appendix H.) When the system shows signs of clogging, one only needs to remove and sift the top 3 inches of gravel to uncover the fabric. Then carefully lift, roll and discard the clogged fabric. Next, place a new layer of fabric over the trench and replace the cleaned gravel. **See more information on BMP maintenance in Chapter 7.**

This above-ground infiltration system captures, stores, and infiltrates roof runoff.

BMP installations need to include elements and features that contribute to long-term functionality and ease of maintenance. The following BMP design elements are required where applicable to help achieve these goals:

- Above-ground infiltration systems such as shallow vegetated basins and swales.
- Natural infiltration on flat, well vegetated area that meet TRPA criteria.
- Borders to prevent sediment migration into infiltration systems.
- Sediment trap between conveyance and infiltration systems.
- Clean outs on subsurface drains, french drains and underground conveyance pipe systems.
- Baffles on sloped armored drip lines (BMP 009.3, appendix H).
- Gravel armor or rock rip rap in conveyance swales to areas where water can naturally infiltrate onsite (BMP-004, appendix H).

Common types of infiltration systems:

Underground ("Closed") Infiltration Systems

Underground Infiltration Systems

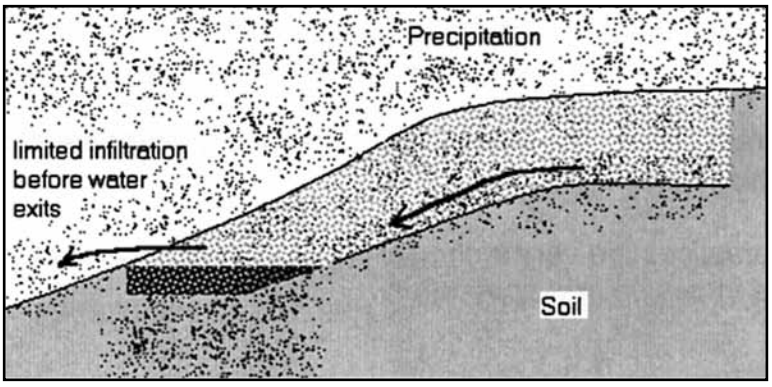
- Infiltration trenches (prefabricated or gravel)
- Infiltration systems (prefabricated or gravel)

Above Ground ("Open") Infiltration Systems

- Gravel armoring under roof driplines and decks on flat or gently sloping land
- Natural infiltration over flat vegetated areas
- Infiltration Basins, vegetated or rock-lined
- Grassed or rock-lined swales

Common infiltration systems are described briefly below:

Infiltration trenches are shallow gravel or drain rock-filled trenches located adjacent to impervious surfaces and beneath roof eaves. (See BMP-001.2, appendix H.) Their purpose is to infiltrate runoff from impervious surfaces and to prevent erosion. Infiltration trenches are not appropriate on steep slopes unless installed along the contour. When on a slope, infiltration trenches not installed level serve as conveyance structures and their infiltration storage capacity is limited. (See illustration below.) Instead, use a drip line conveyance swale to deliver runoff to an infiltration system at the bottom of the drip line (See BMP-004). If a site evaluation recommends a terraced drip line trench, call the evaluator to get a change approved. In locations where runoff gathers upslope of a foundation, a subsurface drain or swale should be placed under the dripline to convey the water to an infiltration system 10 feet away from the structure (see BMP-005.0, appendix H). Trenches filled with gravel should be bordered with larger rocks, bricks, concrete blocks or treated lumber (if 5 feet away from structure) to keep it clean and in place. Use non-flammable borders if they are closer than 5 feet.



Infiltration systems are pits filled with drain rock or prefabricated storage units. These systems are used on sites requiring additional storage capacity for runoff from impervious surfaces, such as at the end of a conveyance structure from a driveway, or as an alternative to linear infiltration trenches on slopes. A dripline conveyance swale can convey the water down a slope to an infiltration system at the bottom. They are also applicable at the foot of downspouts. If gravel is used to fill trenches, it should be ¾"-1½" in diameter and washed.

Gravel Mulch, also called inorganic mulch, can be used to armor soils in the Lake Tahoe Basin which have rapid permeability. Soils of this type have the capacity to infiltrate the volume of runoff generated by a typical (19 foot wide) residential roof eave drip line during a 20 year/1 hour storm, which generates approximately 1 inch of rainfall. On "rapid soil" the minimum width of gravel mulch armor placed 3 inches deep under driplines without additional infiltration

Any infiltration system such as this gravel trench will fail to work properly if its bottom is not level or if the stored runoff can escape out the lower end.

Top left: This large infiltration basin treats runoff from a multi-family property. Top right: Grassed swales can be used along roadsides and parking lots to collect and treat stormwater runoff.

systems is 18 inches, 24 inches and 30 inches for 1-, 2- and 3-story roofs respectively. Alternately, gravel mulch extending 5 feet out from the foundation meets the defensible space criteria. The gravel used to armor roof driplines should be ¾"-1½" in diameter. (See BMP-009.3, appendix H.)

For sites with moderately permeable soil, adequately sized infiltration trenches or conveyance to infiltration systems are required under roof driplines. (See BMP-001.2 and BMP-060.2, appendix H.) Gravel must be contained by a border.

Natural Infiltration. Spreading water over large flat vegetated or mulched areas is another alternative that has advantages for cost, aesthetics and simplicity. This type of infiltration system should be used when soils are not compacted and have good infiltration capacity. In such circumstances, the site evaluation will say "Maintain existing vegetation." If runoff flows to a flat or gently sloping, well-vegetated or mulched area with little runoff potential, it will infiltrate naturally. Conveyance structures are often necessary to redirect water away from foundations to water spreading areas. Use an energy dissipater to spread flows at the discharge end of a conveyance system on a level, vegetated surface to prevent concentration of flows and erosion.

Borders may be necessary to prevent water from running off the property (e.g. rock-covered berms, wood borders or vegetated berms). A major advantage to using natural infiltration is that there is no excavation or soil disturbance. A flat lawn can sometimes function for this purpose.

Infiltration basins are shallow depressions in the ground or areas bordered by berms which are designed to store and infiltrate runoff into the ground. (See photos on this page and page 31.) Shallow basins or bermed areas can also be used as snow storage areas. If used for this purpose, they should be designed with additional capacity so that a rain-on-snow event can be treated. Shallow basins with level bottoms can also be perched on gradual slopes like water terraces. Incorporate a rock-armored spillway to safely accommodate overflow from basins in large rainstorms.

Rain gardens are shallow infiltration basins designed to make use of our rare summer rainstorm runoff as irrigation water.

They work best on rapid permeability soil. The soil surface of rain gardens should be 6 to 8 inches lower than the surrounding soil. The rain garden itself has capacity to hold water from the soil to the top of the lowest border. The rain garden must be designed to prevent standing water at the foundation. Vegetation in rain gardens should be dense and robust enough to stabilize soil by dissipating the energy from roof runoff. Drip or microspray irrigation works well to establish and maintain attractive plants. Rain gardens should not be placed where roof avalanches can destroy them. (See Bioretention publication at http://www.unce.unr.edu/publications/files/nr/2009/fs0925.pdf)

Grassed swales. The term swale (a.k.a. grassed channel, dry swale, grassed swale, biofilter, dry creek bed) refers to an open channel designed specifically to convey, treat and attenuate stormwater runoff from nearby impervious surfaces. (See photo on page 33.) As stormwater runoff flows through a channel or series of channels, it is treated through filtering by the vegetation in the channel, filtering through a subsoil matrix, and infiltrating into the underlying soils. A rock-lined swale can be designed to resemble a dry creekbed with small check dams to slow and pool the water. Ponds, basins, and swales can all be shaped to meet the aesthetic desires of the owners. A sediment trap or forebay should pretreat runoff before entering swales or basins.

A rain garden 10 feet or more from a foundation works well on rapid permeability soil.

How soil characteristics influence the design of your infiltration system

Infiltration systems will vary from property to property due to the variation in soil characteristics in the Tahoe Basin. Most BMP treatment description forms show soil permeability information in the box above the treatments.

The permeability rate (also called saturated hydraulic conductivity or "Ksat") measures the maximum speed at which a soil will absorb water in inches per hour. Any water falling in excess of the permeability rate becomes stormwater runoff, which flows over the soil surface, collecting sediment. Soils with rapid permeability will generally need smaller infiltration systems than moderately drained soils. Since water soaks in faster, less storage space is needed within the infiltration system.

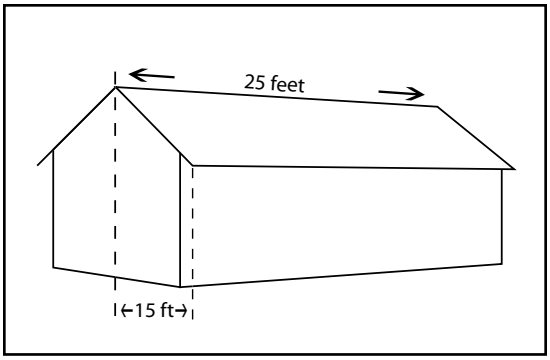
Site Constraints

Soil drainage problems can occur if the groundwater table is close to the soil's surface or if a dense layer that water cannot penetrate (such as bedrock or clay) lies below the soil. Such site characteristics can make it very difficult to capture and infiltrate stormwater. Properties with soil drainage problems can still complete all their erosion control BMPs and receive a "Source Control Certificate" instead of a Certificate of Completion from TRPA. **It is important to contact your local Conservation District or the TRPA if you think a property has these site constraints, especially if the site evaluation called for an excavated infiltration system. See pages 26-27 for additional details.**

How runoff volumes are determined

Calculations are made for a 20 year/1 hour storm event, which roughly equals 1 inch of rain falling in a one hour time period. The volume of runoff (in cubic feet) produced by the design storm is calculated on the site evaluation report. To see how this calculation is done, use the formula at right, or use the calculation spreadsheet found at www.tahoebmp.org. (See sample below.)

Note: Impervious areas are measured in horizontal distances. The coverage that produces runoff is a flat plane projection or a plan view and is typically measured in square feet.



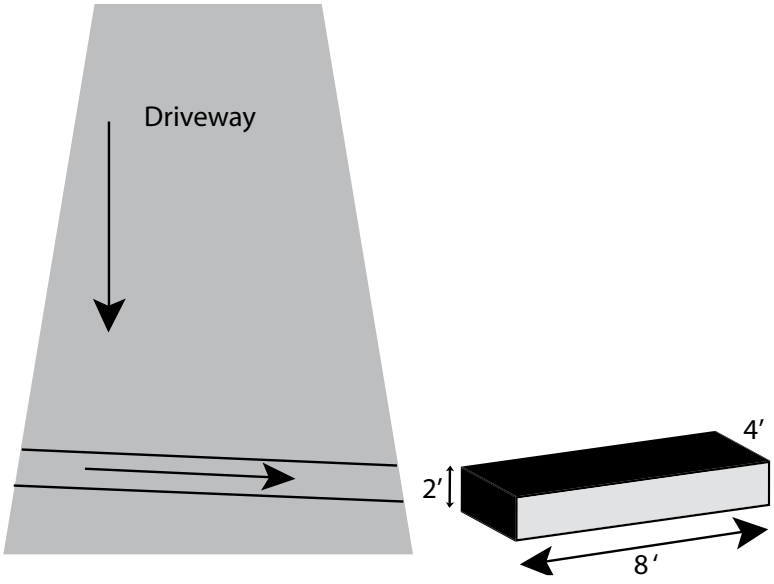
Formula:
(roof area ft^2) x 1/12 foot of rain (1 inch of rain expressed in feet) = volume of runoff ft^3

Example (from drawing above):
(25ft x 15ft) x 1/12 foot = 31.25 ft^3 of runoff for half of the roof

Volumes of runoff can also be determined using the table in appendix C.

Calculation Spreadsheet Example	
Contributing Surface	**DRIVE**
Length (ft.)	30
Width (ft.)	28
Area (ft^2)	840
Runoff (ft^3)	70.0
Treatment Label:	**D2**
Length (ft.)	8
Width (in.)	48.0
Excavation Depth (in.)	24.0
On-Site Ksat (in/hr)	13.0
Mapped Ksat (in/hr)	4.0
Void Space (%)	40%
Volume	2.4
Capability (ft^3)	**71.8**
Drain Rock Quantity	2.37
Excess Runoff	**0.0**
Excess Capacity	**1.8**

A Sample Calculation for the Size of an Infiltration Trench



Different materials can fill underground infiltration systems

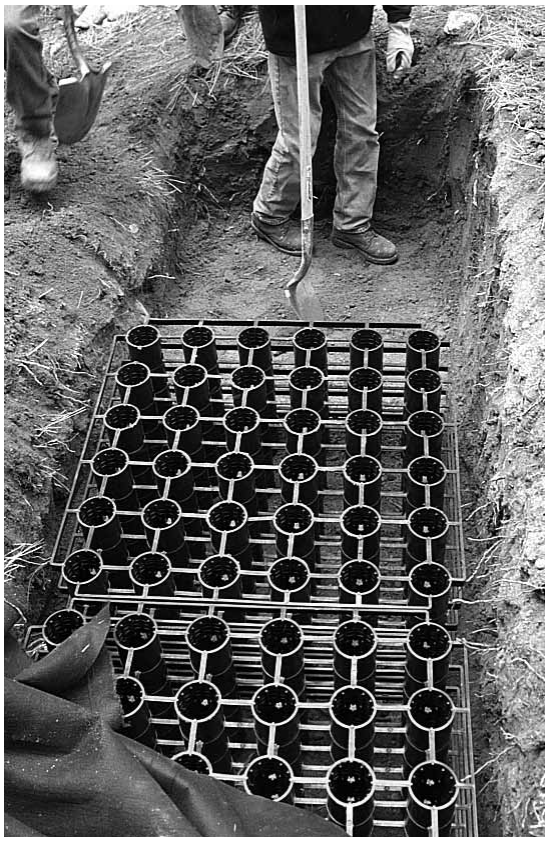
Different materials have different amounts of void areas, referred to as percent void. ¾- to 1 ½-inch graded gravel, for instance, has roughly 40 percent void space, while some prefabricated structures have up to 94 percent void. Extra void space means greater storage capacity.

Two commonly used infiltration system materials are contrasted below. Both types need to have sediment traps to prevent clogging.

Rock or gravel infiltration systems have been used for many years in the Tahoe Basin. While effective, they have drawbacks. As stated above, drain rock typically has only 40 percent void space, so in order to infiltrate a given volume of runoff, the excavation for an infiltration system filled with rock is typically two times larger than one filled with prefabricated infiltration materials, which have up to 94 percent void space.

Prefabricated infiltration systems consist of proprietary BMP product materials having a large percent void space that are placed in an excavated hole in the ground and protected on the top and sides with a geotextile fabric. Prefabricated infiltration systems function almost identically to rock infiltration systems, but due to the increased void space, they require less excavation and therefore less labor.

There are several proprietary BMP products designed for use as prefabricated infiltration systems. Void space varies between different prefabricated materials. "Rainstore" (manufactured by Invisible Structures), "High Capacity Infiltrator Chambers" (manufactured by Infiltrator Systems), "Storm Tech Chambers" (manufactured by Storm



Left: View of a prefabricated infiltration product about to be covered (top and sides) with filter fabric in an excavated hole below a conveyance structure. Right: View of a conveyance swale to an infiltration system 10 feet from the foundation.

Prefabricated vs. Gravel/Rock Filled Infiltration Systems Summary	
Prefabricated	***Rock***
■ More void space—up to 95%. ■ Requires smaller excavation. ■ Possibly less labor costs.	■ Less void space—around 40%. ■ Requires larger excavation. ■ Possibly more labor costs.
■ Easier to maintain. ■ Clean top 3" of gravel every 2-5 years depending on contamination.	■ Difficult maintenance. ■ Clean top 3" of gravel every 2-5 years depending on contamination. ■ If maintenance is deferred too long, all gravel may have to be removed and cleaned.
■ Expensive compared to rock. ■ Overall cost may be less due to labor and maintenance.	■ Inexpensive compared to prefab. ■ Overall cost may be more due to labor and maintenance.
■ New skill to learn, but fairly simple installation.	■ As simple as digging a hole and filling it with rock. Labor involved to wheelbarrow the gravel.
■ Stricter dimensions for hole size, but may be variable as long as overall treatment capacity is the same.	■ Hole size may be variable as long as overall treatment capacity is the same.

Tech) and "Raintank" (manufactured by Atlantis Water Management) are currently the most common prefabricated infiltration materials used in the Tahoe Basin. Information on specific proprietary BMP products is for informational purposes only. University of Nevada Cooperative Extension and its partner agencies do not endorse any stormwater product.

Here are some important things to keep in mind when installing infiltration systems:

❶ Determine appropriate dimensions based on a completed BMP Site Evaluation. (See the dimensions column on pages 8-10.)

❷ If disturbing more than 3 yards of soil, contact TRPA for permitting requirements. Install proper temporary BMPs to protect disturbed soil.

❸ Infiltration systems must not adversely affect nearby foundations or footings. Use an impermeable layer of plastic to prevent the migration of water into a crawl space. Care must be taken to properly assess soil and groundwater conditions to ensure that water does not degrade the integrity of the foundation or cause mold growth. See next section to learn how to convey runoff to infiltration systems away from the foundation.

❹ Gravel mulch under driplines should be at least 18 inches wide and at least 3 inches deep. However, many people now cover the entire 5-foot noncombustible area near structures with gravel and/or dense herbaceous vegetation. Borders should be used to isolate and contain gravel armor. (See BMP-009.3 appendix H.)

❺ When excavating for prefabricated structures, leave an extra 2 inches + on all sides. Allow for 4 to 6 inches extra depth. It is recommended that 3 inches of gravel be laid to even and level the floor of the excavated area.

❻ **To avoid damage to underground utilities, always call 811 at least 48 hours before you dig.**

❼ Storage and infiltration structures must be installed level and along the contour of the existing slope. The bottom of the excavation should be level.

❽ A geo-grid (such as Tenax or equivalent) is necessary to protect the top of some types of prefabricated structures and zip-ties must be used to anchor it to the prefabricated system.

❾ A geotextile fabric must be draped around the top and sides of all prefabricated storage structures with 3 inches of overlapping fabric at all seams.

❿ Backfill around prefabricated structures with drain rock.

⓫ Cover prefabricated structures with a minimum of 3 inches gravel.

⓬ A drainage inlet device to allow inflow of water into the prefabricated structure may be necessary. A removable grate is recommended for ease of maintenance.

⓭ Install a sump pretreatment area, sediment trap or "catch basin" to capture sediment before it enters the infiltration system.

Common methods of conveyance to aid infiltration

Conveyance methods are often needed to transport runoff. For example, it is a good building practice to convey concentrated runoff to an infiltration system located a minimum of 10 feet from the foundation. Common conveyance treatments are:

- Subsurface conveyance of water away from up-slope portions of foundations
- Gutters, downspouts or deflectors
- Slotted drains or swales (asphalt, concrete, vegetated, and/or rock-lined) (see Chapter3)
- Vegetated or rock-lined swale

Subsurface drains capture runoff and convey it to treatment areas away from sensitive structures vulnerable to water damage, such as foundations. For example, infiltration systems should not be installed upslope of foundations. Subsurface drains rarely infiltrate a significant amount of water.

As shown in standard drawing BMP-005, in appendix H, a subsurface drain can be installed using standard 4-inch diameter perforated PVC pipe or perforated polyethylene corrugated pipe. Trenches should be excavated to create a minimum 2 percent slope in the direction of flow. Refer to the diagram on page 39 for a typical installation design.

The trench of the subsurface drain should be excavated to the dimensions indicated in the diagram on the following page. The trench bottom should be smooth and free of clods, loose or exposed rock. Care should be taken when placing the pipe into the trench bottom to avoid direct contact with protruding or sharp rocks. The trench for the standard 4 inches subsurface drain is to be lined with an 8 mil. heavy gauge plastic liner prior to

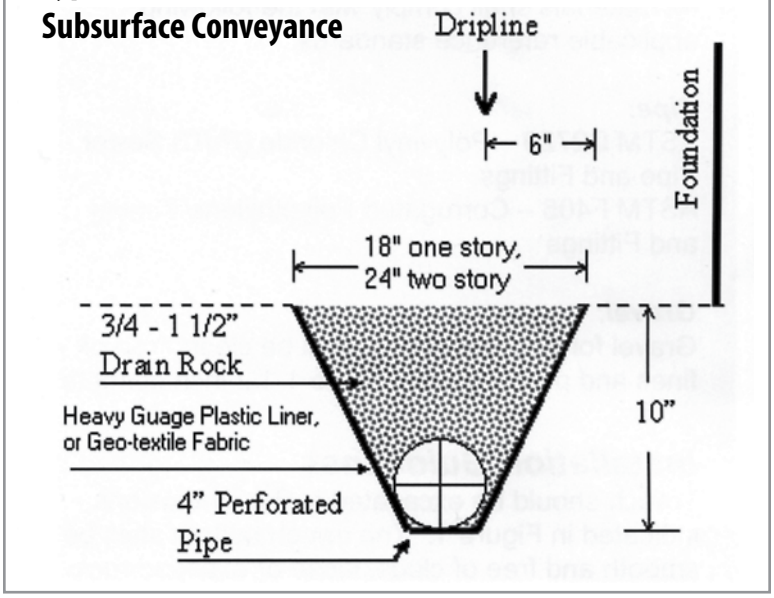
placement of pipe. Geotextile fabrics may replace plastic liners for applications where water will not flow or percolate towards a foundation. Non-perforated pipe or tubing may be used when the line passes through areas where root growth may create an obstruction, or when crossing hard rocky areas.

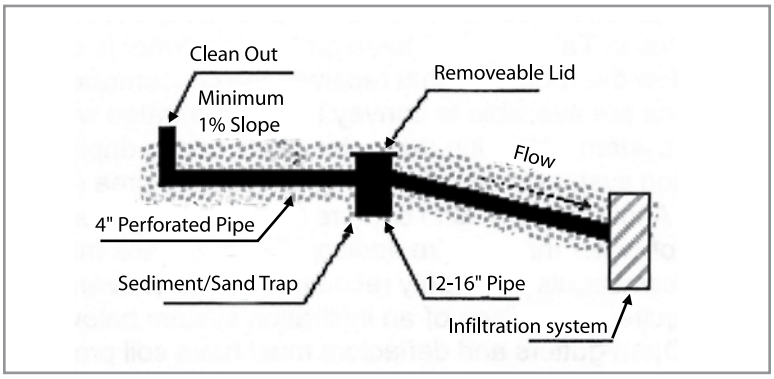
Subsurface drains should include cleanouts and/or sediment traps. These should be installed at the upper and lower end of each pipe section, and at all bends and abrupt changes in slope. Cleanouts can be constructed by the inclusion of an elbow or a 'Y' extending to the surface and capped with a threaded or slip cover. Inline sediment traps can be included into the system by placing a pre-cut culvert section vertically into the trench. Refer to the figure on this page and on page 22 for installation details.

Subsurface drains require maintenance to continue to be effective. Buildup of leaves, conifer needles and sediment should be periodically removed from the drain and clean-out access pipes to ensure adequate capacity. Sediment traps should also be checked and cleaned out regularly.

Subsurface drains will not support extreme surface loading due to vehicular traffic. Damage to the pipe and reduced long-term function may result from driving vehicles over the top of the trenches.

Figure 1.
Typical Installation,
Subsurface Conveyance





Above, a schematic view of a typical subsurface drain. Bottom, view of a cleanout and sediment trap.

All materials should comply with the following applicable reference standards:

Pipe and gravel:

- ASTM D2729 - Polyvinyl Chloride (PVC) Sewer Pipe and Fittings or ADS
- ASTM F405 - Corrugated Polyethylene Tubing and Fittings
- HDPE Pipe specifications
- Gravel for dripline drains should be clean, washed, free of fines and poorly graded 3/4 to 1-1/2 inch diameter.

Roof runoff conveyance (gutters, downspouts or deflectors)

Most homes in Tahoe do not have gutters, so water is conveyed to the roof eave. The ground surface below the roof eave that receives the concentrated water flow is the "dripline." Several options are available to convey the concentrated water to an appropriate infiltration system. Allowing the water to fall on a dripline is acceptable if an appropriate infiltration system is installed along the dripline area (See "Infiltration Trenches," page 32). Another option is to capture the water in gutters, which create higher concentrations of water that require additional conveyance measures and/or infiltration systems. Downspouts are highly recommended to prevent splash from gutters, but usually require the addition of an energy dissipator or conveyance to an infiltration system, which should be placed 10 feet from the foundation. Use heat tape in gutters to prevent freezing.

Vegetated or rock-lined swale

A vegetated or rock-lined swale is a depression that collects runoff and conveys it to an infiltration system at the end of the swale. See BMP-004.0 in appendix H and page 34 for examples.

Helpful Publications

Low Impact Development in Northern Nevada: Bioretention. Available online at: http://www.unce.unr.edu/publications/files/NR/2009/FS0925.pdf

Chapter 5

Slope Stabilization

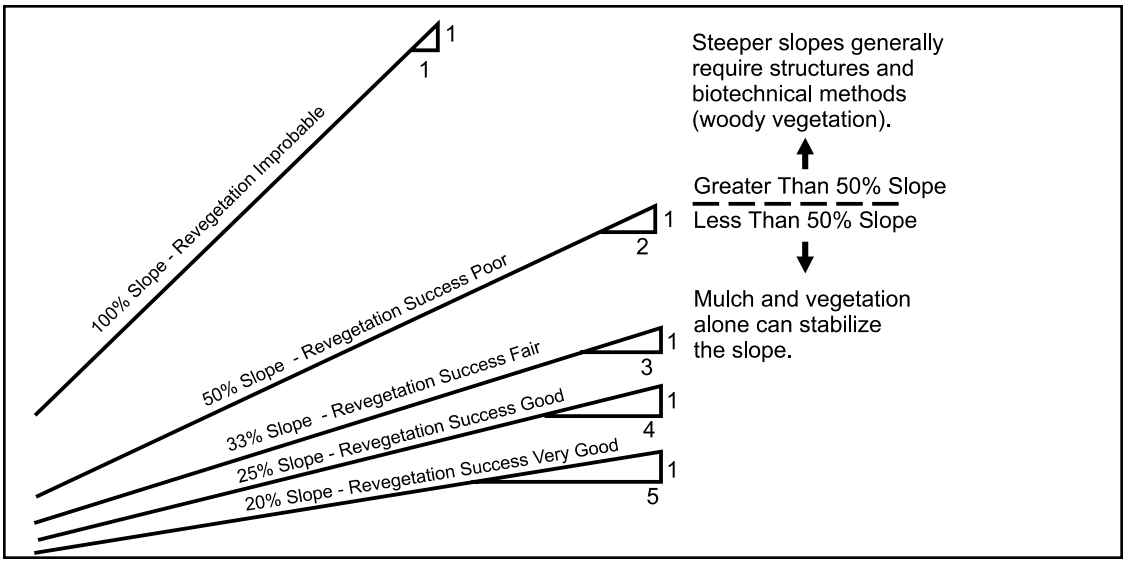
In many cases a BMP Site Evaluation will call for slope stabilization. While soil loss can occur on level ground during high wind or rainstorms, soil erosion is much more severe on unvegetated, sloping ground.

The following information will help you determine what methods can be used to successfully stabilize everything from a slight slope to a steep, severely eroding slope. One method alone is not as effective as a combination of different methods.

As the following diagram shows, the steeper the slope, the greater the difficulty in successfully establishing vegetation.

*Note: Some of these practices are very technical in nature and **may** need a qualified, licensed engineer's assistance in design and application.*

It is important to note in this illustration that slope stabilization with vegetation and mulch is generally successful only on slopes up to 50 percent in steepness. Anything greater than 50 percent should incorporate biotechnical methods such as willow wattling, ***or*** structural methods, such as terraces, concrete or wood retaining walls, erosion control blankets or rock retaining walls.



The steeper the slope, the more difficult it is to revegetate bare soil and stabilize the slope.

Below, a rock-faced retaining wall with nearly level planting terraces above it

Moderate to steep slopes can be stabilized with an erosion control blanket, riprap, or a combination of river rock or other mulch and vegetation.

Extremely steep, eroding slopes like the one above need to be stabilized by incorporating structural means such as retaining walls or sturdy terraces.

Guidelines for stabilizing slopes of various steepness

Moderate Slopes (< 33 percent slope):
A combination of vegetation and mulch are effective on moderate slopes. (See Chapter 6: Vegetation and Mulches for more information on successful revegetation techniques on flat areas and moderate slopes). Mulches such as wood chips or river rock provide a good protective ground cover until vegetation becomes established. Temporary controls such as erosion control blankets can also help stabilize bare soil while vegetation gets established. Irrigate plants carefully, to avoid runoff, for two growing seasons or until plants are well established.

Steep Slopes (33-50 percent slope):
On steep slopes, more care is needed in selecting appropriate plants and the planting technique. If the plants chosen and methods used are appropriate, vegetation can provide excellent long-term erosion control. As

plants develop, the roots will knit together and help hold the soil in place. The leaves, needles and twigs will reduce the impact of rain and wind, and the added organic matter will improve water infiltration. Rock slope protection ("riprap") and/or erosion control blankets will help prevent erosion while the vegetation develops and establishes a healthy community.

Other ways to stabilize slopes of over 50 percent include interlocking concrete blocks, wood retaining walls and rock slope protection.

Terraces made with rock breastwalls, left, have created good areas for establishing plants.

Extremely Steep Slopes (> 50 percent slope): Combining erosion-control practices is more effective on extremely steep slopes than applying a single practice. Terraces, wood retaining walls or rock retaining walls are usually necessary to stabilize the toe of these over steepened slopes in combination with either revegetation and mulching the area and/or applying biotechnical methods. The slope above and behind the retaining structures should be graded to as gentle a slope as possible to provide for revegetation. Use of native or adapted vegetation along the top and around the retaining structures increases their effectiveness. Retaining walls over four feet in height (from bottom of footing) or with cut and fill over 18 inches must be designed by an engineer and permitted by TRPA or your local building department. A BMP Retrofit permit may be needed for slope stabilization work that disturbs between 3 and 7 cubic yards of soil, and is always needed for work that disturbs more than 7 cubic yards of soil. **Remember to call 811 before you dig.**

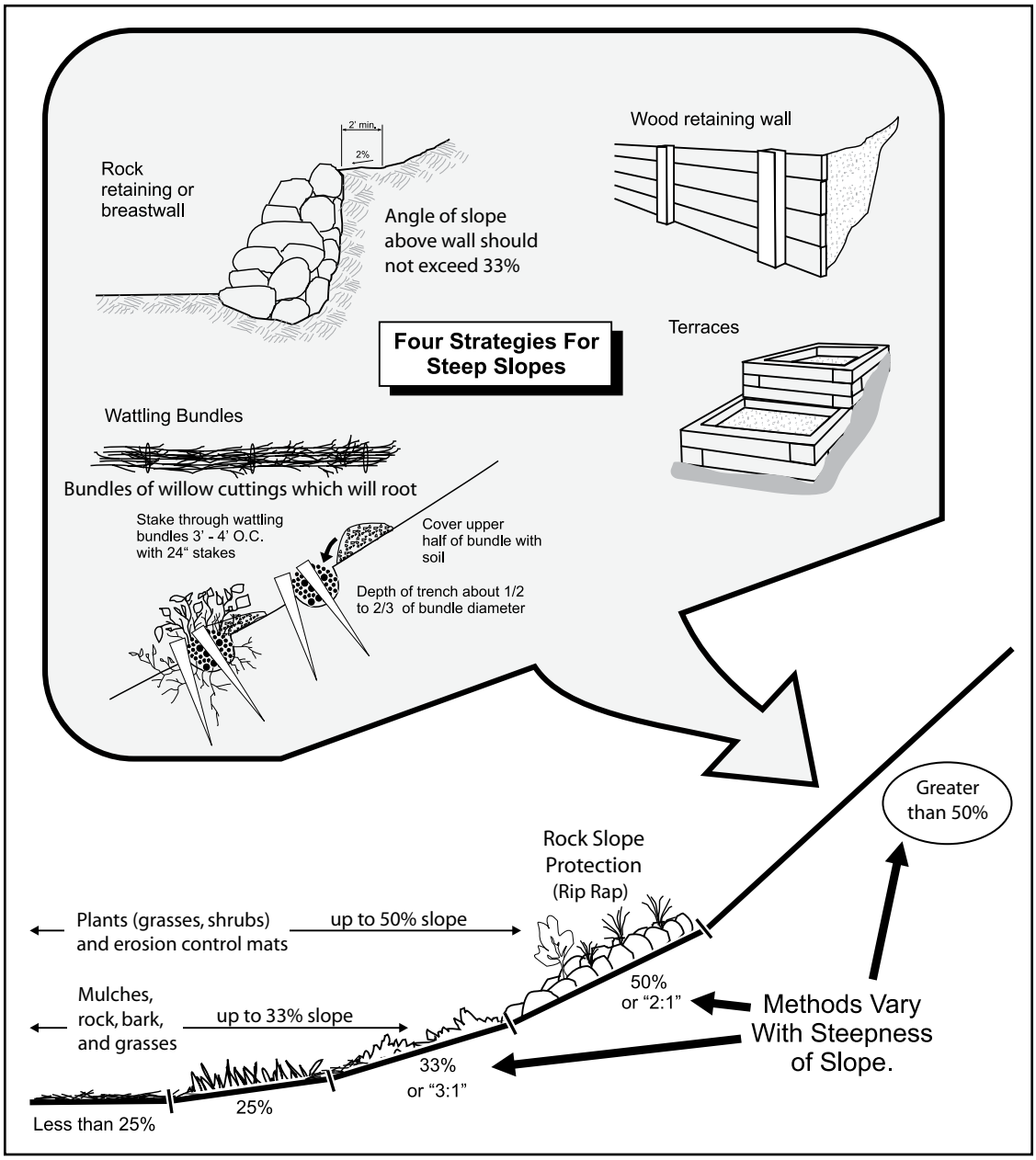
Methods for stabilizing slopes greater than 50 percent (30 degrees or 2:1)

Terraces - The steepness of the slope will dictate the height of the terraces. The terraces should be high enough to allow the soil behind them to be graded to an almost level surface so that vegetation can grow there. Terrace walls, like any retaining walls, need to be engineered if over 4 feet in height or if they alter the natural slope (cut and fill over 18 inches). Do-it-yourselfers can create a series of terrace steps using walls less than 3 feet high. Materials used for building terraces include recycled plastic products, treated wood, rock and interlocking concrete

blocks. Ensure that the terrace material is strong and anchored well to stay in place. Large terraces should be tied securely into the slope and properly drained.

Wood Retaining Walls - 6- by 6-inch posts set in concrete into the ground generally make a sound anchor for wood retaining walls, but need to be engineered and permitted if the wall is over 4 feet in height from the top of the wall to the bottom of the footing. Vegetation should be established on the slope above the wall. Wood retaining walls are most often located between the base of a slope and an adjacent road, driveway or drainage way. Permanent structures should not be installed in the public right-of-way.

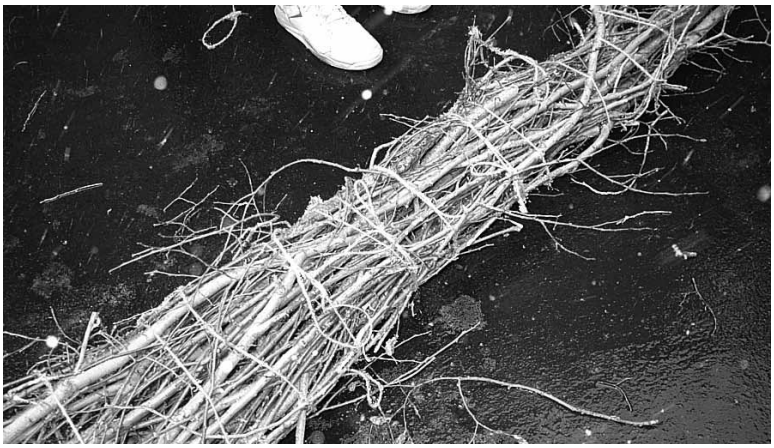
This diagram illustrates how methods used to control erosion vary with the steepness of the slope. While plants and mulch work well on moderate slopes, steeper sites generally require structural strategies as well. See Chapter 6: Vegetation and Mulch for information on specifics of vegetation.



Rock Retaining Wall - Rock retaining walls are an alternative to wood retaining walls and are often used next to a roadway or drainage way. As opposed to rock slope protection ("riprap") which armors the ground, rock retaining walls support the slope and are built from rock 10 inches to 2 feet in diameter. A footing trench is dug along the toe of the slope and the largest boulders are placed in the trench. Subsequent rocks are laid with three or more bearing points on previously laid rocks. The external face of the wall should incline slightly uphill. Since the slope above the wall will be flatter than before, it should be easier to establish vegetation above the wall. (*Note: make the slope above the wall as flat as possible—preferably less than 25 percent.*) A concrete retaining wall can be made to look like a rock retaining wall by covering it with rock and mortar (see photo this page).

Willow Wattling - This practice, also called contour wattling, involves staking long bundles of fresh willow cuttings in shallow trenches that have been dug along the contour lines of cut or fill slopes. Once the bundles or wattles are staked into the slope and covered with stabilized, packed topsoil, they intercept runoff from the slope above and help infiltrate it into the soil. If the site is carefully irrigated for the first few growing seasons, and if the roots can eventually reach the water table, the willow branches will sprout, providing excellent vegetation cover and wildlife habitat. Other approved biotechnical BMPs for slopes over 50 percent include brush matting and brush layering. **See appendix D** for more details on these methods.

Above, a rock-faced retaining wall adjacent to a driveway.



Below, bundles of dormant willows tied into a willow wattle ready for installation across a steep slope.

Erosion control blankets and geotextiles

Purpose: Erosion control blankets or mats are biodegradable products that are used for temporary or permanent stabilization of disturbed soils.

Erosion control blankets:

- Accelerate vegetative development while decomposing over time and becoming part of the soil.
- Protect disturbed or bare soil from rain and surface runoff.
- Increase infiltration.
- Decrease soil compaction and crusting.
- Protect seeds from impact and predators.
- Moderate soil temperature.
- Increase soil moisture retention.

Applications: Erosion control blankets are most effective when used for the following:

- Slopes and disturbed soils where mulch must be anchored and other methods such as crimping or tackifying are not feasible or adequate.
- Steep slopes, generally steeper than 3:1.
- Slopes where erosion hazard is high.
- Critical slopes adjacent to sensitive areas such as streams, wetlands, or other highly valued resources.
- Disturbed soils where plants are slow to develop protective cover.
- Channels intended to be vegetated where the flow velocity is low.

Limitation: Erosion control blankets are not suitable for rocky sites or areas where final vegetation will be mowed. Proper site preparation is necessary to ensure adequate contact of the blanket/matting with the soil.

Note how the erosion on the bare slope (top photo) has deposited a fan of sediment at the bottom. This will be prevented on the slope with the erosion control blanket (lower photo).

Installation: Follow manufacturer's recommendations for installation. Please compare the instructions below with the illustration on the next page.

- Prepare and smooth soil on slope. Plant seeds if desired.
- Begin at the top of the slope and anchor the blanket in a 6 inch deep by 6 inch wide trench. Backfill trench and compact earth firmly.
- Unroll blanket down slope in the direction of water flow, not horizontally.
- Overlap the edges of adjacent parallel rolls 3 inches and staple every 3 feet.
- Use wire staples No. 11 gauge or heavier, or follow the manufacturer's instructions. The "U" shaped staples shall be 6" to 10" long with a 1" crown. Use longer staples in loose or sandy soils.
- When blankets must be spliced, place blankets end over end (shingle style) with 6 inches of overlap. Staple though overlap areas, approximately 12 inches apart.
- Lay blankets loosely and maintain direct contact with the soil – do not stretch. If the blanket is not in intimate contact with the soil, water will be able to run down the soil beneath the blanket.
- Staple blankets sufficiently to ensure that materials will remain in direct contact with the soil.

Inspection and Maintenance: Erosion control blankets, if properly installed, require little maintenance. However, periodic inspections, especially in the late fall and early spring, and while the vegetation becomes established will keep the erosion control blanket effective. When inspecting an erosion control blanket, be sure to note the following:

- Vegetate and mulch the blanket according to design. Irrigate during plant establishment.

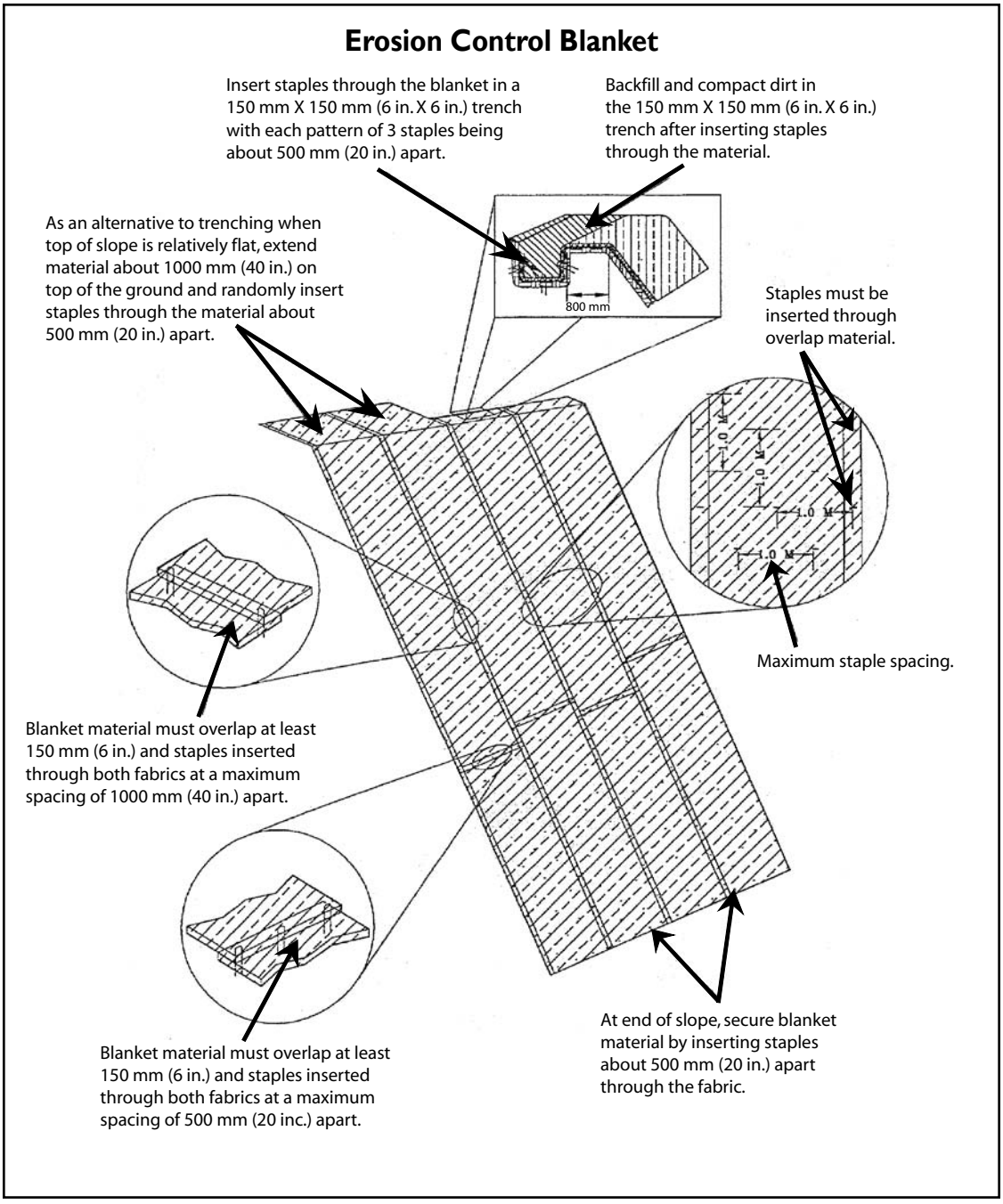


Illustration of installing an erosion control blanket on a hillside (From "Designing for Effective Sediment and Erosion Control on Construction Sites")

- Inspect blankets and mats before and after significant rain events for erosion and undermining. Repair failures immediately.
- If washout or breakages occur, re-install or re-anchor materials only after repairing damage to the slope or channel (rills, gullies, etc.).

Resources:

Home Landscaping Guide for Lake Tahoe and Vicinity. 2006. University of Nevada Cooperative Extension.

TRPA's Handbook of Best Management Practices. 1987. Tahoe Regional Planning Agency.

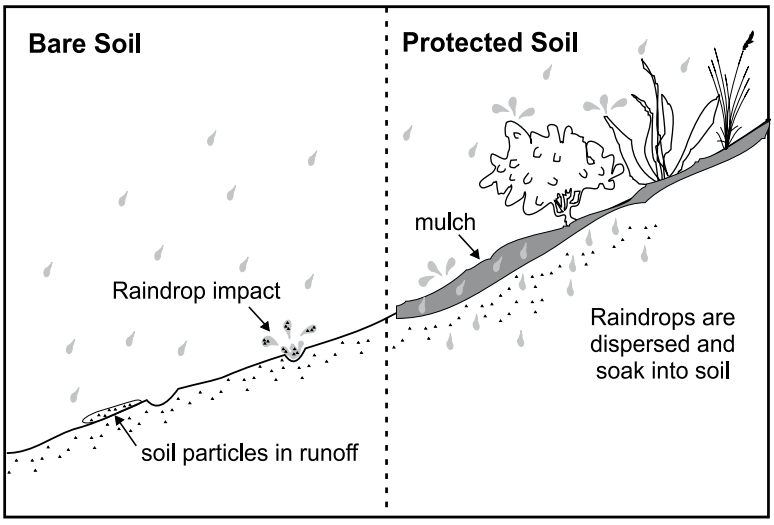
Notes:

Chapter 6

Vegetation and Mulch

Every Site Evaluation requires property owners to "vegetate or mulch all bare soil areas." When water is unable to infiltrate into the soil due to soil compaction or the presence of impervious surfaces, it accumulates on the surface, creating runoff. This runoff erodes bare soil and carries it and attached nutrients directly to streams and eventually to Lake Tahoe. Research indicates that the most cost-effective way to protect Lake Tahoe is to keep soil in place on the landscape by protecting bare soil. (See diagram at right.) Vegetation and mulch can effectively stabilize soil and infiltrate runoff from developed areas, reducing erosion and effectively filtering sediment.

In order to create a successful revegetation project, you must first consider the soil. Plants get their nutrition from the soil, so if nutrients are lacking, the vegetation will not flourish. Organic matter provides most of the nutrition in natural, undisturbed settings. When trying to develop a good plant community, using natural organic materials is likely to produce the best results with the least potential for pollution (however, do not use fresh manure). Compost and slow release organic fertilizers are the most trouble-free and dependable type of organic matter that can be added to poor soil.



Because bare soil is extremely vulnerable to raindrop impact and soil loss by wind or water, it is especially important to protect bare soil areas with vegetation and mulch. Within 30 feet of structures, use mostly erosion control grasses, turfgrass or other herbaceous (non-woody) plants.

TRPA requires that you choose native and adapted plants for Lake Tahoe. Native plants existed here at the time of the arrival of European-American settlers, while adapted plants originated elsewhere, but are also well-suited to Lake Tahoe's climate. Once established, native and adapted plants need little to no fertilization or irrigation unless it is a drought year **or** the plant is not suited for its site (e.g., a water-loving plant in a dry, sunny spot). Look for perennials rather than annuals when shopping for native and adapted plants at your local nursery.

When choosing plants, be sure to select species that are considered to be a lower fire hazard (See Tables 1 and 2 in Chapter 7 of the *Home Landscaping Guide for Lake Tahoe and Vicinity* for a list and color photos of TRPA approved plants). This will help reduce the chance of fire spreading from the wild land to your structures. You should also separate vegetated areas with noncombustible areas in a mosaic pattern.

Be careful not to choose plants considered invasive or noxious (weeds). These are plants which out-compete native species and decrease biological diversity. **Some common invasive and noxious weeds that pose a threat to the Tahoe Basin include tall whitetop (also known as perennial pepperweed), Scotch broom, oxeye daisy, Eurasian watermilfoil, Russian knapweed, spotted knapweed, Canada thistle, bull thistle, yellow starthistle, dalmatian toadflax, yellow toadflax, and diffuse knapweed.** For more information on invasive and noxious weeds, **see Appendix F** and visit the Lake Tahoe Basin Weed Coordinating Group's website at www.TahoeInvasiveWeeds.org.

Reasons for creating a vegetated landscape using native and adapted plants at Tahoe

- **Protects against Erosion**
- **Requires Less Water and Fertilizer**
- **Minimizes Maintenance**
- **Adapted to Tahoe climate**
- **Attracts Wildlife**
- **Improves Aesthetics & Property Value**

(See Chapter 7 of the *Home Landscaping Guide for Lake Tahoe and Vicinity* for a list and color photos of TRPA approved plants).

A flat vegetated and mulched area is shown below.

All completed BMP site evaluations direct property owners to *"vegetate and mulch all bare soil areas."* TRPA will not issue a BMP Certificate of Completion for the property if bare soil is evident. A combination of vegetation (native and adapted ground covers, shrubs, trees, forbs, grasses) and mulch (chipped wood, bark mulch, stones or gravel) are most effective. Depth of the mulch should be between 1 ½ to 3 inches. See the section "Create fire defensible space" on page 53-54 for recommendations regarding vegetation, organic mulch and defensible space.

When bare soil exists on slopes, erosion risks increase, and extra measures are required. If slopes are over 50 percent in steepness, mechanical structures like rip rap,

terraces and retaining walls are required in addition to vegetation and mulch. (See Chapter 5 for details.)

Steps for establishing herbaceous plants and grasses from seed

❶ **Test Soils.** First you need to determine whether your soil has adequate nutrition for revegetation. Contact a NRCS soil scientist for assistance.

❷ **Apply soil amendments.** Amendments will usually consist of compost and a slow-release organic fertilizer, but depend on the results of the soil tests. Fresh manure should not be used as a soil amendment. (See "Soil Amendments vs. Mulch" below.) Tilling soil amendments into the soil to a depth of 6 to 8 inches breaks up any soil compaction that may exist. Dense soil is easier to till when moist, especially in the spring.

❸ **Select appropriate plant species.** This selection will depend on the goals of the project but needs to consist of native and adapted plants appropriate for the site's defensible space and erosion control needs.

❹ **Seedbed and seeding.** Rake the seedbed smooth. Remove rocks and debris. Broadcast seeds according to seed package instructions; then roll the seed or tamp it down to increase seed contact with soil.

❺ **Apply mulch.** For grass seed, a light dusting of peat moss, less then 1/8 inch, helps retain moisture. Between and around container plants, bark chips and wood chips look attractive and protect soil from erosion. (See "Soil Amendments vs. Mulch" below.) Wood chips are not appropriate for slopes greater than 33 percent because they will migrate off the slope.

❻ **Tackify mulch.** In some cases and especially for steeper slopes, mulch may need to be stabilized with an organic tackifier, which is a glue that holds mulch in place until plants are established.

❼ **Irrigate carefully.** Irrigation will allow seeds to germinate quickly and will help transplanted seedlings survive. Since the soil has been adequately amended and mulched, irrigation should be applied slowly and carefully, so that the root zone is wetted without causing any runoff. During the first month or so, the soil should be kept moist every day. If seed or seedlings dry out, they die. Do not over water. Gradually wean the plants to less frequent watering during the first two summers. By the third season, watering plants every two to three weeks during summer is usually sufficient. Most plants should be well enough established after three or four growing seasons to not need regular irrigation.

See Chapter 8 of the *Home Landscaping Guide* for steps for planting container plants.

Vegetated infiltration systems

Vegetation and mulch are very useful and attractive when employed in above-ground infiltration systems away from foundations (Chapter 4, pages 33-34). Property owners can make shallow, bermed basins for storage and infiltration of snow and snowmelt. If planted with hardy perennials and mulched, these become attractive "rain gardens" in summertime (see page 33). Careful consideration of appropriate vegetation is crucial to create a low maintenance, effective system.

Special considerations for planting beds near structures

A ***vegetated dripline*** is the area below the roof dripline (where water drips from your roof onto the ground) that contains established herbaceous (non-woody) vegetation. A clear example of this is a dripline covered with a thick mat of grass or other non-woody vegetation. If you design a flowerbed for the dripline, you must address the following:

Border the planting bed. Use noncombustible landscape edging tall enough to retain all of the soil in the event of an extreme precipitation event. Place filter fabric along the inside edge of the border to retain fine sediment.

Protect the foundation from mold. If under a dripline, the planting bed should be at least 5 feet wide and graded so that water drains away from the structure. An impermeable membrane can be installed along the foundation as well. Use only drip irrigation to minimize the amount of water applied to the planting bed and to ensure that the foundation is not being sprayed.

Soil amendments vs. mulch

Soil Amendment

Organic material added to the soil will promote healthy soil and plants. An organic soil amendment such as compost will help keep moisture in the soil for a longer period of time, increase infiltration and provide essential nutrients to your vegetation. Do not use fresh manure. Soil amendments are more effective than fertilizers because they help to create a healthy soil for the long term, while fertilizers only provide instant food for the plants. If applied incorrectly, they can also wash through the soil profile quickly, polluting groundwater.

Till amendments into the soil

Compacted soils no longer infiltrate water and contribute runoff that carries nutrient-laden soil particles to Lake Tahoe. Before revegetating compacted areas or other areas with poor soil, be sure to till soil amendments into the soil to a depth of 6 to 8 inches. It is helpful to start with a rototiller for severely compacted sites. For best results, till compacted soil in the spring, when it is moist.

Mulch covers the soil surface

The term "mulch" is used to describe a loose ground cover that protects the soil surface from wind and water erosion. Organic mulch also reduces moisture loss from the soil, reduces weed growth, adds nutrients to the soil, and helps insulate the soil from extreme temperature changes. Inorganic mulches such as gravel do not provide the same benefits as organic mulches, but can be beneficial when used appropriately and work well to reduce wildfire threats near structures.

Mulch Depth

When required on a residential property, properly installed organic mulch is effective at reducing erosion potential. Wood or bark chips should be from 1 ½ to 3 inches deep. They should not be used within 5 feet of structures. Inorganic mulch (i.e. gravel) should be at least 3 inches deep in all cases. Do not use rubber mulch.

Mulch Maintenance

Because of their ability to decompose into the soil, organic mulches need to be maintained yearly to be effective. The best maintenance method is to apply mulch in the

The top left photo shows a combination of organic mulch (bark) and inorganic mulch (rock). Organic mulches include pine needles, which may be used more than 30 feet from structures, and bark or wood chips (left).

spring after the snow has melted, and then supplement with some more mulch before the snow falls to help protect your plants. If you have pine trees on your property and use pine needles as mulch over bare soil, you face the challenge each spring of raking off needles that have fallen within 30 feet of structures. Fir tree needles that have been matted down by snow for two or more winters often knit together as they decompose, creating good erosion control cover and adding organic matter to your topsoil as the old needles decay. See more information about pine needle mulch on the next page.

Create fire defensible space as well as BMPs

Because we live in an urban forest environment, there is a definite threat from wildfire. Property owners are encouraged to design defensible space areas as shown on the next page at the same time they are planning the installation of their BMPs.

Guidelines for fire defensible space for residential properties

(See *Living with Fire for the Lake Tahoe Basin*, 2nd edition, for details)

- **Choose plants that minimize fire hazards**. Near structures, use only herbaceous (not woody) plant species with an airy stem spread such as columbine and bleeding heart. Turf and erosion control grasses also work well. Do not use high fire hazard plants. Drip irrigation (sprinklers for turf) is recommended to maintain adequate moisture levels close to structures.
- Design a 5-foot-wide **noncombustible area** around the structure. It should be free of flammable shrubs and trees, dead branches, pine needles, organic mulches and flammable building materials. In this noncombustible area, apply a layer of inorganic mulch such as gravel or rocks or plant low growing, irrigated herbaceous vegetation to reduce fire hazard and control erosion.

- Avoid widespread use of organic mulches within 30 feet of structures. Wood chips and bark chips can be used as mulch in planters and on bare spots. If organic mulches are used in planters within the 5- to 30-foot zone, they should be separated by noncombustible groundcovers and arranged so that they will not allow a fire to travel rapidly across the area.
- Cut down dead trees and shrubs but leave the roots in place.
- Thin dense stands of trees and shrubs within 30 feet of structures. It is now legal to remove trees up to 14 inches in diameter at breast height (measured 4 ½ feet off the ground) without a TRPA tree removal permit. This rule change does not apply to trees that are in wetlands or near streams (i.e., Stream Environment Zones) or in backshore areas. Before removing any trees for defensible space purposes, however, the homeowner should get the local fire protection district to mark trees appropriate for removal. See "Tree Removal and Tree Protection" in appendix E.
- Eliminate low-lying branches and ladder fuels.
- Move firewood piles away from the house.
- Cut and remove dried grass and flowers.
- Remove fallen branches and pinecones.

Pine Needle Do's

DO remove needles accumulating on hard surfaces such as pavement, decks, rooftops and gravel-covered surfaces regularly.

DO remove all pine needles within 30 feet of structures once each year, in early spring.

DO revegetate and/or mulch an area if you have removed all pine needles to bare soil.

Pine Needle Don'ts

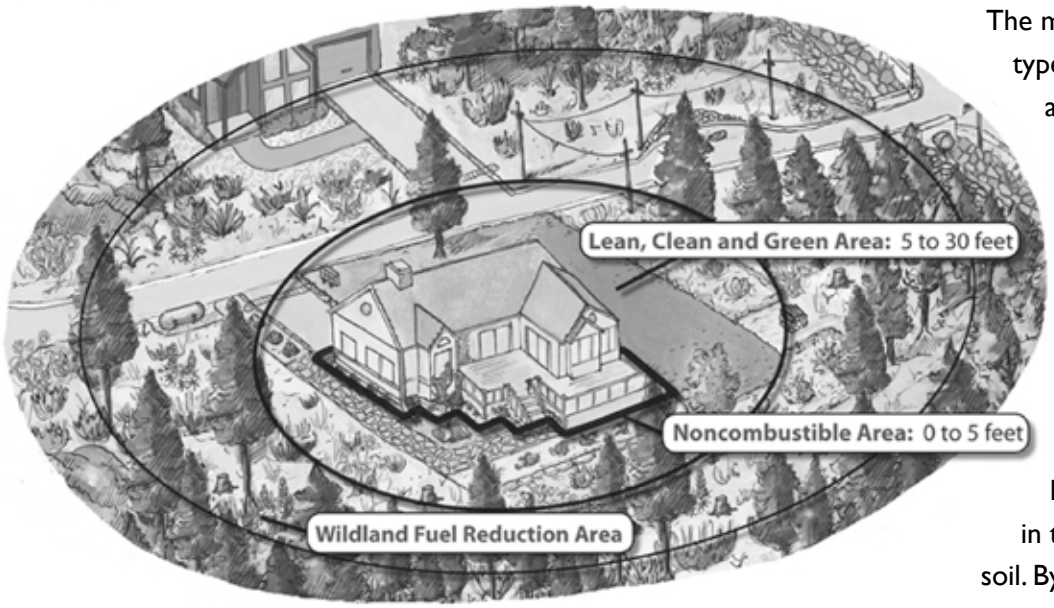
DON'T use pine needles as mulch within 30 feet of structures.

DON'T rake pine needles covering bare soil except during spring clean-up.

DON'T apply pine needles or allow them to accumulate within five feet of any structures. Use non-flammable, inorganic (gravel or stone) mulch, herbaceous plants, or hard surface in these areas.

Create water-efficient irrigation

If you are creating a native or 'natural' looking landscape, have amended the soil and added adequate mulch, your irrigation needs will be substantially reduced.



The main principle in this type of landscape is to add water slowly and allow it to penetrate to the root zone and below. According to the USDA/ Natural Resources Conservation Service (NRCS), most of Tahoe's soils can only hold one inch of water in the top 12 inches of soil. By testing your sprinkler

system, you can determine how long it takes to deliver a ½ inch of water to your lawn and only irrigate for that amount of time, according to the weekly watering table on this page.

If ponding or runoff occurs before you have applied ½ inch of water, program your systems to run "on," until ponding or runoff begins, and then "off," for a couple of hours, and then "on" for the same on time as before. Continue the "on/off" cycled irrigation until you have applied approximately ½ inch of water. The wait time is very important. It allows the water to move through the soil profile before more is added. This prevents runoff and allows for deeper watering, which encourages deeper rooting.

Please refer to Chapter 4 of the *Home Landscaping Guide for Lake Tahoe and Vicinity* for more information on setting up Hydrozones (groupings of plants with similar water needs), installing irrigation systems, and maintaining irrigation systems for efficient water management.

Good watering and lawn care tips

- Water early in the morning, preferably before 8AM.
- Know your public utility district rules for watering landscapes.
- Keep your irrigation schedule flexible for periods of rain or excessive heat.
- Use automatic controllers to improve water conservation.

A note on water restrictions

Water restrictions may be enforced during the dry summer months. It is important to follow the guildelines established for your area. Regulations in California can be obtained from the South Tahoe Public Utility District (www.stpud.us) or the North Lake Tahoe Public Utility District (www.northlaketahoe.net). In Nevada, contact your local water supplier or www.nevadatahoewater.org.

Inches of Water Used Each Week by Turf Grass at Lake Tahoe

	April	May	June	July	August	Sept.	Oct.
Weekly	.98	1.18	1.45	1.60	1.50	1.12	.96

To set your irrigation controller to apply the amounts of water in this table, just measure how long it takes your sprinkler system to apply a ½ inch of water, then water your lawn for that amount of time:

- 2 times a week beginning in April and mid–September.
- 3 times a week, where needed, June through mid–September.

Fertilize with care!

Please refer to Chapter 9 of the *Home Landscaping Guide for Lake Tahoe and Vicinity* for specific information on fertilizing your landscape properly, so that you are not polluting ground water or contributing to Lake Tahoe's declining clarity. As a rule of thumb, apply fertilizer only twice per year, in spring and fall, and then sparingly—at about half to three quarters the recommended rate found on the label. Be sure to water slowly following the application. Watering moves the fertilizer into the root zone of the soil so the plant can use it. Secondly, without water, the fertilizer may burn the plants wherever it contacts tissue.

Note: Never fertilize in the shorezone or near a stream.

Resources

Publications:

Home Landscaping Guide for Lake Tahoe and Vicinity. Revised 2006. http://www.unce.unr.edu/publications/files/nr/2006/eb0601.pdf
University of Nevada Cooperative Extension.
Choosing Turf and Erosion Control Grasses for the Lake Tahoe Basin,
http://www.unce.unr.edu/publications/files/nr/2009/sp0907.pdf

Combine Defensible Space with Best Management Practices (BMPs)
www.unce.unr.edu/publications/files/NR/2008/fs0826.pdf

Living With Fire for the Lake Tahoe Basin, 2nd edition.
http://www.unce.unr.edu/publications/files/nr/

Sunset Western Garden Book
Lane Publishing Co., Menlo Park, CA.
Available at most bookstores and home centers.

A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California
This book is free by contacting the Department of Water Resources at (916) 653-1097.

Sierra Nevada Yard and Garden
A homeowners guide to landscaping in the Sierra Nevada. For a copy, visit www.SierraNevadaAlliance.org

Landscape Demonstration Gardens:
Lake Tahoe Community College
BMP Demo and Native Plant Garden,
One College Drive, South Lake Tahoe, CA

North Lake Tahoe Demonstration Garden
Sierra Nevada College, Incline Village, NV
www. demogarden.org

UC Davis
Historic Fish Hatchery, Tahoe City, CA

Tahoe Women's Center
2941 Lake Tahoe Blvd
South Lake Tahoe, CA

Seed Sources:
Comstock Seed
Locally collected seed source
Gardnerville, NV
(775) 265-0090
www.ComstockSeed.com

Sierra Valley Farms, Attn: Gary Romano
1329 County Road A-23
Beckworth, CA 96129
(530) 832-0114

Applewood Seed Co.
Arvada, CO
www.applewoodseed.com
(303) 431-7333

Cornflower Farms Inc.
California Native and Water Wise Plants
Elk Grove, CA
natives@cornflowerfarms.com
(916) 689-1015

Stepables
Resilient Perennials for Pathways and Borders
Oregon
www.STEPABLES.com

Educational Classes:
Truckee Meadows Community College
(775) 829-9010

Lake Tahoe Community College
(530) 541-4660

Websites:
CalFlora Database
http://galaxy.cs.berkeley.edu/calflora

California Native Plant Society
http://cnps.org/conservatio/exotics.htm

California Department of Agriculture, Weed Encyclopedia http://www.cdfa.ca.gov/weedinfo

www.LivingWithFire.info/Tahoe

www.TahoeBMP.org

Chapter 7

Maintenance and Monitoring

Basic concepts of BMP maintenance

To maintain the effectiveness of Best Management Practices (BMPs), regular monitoring inspections and maintenance are essential. Generally, inspection and maintenance of BMPs can be categorized into two groups—***expected routine maintenance*** and ***nonroutine (repair) maintenance***.

Routine maintenance refers to checks performed on a regular basis to keep the BMP in good working order and aesthetically pleasing. In addition, routine inspection and maintenance is an efficient way to prevent potential nuisance situations (odors, mosquitoes, weeds, etc.), reduce the need for repair maintenance, and reduce the chance of polluting stormwater runoff by finding and correcting problems before the next rain event. Routine maintenance also refers to removing the buildup of sediment in certain types of BMPs, cleaning out proprietary vaults with a vactor truck, and sweeping parking lots and road surfaces.

Non-routine maintenance refers to any activity that is not performed on a regular basis. This type of maintenance could include major repairs after a violent storm, extended rainfall, or a heavy winter, or replacement and redesign of existing BMPs (e.g. installing sediment traps and clean-out ports).

Routine monitoring and maintenance

The TRPA Code of Ordinances requires BMPs to be maintained. This subsection states:

> ***"Maintenance of BMPs: BMPs shall be maintained to ensure their continued effectiveness."***

BMPs should be inspected/monitored at least every year and perhaps more often depending on the type of BMP as well as individual site circumstances. Over time, BMPs become clogged or damaged, which decreases effectiveness and functionality. Maintenance can be as simple as raking the accumulated debris away from the entrance

to an infiltration system after a heavy downpour, or can be as complex as digging up and replacing an entire subsurface drain that is clogged due to improperly installed clean-outs.

For a commercial site, monitoring may include stormwater quality sampling to ensure that water leaving pre-treatment systems falls within TRPA's standards for surface or groundwater discharge. Maintenance in this example would include the commercial property owner having a stormwater pollution prevention plan which incorporates routine servicing of the stormwater pretreatment system and the parking areas.

Best Management Practices that are no longer functioning are out of compliance with local ordinance requirements, ultimately rendering the accompanying BMP Certificate of Completion void.

Important:
Any debris/sediment cleaned out of a BMP should be disposed of properly, either transported off-site to a TRPA approved location, or contained and stabilized in a planted/mulched area on-site where it will be unaffected by wind and/or water.

Poor erosion control and an inefficient retaining border allows sediment to spill onto driveway, which will prematurely clog the infiltration system.

Plan ahead when installing BMPs for ease of maintenance

When installing any BMP, proper planning will save time, money and headaches later. Accessibility to perform maintenance is an important factor to consider.

Source control (erosion control) will prevent excessive maintenance. Source control refers to the practice of making sure that all soils near the BMP are stabilized and not prone to erosion. Bare dirt can easily be transported from one location to the BMP location and cause clogging or inefficiency. For example, if the soil on the edge of a driveway is not stabilized with vegetation and mulch and retained with a border, the soil can be washed down onto the paved surface, through the slotted drain and, if there is no sediment trap, into the infiltration system. This can clog the system and prevent proper functioning, perhaps even after the first heavy storm (see photograph below).

A simple practice that makes some BMPs easier to maintain is to **install a border** such as wood, rock or bender board to help prevent sedimentation and to keep gravel in place. **Hint:** *Make sure that when the border is installed, it does not prevent any inflow of water or divert water off site.*

Filter fabric is another tool that can be used to prevent the need for completely removing a BMP for cleaning. (See BMP-060.2, appendix H.) Filter fabric allows water to infiltrate into the BMP while preventing sediment particles from entering, thus allowing for easier cleaning. Be sure to clean the top layer of fabric thoroughly or replace it with new filter fabric periodically, because it can become clogged over time.

Underground conveyance and infiltration systems should always be installed with one or more sediment traps that can be cleaned out easily.

Maintenance of infiltration and conveyance systems

In order for a typical infiltration system to work appropriately for the long term, it should be installed to allow for easy maintenance. The following discussions will give examples of different types of infiltration systems and how each should be inspected and cleaned regularly to maintain their effectiveness.

Gravel Trenches

To inspect gravel trenches, observe the BMP and notice if sediment and debris has accumulated on top of the gravel and in the spaces between each rock. If debris such as pine needles, leaves and/or twigs are only fresh on the surface, simply rake them off to prevent clogging. However, over time, the spaces between the gravel that normally store runoff until it can soak into the ground will become clogged and the BMP will no longer function. The frequency of clogging varies according to how well source control is occurring, but can occur in one year's time if conditions allow for it. Once the gravel is clogged, this BMP is considered to be inadequately functioning and out of compliance.

To clean the gravel and restore the functionality of the infiltration system, sift to remove debris and replace the cleaned gravel. Use a medium sized mesh that is small enough to hold the gravel, but large enough to allow the dirt and debris to fall through. **Hint:** *Make sure to sift over a wheel-barrow, flower bed or other contained area so that the fine soil particles will not be eroded away by wind or water.* If sifting over a driveway, sweep up the dirt and debris thoroughly and stabilize onsite. (Do not sift over pavers or pervious pavement.) Once the gravel is sifted and cleaned as much as possible, return it to its original location.

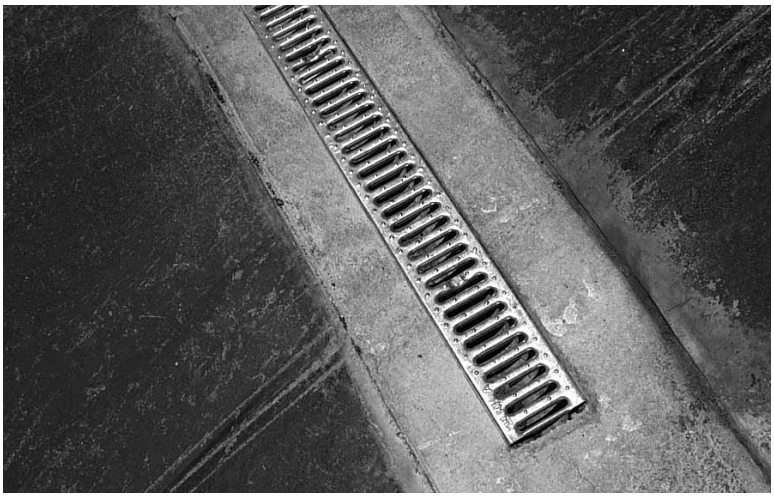
Perforated Drain Pipes

Planning a perforated subsurface drain installation includes designing an effective cleanout for sediment and debris. A poorly installed drainpipe that lacks a cleanout will end up clogging and will no longer function to control runoff.

Proper installation of a cleanout will add life to the system and allow for easy maintenance. A properly installed cleanout includes a removable cap. They should be placed at both ends of the system and at any bends/elbows in the pipe. See the Chapter 4 for more details.

Slotted Drains/Channel Drains

Slotted drains are used to divert and convey driveway runoff to a properly sized infiltration system. Slotted drains should have ***removable grates*** to allow access for cleaning accumulated debris and sediment that block the flow of water. Slotted drains generally need to be cleaned twice a year, once in the spring after snowmelt and once in the fall prior to snowfall. These systems should be swept or vacuumed out rather



Slotted channel drain with removable grates for cleaning.

than flushing out debris with high-pressure washers or water, which will just prematurely clog the infiltration system.

The sediment trap with a clean out port, installed at the point where runoff flows from the slotted drain into an infiltration system, needs to be inspected regularly and cleaned out twice a year.

Prefabricated infiltration systems

Prefabricated infiltration systems are infiltration systems that are filled with prefabricated stormwater storage units (see Runoff & Infiltration Section). These systems catch and store runoff onsite, eventually letting it seep into the surrounding soil. For long term operation, these infiltration systems require a sediment trap at the discharge of the conveyance system before the stormwater reaches the infiltration system. Check the inlet to the infiltration system often to ensure that it is providing adequate flow into the storage chamber(s).

Gravel covering the filter fabric over the entrance to the infiltration system may also become clogged. See the above section on maintaining gravel trenches for a description of how to maintain gravel infiltration areas.

Pre-treatment sediment trap with large grate is easily cleaned.

Also be aware of the interior storage area of the infiltration system. Is it filling up with sediment and reducing the system's storage capacity? If this occurs, the entire infiltration system may need to be removed, cleaned and replaced. See Chapter 4 for more information on installing infiltration systems.

Roof Gutters

Roof gutters capture roof runoff and convey it to an infiltration system where the water can be stored. Gutters require regular maintenance in order to function properly. Careful cleaning of debris from the gutter and off the roof will allow runoff to reach the infiltration system.

Vegetation and Buffer Strips

Planting native or adapted vegetation as a BMP may be the simplest and most effective means to control erosion. Besides controlling erosion, vegetation adds aesthetic value to a property, provides habitat for wildlife and provides a buffer strip to collect sediment and runoff.

Maintaining vegetation is key to its long-term success. If vegetation is neglected or mistreated it may die, which eliminates its effectiveness, potentially making the property out of compliance with local BMP ordinances. (See Chapter 6, Vegetation & Mulch.)

If vegetation is used as a BMP under a dripline to control erosion from roof runoff, it should be non-woody herbaceous vegetation such as turf or perennial flowers. It is important to make sure the vegetation is dense and strong enough to withstand the runoff impact. Look to see if there is exposed soil between plants. Bare soil between plants within 5 feet of flammable structures should be protected using a noncombustible mulch, i.e. gravel, to enhance the defensible space.

Native and adapted species, if chosen correctly for site conditions, need less water and less fertilizer to live in Lake Tahoe's harsh growing environment. **HINT:** *Make sure that any plants used next to or near structures have a low fire hazard rating. They should not have stems made of wood. (*See Chapter 5 and Chapter 7 in *Home Landscaping Guide for Lake Tahoe and Vicinity*).

Limit the use of nonadapted plants, since they will need greater amounts of fertilizer and water to maintain their health. Use low or no phosphorus fertilizers, and low-flow irrigation systems to maintain plants other than turf. See Chapter 12 in the *Home Landscaping Guide for Lake Tahoe and Vicinity* for more information.Contact your local conservation district to learn more about installing and maintaining vegetated BMPs.

Organic Mulch

Organic mulch, such as wood chips, is spread over bare soil to help control wind and water erosion. Wood chips and bark chips can be used as mulch in planters and on bare spots, outside the 5-foot noncombustible area, but pine needles should not be used as mulch at all within 30 feet of structures. If organic mulches are used in planters within the 5- to 30-foot zone, they should be separated by noncombustible groundcovers and arranged so that they will not allow a fire to travel rapidly across the area. Over time, foot traffic, pet traffic, and natural decomposition will wear away organic mulch, creating exposed bare soil that is vulnerable to erosion. *It is important to continually add organic mulch to areas that have worn away, blown away or decomposed* (see Mulch Section, pages 52-53). Spreading 1½ - 3 inches of wood or bark chips will help control erosion on slopes less than 33 percent.

Infiltration Basins

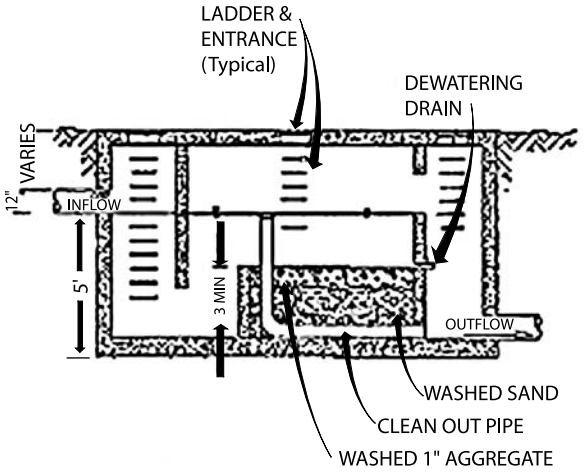
Routine inspection and maintenance of infiltration basins is essential to their continued effectiveness. Basins should be inspected after each storm event to ensure proper drainage from the collection pool, and to determine the need for structural repairs. Infiltration basins should be designed to allow for easy maintenance access. Sediment should be removed from the basin when its storage capacity is diminished. Trash and debris that accumulate around detention basins should be removed promptly after rainfall events. Remember to dispose of the debris and soil appropriately.

IMPORTANT: Do not dump removed sediment and debris into an area that could connect or wash to a waterway emptying into Lake Tahoe. This defeats the whole purpose of having an infiltration basin!

Mechanical Treatment Devices

Mechanical treatment devices, or sand/oil separators, are typically installed as pre-

This mechanical treatment device needs to be maintained regularly to remain effective.



UNDERGROUND VAULT FILTER

treatment devices at commercial sites or larger scale, high-traffic parking lot areas. These mechanical treatment devices can be strategically located in areas where large amounts of trash and coarse debris and high concentrations of oil, grease, gasoline, heavy metals and other pollutants are a problem. Sand/oil separators should discharge to an infiltration system (i.e. infiltration trench or detention basin) for final treatment and nutrient removal.

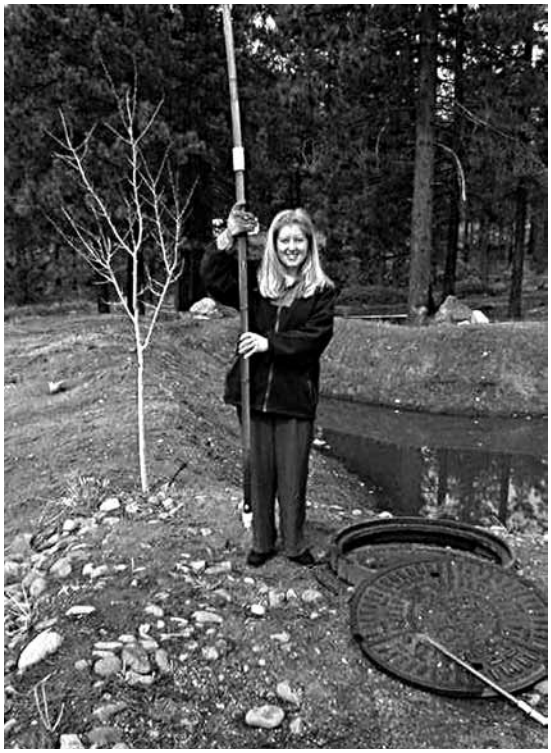
Typical maintenance of sand/oil separators includes: trash removal if a screen or other debris capturing device is used, changing of oil absorbent pillows or cartridges and removal of sediment and sludge using a vactor truck. Maintenance should include keeping a log of the amount of sediment collected and the date of removal. Some cities have incorporated the use of GIS systems to track sediment collection and to optimize future sand/oil separator cleaning efforts.

Keep in mind that when the sump within the device begins to reach capacity, storm flows can re-suspend sediments trapped in the mechanical treatment device that will ultimately bypass treatment. Frequent clean-out can retain the designed volume within the device's sump, thus allowing for optimal treatment.

There are a wide variety of mechanical treatment devices on the market. These products vary from baffle-type systems to swirl separators, or hydrodynamic structures (see figure on page 63). Swirl separators are modifications of the traditional oil-grease separator and include an internal component that creates a swirling motion as stormwater flows through a cylindrical chamber.

No matter what type of mechanical treatment device is installed, it is essential to work closely with the manufacturer and installer to create an effective maintenance and monitoring plan to ensure the system's proper functionality. The maintenance specifications for the device should be submitted during the permit process.

Mechanical treatment devices such as sediment traps need to be monitored visually to determine when clean out is necessary.



Maintenance activities and schedules for urban infiltration Best Management Practices
(Adapted from CWP, 1998)

Management Practice	Maintenance Activity	Schedule
Infiltration Trench	❑ Cleaning and removal of debris after major storm events; (>2" rainfall) ❑ Mowing and maintenance of upland vegetated areas ❑ Sediment cleanout ❑ Repair or replacing of stone aggregate ❑ Maintenace of inlets and outlets	Annual or as needed
	❑ Removal of accumulated sediment from sediment storage areas when 50% of the original volume has been lost	4-year cycle
Infiltration Basins	❑ Cleaning and removal of debris after major storm events; (>1" rainfall) ❑ Irrigation, mowing and maintenance of vegetated areas ❑ Sediment cleanout	Annual or as needed
	❑ Removal of accumulated sediment from sediment storage areas when 50% of the original volume has been lost	3- to 5-year cycle
Dry Swales, Grassed Channels, Biofilters	❑ Mowing and litter/debris removal ❑ Stabilization of eroded side slopes and bottom ❑ Nutrient and pesticide use management ❑ Dethatching swale bottom and removal of thatching ❑ Disking or aeration of swale bottom	Annual or as needed
	❑ Scraping swale bottom and removal of sediment to restore original cross section and aeration to restore infiltration rate ❑ Seeding or sodding to restore ground cover (use proper erosion and sediment control)	5-year cycle
Water spreading area	❑ Mowing and litter/debris removal ❑ Nutrient and pesticide use management ❑ Aeration of soil on the infiltration area ❑ Watering of plant material ❑ Repair of eroded or sparse grass areas	Annual or as needed
Vegetated Above Ground Infiltration Systems	❑ Repair of erosion areas ❑ Mulching of bare soil areas ❑ Removal and replacement of all dead and diseased vegetation ❑ Watering of plant material	Biannual or as needed
	❑ Removal of excessive mulch and application of a new layer if necessary	Annual

References

Center for Watershed Protection (CWP). 1998. *Costs and Benefits of Stormwater BMPs: Final Report 9/14/98.* Center for Watershed Protection, Ellicott City, MD.

EPA Website at http://cfpub.epa.gov/npdes/stormwater/menuofbmps.

For more information, go to the website listed above.

Chapter 8

Permitting

The installation of Best Management Practices (BMPs) may require the property owner to obtain permits from the Tahoe Regional Planning Agency (TRPA) and/or the local jurisdiction where the property is located (City of the South Lake Tahoe, Washoe County, El Dorado County, Placer County or Douglas County). The need to obtain permits may be initiated due to the amount of excavation being performed, paving of unpaved driveways, the installation of BMPs in easement areas, the removal of trees or other vegetation, landscaping or issues concerning land coverage on the subject property. This chapter is intended to provide a general overview of situations where permits are required when installing BMPs. This chapter should not be construed to cover every scenario or be a comprehensive guide to permitting. If additional questions are raised beyond what is provided for in this chapter, please call either TRPA at (775) 588-4547 or your local jurisdiction as appropriate.

Definitions

Hard Land Coverage: A man-made structure, improvement or covering, either created before February 10, 1972 or created after February 10, 1972 pursuant to either TRPA Ordinance or other TRPA approval, that prevents normal precipitation from directly reaching the surface of the land underlying the structure, improvement or covering. Such structures, improvements and coverings include but are not limited to roofs, decks, surfaces that are paved with asphalt, concrete or stone, roads, streets, sidewalks, driveways, parking lots, tennis courts, patios.

Soft Land Coverage: Lands so used before February 10, 1972, for such uses as for the parking of cars and heavy and repeated pedestrian traffic that the soil is compacted so as to prevent substantial infiltration. A structure, improvement or covering shall not be considered as land coverage if it permits at least 75 percent of normal precipitation directly to reach the ground and permits growth of vegetation on the approved species list.

Excess Land Coverage: The amount of legal existing land coverage on the property that exceeds the base land coverage for the parcel based on the Land Capability system developed by Dr. R.G. Bailey. If the land coverage has been legally established pursuant to the definitions of Hard and Soft Land Coverage above, the coverage is often referred to as "grandfathered" land coverage.

Allowable Land Coverage: The amount of allowable land coverage for most parcels with existing development (exclusive of residences approved under the Individual Parcel Evaluation System (IPES) is based on the Bailey Land Classification System. The Bailey System rates land based on sensitivity to development as determined by soil type and slope: Classes 1, 2, and 3 are defined as "sensitive" and Classes 4, 5, 6, and 7 are defined as "non-sensitive". Land Capability District 1b, also known as *Stream Environment Zone* (SEZ), is the most environmentally sensitive land capability district. In general, a SEZ is an area which owes its biological and physical characteristics to the presence of surface or ground water. Each of the seven land capability classes has a corresponding percentage of allowed land coverage.

Bailey Land Classification System

Land Capability District	*Land Coverage Allowed*
1 (a,b,c)	*1%*
2	*2%*
3	*5%*
4	*20%*
5	*25%*
6	*30%*
7	*30%*

Land Capability District: A soils unit designated on the adopted TRPA land capability map and denominated by a numerical rating of one through seven, e.g. Land Capability District 1. The system devised by Dr. Robert G. Bailey sets forth **"land coverage standards"** for construction on parcels based on their geological characteristics and their suitability for development. TRPA has these maps, available at www.TRPA.org.

Individual Parcel Evaluation System (IPES): Since Jan. 1, 1989, the IPES system has been in place for the review of single family dwelling applications. The IPES score is generated by evaluating the property-specific environmental characteristics using eight evaluation criteria, (Relative Erosion Hazard, Runoff Potential, Degree of Difficulty to Access the Building Site, Parcels Requiring Access Through a Stream Environment Zone, Stream Environment Zone, Condition of Watershed, Ability to Revegetate, Need for Water Quality Improvements in Vicinity of Parcel and Proximity to Lake Tahoe) which determines the suitability of the parcel for development. The IPES system sets forth land coverage limitations in addition to a numerical score which determines its eligibility to be built upon.

"Exempt" Projects: If a project is considered **Exempt** pursuant to Chapter 4 of the TRPA Code of Ordinances, then the project does not require review by TRPA or a TRPA permit. However, permits may be required from the local jurisdiction where the property is located.

"Qualified Exempt" Projects: If the proposed project is considered Qualified Exempt pursuant to the TRPA Code of Ordinances, then the applicant must submit a Qualified Exempt Declaration form to TRPA that describes the proposal. Additional permits may be required from the local jurisdiction where the property is located.

When are permits needed?

Grading and Excavation

Please note that any amount of grading, excavation, or filling in a stream environment zone (SEZ), a flood plain, or in the shorezone **is generally prohibited**. In addition, proper erosion control measures, such as erosion control fences or fiber logs, must be in place before any grading, excavation, or filling is initiated anywhere else. Call TRPA for a pre-grade inspection. General excavations that meet the following criteria may either be Exempt or Qualified Exempt.

Grading, Excavation, or Filling Less than 3 Cubic Yards:

Grading, excavation, or filling less than 3 cubic yards is considered **Exempt** by TRPA, provided that:

- The associated grading, excavation, or filling does not exceed 3 cubic yards
- The work is completed within 48 hours;
- The site is stabilized to prevent erosion;
- The grading, excavation, or filling does not occur during periods of precipitation, when the site is covered with snow, or is in a saturated, muddy or unstable condition; and
- The grading, excavation, or filling is not part of a series of excavations that, when viewed as a whole, would require a TRPA permit. E.g. The excavation of four pits of 2 cubic yards each would require a permit.

Grading, Excavation, or Filling Less Than 7 Cubic Yards:

Grading, excavation, or filling less than 7 cubic yards is considered **Qualified Exempt** by TRPA, provided that:

- A TRPA qualified exempt form is submitted to TRPA.
- The grading, excavation, or filling occurs between May 1 and Oct. 15.
- The grading, excavation, or filling occurs on high capability land (Class 4-7) or on a parcel with a buildable IPES score;
- The site is stabilized within 48 hours to prevent erosion;
- The grading, excavation, or filling does not occur during periods of precipitation, or when the soil is covered with snow, or is in a saturated, muddy or unstable condition; and
- The grading, excavation, or filling is not part of a series of excavations that, when viewed as a whole, would require a TRPA permit.

Grading, Excavation, or Filling Greater Than 7 Cubic Yards:

Grading, excavation, or filling greater than 7 cubic yards of soil requires a TRPA review and permit, and may require a permit from the local jurisdiction.

Always call before you dig.

Before any excavation, call 811 to get a free site inspection to locate any gas or electric lines beneath the ground surface.

Landscaping

Landscaping and Gardening:

Landscaping and gardening is considered **Exempt** by TRPA, provided that:

- The landscaping is in accordance with the TRPA Handbook of Best Management Practices requirements for fertilizer use and the TRPA plant list, found in Chapter 7 of the *Home Landscaping Guide for Lake Tahoe*.
- The landscaping does not occur in a SEZ or SEZ setback.
- There is no creation or relocation of land coverage (e.g., pathways);
- Any associated grading, excavation, or filling is Exempt (i.e. does not exceed three cubic yards); and
- The natural slope of the site is maintained (i.e., no terracing, recontouring or cuts and/or fills over 18 inches high).

Residential Driveways

There are many different scenarios encountered when installing Best Management Practices for driveways. Most driveway situations should fit into one of the categories below, however, if additional questions arise, please contact the TRPA offices at (775) 588-4547.

- If the property owner is simply constructing overlays upon existing paved surfaces, and is neither creating nor relocating coverage on site, this activity is considered Exempt by TRPA. Check with the local jurisdiction.

- To pave a dirt driveway, the property owner must complete a Driveway Paving Application. Driveway Paving Applications can be completed at the City of South Lake Tahoe, El Dorado County, Placer County and TRPA.

  The paving application is intended to provide "the minimum driveway access and parking" (approximately 400 square feet). Generally, if there is a garage or other parking structure, the area to be paved should be located in front of the garage or other parking structure, for access. If the property owner would like to have additional compacted areas verified as "legal existing land coverage" pursuant to the TRPA Code of Ordinances, beyond what is permittable in the Driving Paving Permit, the property owner would need to submit a land coverage verification or site assessment application to TRPA or the local jurisdiction (as applicable).

- Some residential properties do not have an existing driveway on site. Most local jurisdictions require that property owners have two on-site parking spaces. Contact the local jurisdiction for details. In calculating the number of spaces needed on site, please be aware that TRPA recognizes existing garages as one on-site parking spot (regardless of the size of the garage). In order to install a new driveway or parking pad, property owners must either: 1) have the allowable land coverage on site to install a driveway, 2) relocate legally existing land coverage on-site, 3) transfer in the minimum amount of land coverage based on the TRPA Code of Ordinances through a TRPA permit, or 4) in some cases, parking areas may be designated in the right-of-way if there is no other feasible alternative and the local jurisdiction or highway department provides approval. The fourth option should be explored, only when no other

option is available. In order to determine whether a property fits any of the above criteria, a land coverage verification and land capability verification or a site assessment is required. These applications should be submitted to TRPA or the local jurisdictions as appropriate.

There are several other standards that must be used in designing residential driveways. First, driveways must be consistent with the driveway standards found in the TRPA Code of Ordinances and local regulations. Secondly, parking barriers must be installed to prevent parking or the storage of equipment on unpaved areas where there is potential for off-pavement parking. Split-rail fences, wood bollards or large, keyed-in boulders are often used as parking barriers. If you have additional questions on driveway standards, please contact TRPA or your local jurisdiction. See also the "permitting process" section in Chapter 3 of this manual.

Paving of parking lots and driveways for commercial, tourist accommodation, recreation and public service properties
Depending on size and use, these projects generally require the installation of sand/oil separators to remove pollutants and sediment that is generated from stormwater runoff. In addition, these projects generally require a substantial amount of grading, and therefore a TRPA permit is required for these activities. TRPA requirements for driveway installation are found in the TRPA Code of Ordinances. Parking areas will require a permit from TRPA as well as the local jurisdiction (City of South Lake Tahoe, Washoe County, Placer County, Douglas County, or El Dorado County).

Retaining walls
TRPA requires permits for retaining walls under the following situations or conditions:

- Large retaining walls that are visible from scenic corridors (i.e. Lake Tahoe, Highway 89 and 50).
- Installations that require the excavation of greater than 3 cubic yards of dirt;
- Installations that require the removal of any trees or vegetation.
- Installations where the wall is 4 feet in height or taller (measured from the bottom of the footing to the top of the wall), which need to be designed by an engineer licensed in the state where the work is being performed. If the plans are stamped by an engineer, a free BMP retrofit permit can be issued unless part of a larger project.
- Retaining walls installed that alter the natural slope of the site (with cuts and/or fills over 18 inches high).

There may be other instances where TRPA permits are required. Please contact TRPA at (775) 588-4547 to determine if a permit will be required for your project.

Your local jurisdiction may also require the submittal of a permit and engineered plans.

Shoreline protective structures
Shoreline protective structures are used to prevent erosion of the backshore of Lake Tahoe. These structures require the submittal of a TRPA Shorezone Application to TRPA for review and approval. These structures must be designed by a qualified professional engineer and meet the standards found in the TRPA Code of Ordinances in terms of the necessary environmental findings and design criteria.

Notes:

Glossary

Aquifer: An underground bed or layer that contains fresh water in sufficient amounts to yield useful quantities to wells and springs.

Basin: A region drained by a single river system. May also refer to an above-ground infiltration system.

Best Management Practice: Structural or nonstructural practices proven effective in managing surface-water runoff and reducing water pollution from soil erosion and other nonpoint sources.

Constrained site: A property with site characteristics like shallow bedrock, shallow water table or underground utilities that make infiltration of stormwater onsite infeasible. This condition should be stated on the site evaluation. If an installer discovers such conditions on a site, and they are not noted on the evaluation forms, he or she should call the Conservation District.

Culvert: A short, closed (covered) conduit or pipe that passes stormwater runoff under an embankment, usually a roadway.

Erosion: Detachment and movement of rocks and soil particles by gravity, wind and water. Often the eroded debris (silt or sediment) becomes a pollutant via stormwater runoff. Erosion occurs naturally, but can be intensified by land-clearing activities such as farming, urban development, road building, and timber harvesting.

Filter Fabric: A permeable textile of relatively small mesh that is used to allow water to pass through while causing the sediment to settle out.

Grading: The cutting and/or filling of the land surface to a desired slope or elevation.

Groundwater: That portion of the water beneath the surface of the earth that can be collected with wells, tunnels, or drainage galleries, or that flow naturally to the earth's surface via seeps or springs.

Infiltration: The penetration of water through the ground surface into sub-surface soil.

Inlet: An entrance into a sediment trap, infiltration system or other waterway.

Nonpoint Source (NPS) Pollutants: Pollutants from many different sources. NPS pollution is caused by rainfall or snowmelt moving over impervious surfaces or the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, costal waters, and even underground sources of drinking water.

Oil/Water Separator: A sub-surface mechanical device which separates oil and grease from water entering the drain. This device requires regular maintenance to be effective.

Outfall: The point where wastewater or drainage discharges from a pipe, ditch, or other conveyance to a receiving body of water.

Permeability: The characteristic of soil that allows water or air to move through it. Usually described in inches/hours or inches/day.

Point Source Pollutant: Pollutants from a single identifiable source such as a pipe discharging from a factory, refinery, or place of business.

Pollutant Loading: The total quantity (mass) of pollutants in stormwater runoff. TDML (Total Daily Maximum Loading) is the maximum amount of pollutants that may be discharged into a body of water according to EPA regulations.

Recharge: Downward movement of water through soil to groundwater.

Retention: A process that halts the downstream progress of stormwater runoff. This is typically accomplished using total containment involving the creation of storage areas that use infiltration devices, such as dry wells, to dispose of stored stormwater via percolation over a specified period of time.

Right of Way: A strip of land which is used as a roadbed, either for a street or railway. The land is set aside as an easement. May also be used to describe the right itself to pass over the land of another.

Riprap: A layer of rocks or boulders on a slope, used to prevent erosion. This BMP is also called "rock slope protection."

Riparian: Of, or pertaining to, rivers and their banks.

Runoff: That portion of precipitation or irrigation water which fails to infiltrate soil and flows over the surface to streams or water bodies.

Sanitary Sewer: A system of underground pipes that carry sanitary waste or process wastewater to a treatment plant.

Secondary Containment: Structures, usually dikes or berms, surrounding tanks or other storage containers to catch spilled material.

Sediment Trap: A device for removing sediment from water conveyance and infiltration systems.

Sedimentation: The natural process of depositing soil, clay, sand, or other sediments that were moved by the flow of water.

Site Evaluation: A free visit by an agency staff person to a residence or small business to develop site-specific BMP designs including an evaluation package with a site plan and BMP treatment descriptions and dimensions.

Stream Environment Zone (SEZ): Land area adjacent to stream, creek, wetland or lake that is influenced by flowing water or saturated soil for at least a week during the growing season each year. Can include riparian zones or streambeds that are dry except during rain or snowmelt. SEZs protect the lake's water quality, and their boundaries must be delineated by TRPA staff before construction is allowed near them. Landscaping activities are prohibited in SEZs.

Storm Drain: A drop inlet, channel or pipe that carries runoff from rain or snowmelt from a roadside gutter to a river or lake without any treatment.

Stormwater: Precipitation that runs off impervious land coverage (rooftops and pavement) to storm drain systems during and immediately following a storm event.

Stormwater Facilities: Systems such as watercourses, constructed channels, storm drains, culverts, and detention/retention facilities that are used for the conveyance and/or storage of stormwater runoff.

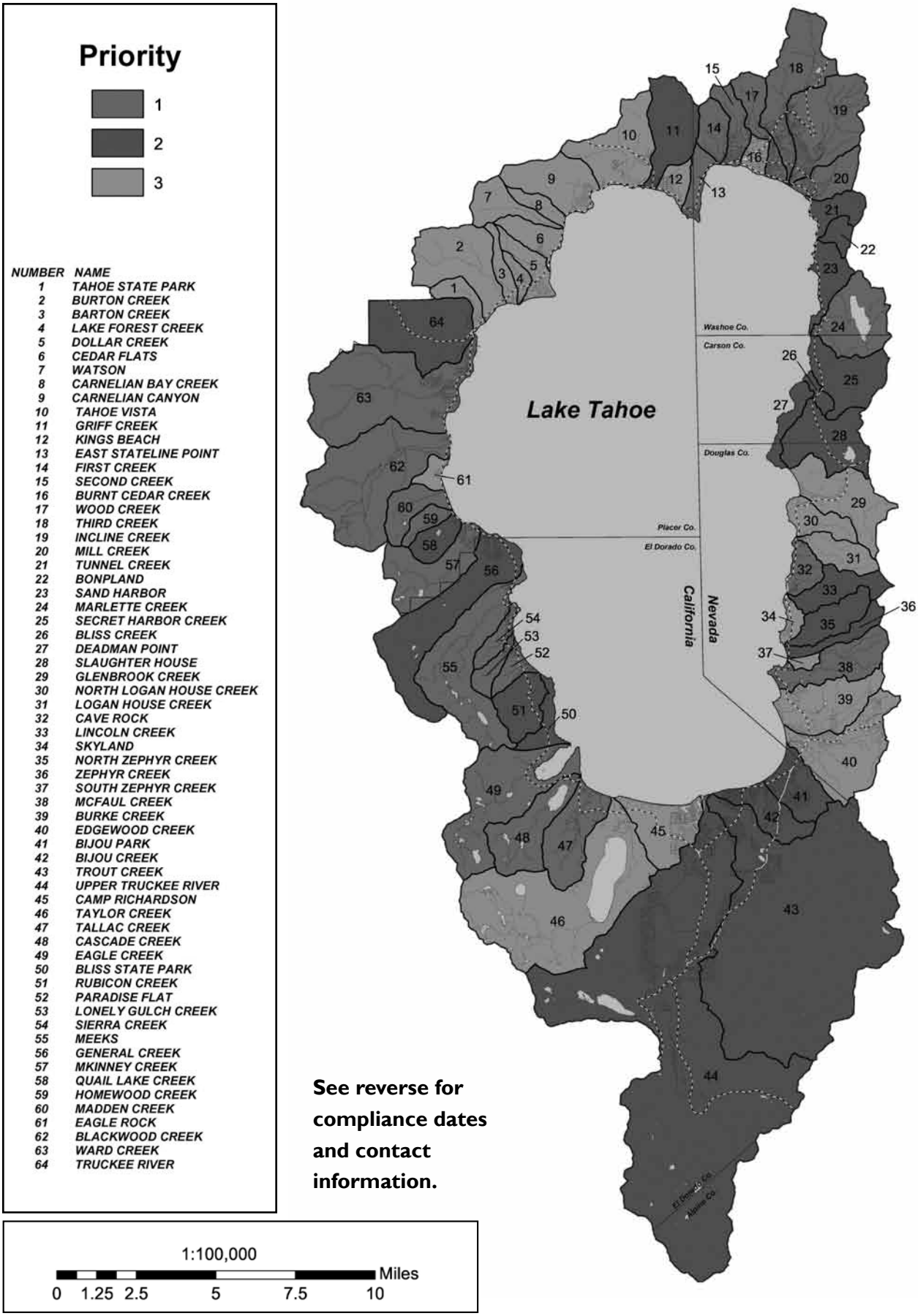
Swale: A linear depression, often constructed of earth, lined with grass or gravel and used as a conveyance for stormwater. May also refer to a shallow depression in a paved surface designed to convey water.

Urban Runoff: Stormwater from urban areas, that tends to contain pollutants from vehicles and industry along with pathogens, sediments and nutrients.

Watershed: That geographical area which drains to a specified point on a watercourse,

Notes:

Appendix A: Priority Watershed Map



NUMBER	NAME
1	TAHOE STATE PARK
2	BURTON CREEK
3	BARTON CREEK
4	LAKE FOREST CREEK
5	DOLLAR CREEK
6	CEDAR FLATS
7	WATSON
8	CARNELIAN BAY CREEK
9	CARNELIAN CANYON
10	TAHOE VISTA
11	GRIFF CREEK
12	KINGS BEACH
13	EAST STATELINE POINT
14	FIRST CREEK
15	SECOND CREEK
16	BURNT CEDAR CREEK
17	WOOD CREEK
18	THIRD CREEK
19	INCLINE CREEK
20	MILL CREEK
21	TUNNEL CREEK
22	BONPLAND
23	SAND HARBOR
24	MARLETTE CREEK
25	SECRET HARBOR CREEK
26	BLISS CREEK
27	DEADMAN POINT
28	SLAUGHTER HOUSE
29	GLENBROOK CREEK
30	NORTH LOGAN HOUSE CREEK
31	LOGAN HOUSE CREEK
32	CAVE ROCK
33	LINCOLN CREEK
34	SKYLAND
35	NORTH ZEPHYR CREEK
36	ZEPHYR CREEK
37	SOUTH ZEPHYR CREEK
38	MCFAUL CREEK
39	BURKE CREEK
40	EDGEWOOD CREEK
41	BIJOU PARK
42	BIJOU CREEK
43	TROUT CREEK
44	UPPER TRUCKEE RIVER
45	CAMP RICHARDSON
46	TAYLOR CREEK
47	TALLAC CREEK
48	CASCADE CREEK
49	EAGLE CREEK
50	BLISS STATE PARK
51	RUBICON CREEK
52	PARADISE FLAT
53	LONELY GULCH CREEK
54	SIERRA CREEK
55	MEEKS
56	GENERAL CREEK
57	MKINNEY CREEK
58	QUAIL LAKE CREEK
59	HOMEWOOD CREEK
60	MADDEN CREEK
61	EAGLE ROCK
62	BLACKWOOD CREEK
63	WARD CREEK
64	TRUCKEE RIVER

See reverse for compliance dates and contact information.

All properties in the Tahoe Region are required to have BMPs installed. Your property is located within a Priority One, Two or Three watershed.

The compliance dates are as follows:

Priority One - October 15, 2000
Priority Two - October 15, 2006
Priority Three - October 15, 2008

For a free BMP Site Evaluation, property owners can contact the appropriate agency below:

For Commercial & Multi-Family Properties in NV and CA:

Tahoe Regional Planning Agency
P.O. Box 5310, 128 Market St
Stateline, NV 89449-5310
Phone 775-588-4547, ext. 202.
Fax: 775-588-4527
email: bmp@trpa.org
http://www.trpa.org

For Residential Properties in California:

Tahoe Resource Conservation District
870 Emerald Bay Road, Suite 108
South Lake Tahoe, CA 96150
Phone: 530-543-1501, ext. 113
Fax: 530-543-1660
email: tahoercd@yahoo.com
http://www.tahoercd.org

For Residential Properties in Nevada:

Nevada Tahoe Conservation District
P.O. Box 915, 400 Dorla Court
Zephyr Cove, NV 89448
Phone: 775-586-1610, ext. 28
Fax: 775-586-1612
email: bcp@ntcd.org
http://www.ntcd.org

IMPORTANT:

Because priority watershed deadlines have passed, all property owners who are out of compliance are required to install BMPs as quickly as possible. TRPA has begun enforcement activity on all property types in California and Nevada.

Appendix B: The Temporary BMP Hall of Shame, or How NOT to Install Temporary BMPs

Prevent this kind of erosion by keying the silt fence at least 6 inches into the soil at the toe of the slope.

Concentrated flow should not be directed onto exposed, vulnerable slopes. More than one BMP is needed here.

Tree protection fencing is not a substitute for tightly woven silt fence fabric.

Appendix B: The Temporary BMP Hall of Shame, or How NOT to Install Temporary BMPs

Tree protection fencing is required to be fenced around the fullest extent of the tree's dripline, not just around the tree trunk.

The straw bales pictured are not preventing sediment from entering the drop inlet. Furthermore, straw bales are no longer recommended for erosion control in the Lake Tahoe Basin.

This silt fence is not properly keyed in to a depth of at least 6 inches to prevent runoff from leaving the disturbed area.

Chart 1: Volume of Runoff From Impervious Surfaces for a Design Storm

VOLUME OF RUNOFF IN CUBIC FEET FOR A ONE INCH IN ONE HOUR STORM EVENT ON AN IMPERVIOUS SURFACE

IMPERVIOUS SURFACE LENGTH IN FEET (columns) / IMPERVIOUS SURFACE WIDTH IN FEET (rows)

Width \ Length	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
5	2	4	6	8	10	13	15	17	19	21	23	25	27	29	31	33	35	38	40	42
10	4	8	13	17	21	25	29	33	38	42	46	50	54	58	63	67	71	75	79	83
15	6	13	19	25	31	38	44	50	56	63	69	75	81	88	94	100	106	113	119	125
20	8	17	25	33	42	50	58	67	75	83	92	100	108	117	125	133	142	150	158	167
25	10	21	31	42	52	63	73	83	94	104	115	125	135	146	156	167	177	188	198	208
30	13	25	38	50	63	75	88	100	113	125	138	150	163	175	188	200	213	225		
35	15	29	44	58	73	88	102	117	131	146	160	175	190	204	219					
40	17	33	50	67	83	100	117	133	150	167	183	200	217							
45	19	38	56	75	94	113	131	150	169	188	206	225								
50	21	42	63	83	104	125	146	167	188	208										
55	23	46	69	92	115	138	160	183	206											
60	25	50	75	100	125	150	175	200	225											
65	27	54	81	108	135	163	190	217												
70	29	58	88	117	146	175	204													
75	31	63	94	125	156	188	219													
80	33	67	100	133	167	200														
85	35	71	106	142	177	213														
90	38	75	113	150	188	225														
95	40	79	119	158	198															
100	42	83	125	167	208															

Notas:

Appendix D

Innovative Slope Stabilization Techniques
Biogeotechnical Construction

Based on the work of Andrew T. Leiser
University of California, Davis

INTRODUCTION

A brief description of several biogeotechnical construction methods will be given. Detailed construction methods are described in the attached sample specifications and diagrams.

Wattling:

The word "wattle" is derived form an Anglo-Saxon word, "watel", meaning interwoven twigs and hence a framework or hurdle of such. The word was adopted by Dr. Kraebel of the U.S. Forest Service in the 1930's to describe a process of erosion control where willow or other materials were placed in trenches, on contour, staked and partially covered with soil. These wattles provided slope stability until the interplantings were established. The wattles also rooted and grew if constructed of easily rooting species and installed at the proper time of year.

Wattling must be placed strictly on contour (level) on steep sites. On riparian sites subject to stream or wave action, wattling may be placed diagonally to wave action although this technique has not been well researched.

Wattling has several advantages: energy dissipation, temporary stabilization to allow establishment of other vegetation, sediment entrapment, and the resulting plants become a part of the vegetation component. The wattling may later be crowded out by more dominant or better adapted species.

Wattling works well on basically stable slopes that have a shallow, unstable surface layer. It is also useful to repair curved slopes which are wide enough to allow bending of the wattling bundles.

Brush Layering:

Brush layering is a technique used in Europe and to a limited extent in the United States. Brush layering may be installed at the time of construction of new fills or in existing slopes by digging two to three foot or larger "steps" sloping slightly in to the slope, placing willow cuttings on the step and covering with soil. Butts are placed inward and the brush is criss-crossed in a random fashion. The tips of the brush are left exposed to intercept and slow water and detritus.

Successive lifts are installed as needed. Criteria for vertical spacing is similar to that for wattling. In new fill, the brush may be as long as is available. When placed at the right time of year the brush will root and grow.

Brush layering is indicated for new fills, shallow mass failures and repair of deep and/or narrow gullies.

Brush Trenching:
Brush trenching is a useful technique for intercepting shallow seeps and controlling piping, for spreading water in wetland construction or renovation, as energy dissipation along shorelines and as water breaks on abandoned roads. A narrow trench is dug, one to three feet deep, packed with a band of willow cuttings of the desired thickness and the trench is backfilled. Height above ground may vary according to the needs.

Spacing of rows will vary with the need. In wetland construction and renovation the rows may be spaced so that the vertical distance between successive rows is as little as six inches. Horizontal spacing will depend on the slope.

Brush Matting:
This procedure is the laying of a mat of willow brush sufficiently thick to prevent scour along streams, rivers and shorelines. The mat is staked and wired to hold it in place and in some instances it may be partially covered with soil. The site must have a fairly flat profile up and down slope but can follow the meander of the shore in a horizontal direction. The frequency of staking and method of wiring, line wire or fencing wire will depend on the expected erosion forces. The toe of the matting should be below the mean low water level and should be anchored with logs, stones or rows of wattling.

Combination Treatments:
The biogeotechnical methods can be used in any combination. Interplanting of cuttings or transplants usually should be done. All work and combinations of work should be "tied" together and to the surrounding stable areas. "A chain is only as strong as its weakest link."

IMPLEMENTATION
Scaling and site preparation should take place from the top of a slope and working down. Installation of structural and biogeotechnical work should proceed from the bottom to the top and planting should proceed from the top to the bottom.

Tools: The tool required will depend upon the revegetation plan, the size of the plants, soils, and size of the project and site conditions.

Chain saws, lopping and hand pruners and hatchets may be needed for the preparation of cuttings and materials for wattling, brush layering, brush trenching and brush matting. Heavy hammers and sledges are needed for staking the job, driving stakes in the installations of wattling and for installation of fencing and cages for plant protection.

Picks, mattocks and shovels are needed for site preparation, shovels and spades or tile spades for trenching for wattling and brush layering, and dibbles or small hand picks for planting smaller plants and cuttings. Star drills and hammers may be needed for planting unrooted cuttings in cemented soils. On some sites, power augers are useful for planting.

Other materials may include fertilizers, fencing for plant protection, wire or fencing for installation of brush matting and stakes for layout and biogeotechnical work.

Planting: After site preparation and biogeotechnical work is done, planting can proceed. Plants, unrooted cuttings and brush (willow or dogwood cuttings) for biogeotechnical construction are living things and must be handled accordingly. They should be kept moist or well watered, as cool as possible and protected until actually planted.

Size of planting holes depends of the size of the material to be planted and sometimes

on the soil conditions. When soils are friable the holes may not need to be much larger than the plant root system. In heavy and compacted soils, a larger hole to allow backfilling of looser material may allow better initial root penetration. The depth of the holes must be greater when fertilizers are to be used beneath the plant than when no fertilizer is used.

When fertilizers are used the hole should be deep enough to place the fertilizer in the bottom of the hole, back fill with two or three inches of soil, place the plant, cover the roots with one to two inches of native soil and still leave a depression around the plant to collect water. Use only quantities of fertilizer recommended by the manufacturer or as determined by soil or pot tests.

Older recommendations often called for amendments to be added to the backfill to loosen the soil and increase water holding capacity. Research has shown that although roots proliferate well in amended backfill, they do not penetrate the native soil as well as they do when no amendment is used. Amendments increase planting costs substantially.

Planting holes on slopes need special attention. First, dig a "step" sloping into the bank and then dig the hole at the back of this step. Be careful to not loosen the front "lip" of the step. Hole size and planting techniques are for more level sites.

Planting should be done immediately after digging the hole to reduce drying of the backfill. This is especially important where supplemental irrigation is not available. Plants should be removed from the containers even though they are "biodegradable". The object is to get the maximum contact between the roots and the native soil. If the rim of a "biodegradable" pot becomes exposed to the air, the pot will act as a wick and create a dry zone between the roots and the native soil.

Any circling roots on the outside of the root ball must be removed before planting.

In revegetation projects it is usually desirable to set the plants just below the level at which they were and to cover the root systems with two or three inches of soil to act as a mulch. This is contrary to the usual horticultural advice for planting in the irrigated landscape. Backfill should be thoroughly tamped to insure good root soil contact and to eliminate air pockets. If irrigation is available, the plants should be watered in to aid this compaction and to supply supplemental water.

The use of berms around the planting hole may be useful to concentrate rainfall or irrigation. Berms should be two to four inches higher and of sufficient diameter to perform this function. On sloping ground it is desirable to leave the berm open on the uphill side to trap more run-off. The inside of the berm should be tapered toward the plant to concentrate water near the root system.

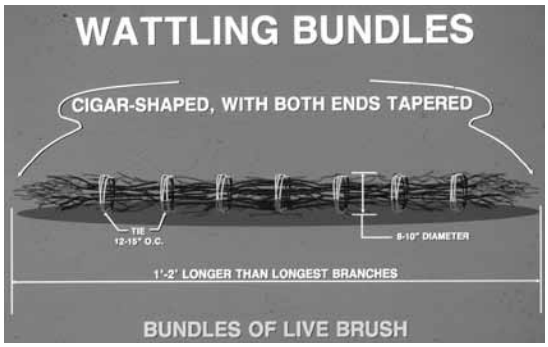
BIOTECHNICAL CONSTRUCTION SAMPLE SPECIFICATIONS

Contour wattling installation

Materials: Wattling bundles shall be prepared from live, shrubby stems of species which will root such as willow, baccharis, dogwood, etc. Where woody species are undesirable, e.g. channels with restricted flow or where shading would restrict the growth of herbaceous emergent or aquatic species, stems of non-rooting species or of dead material of species that would normally root shall be used.

Bundle Length: Wattling bundles may vary in length depending on the length of the species used. Bundles shall taper at the ends and shall be one (1) to two (2) feet longer than the average length of stems to achieve this taper. Butts of stems shall not be more than one and one-half (1 ½) inch in diameter.

Bundle Diameter: When compressed firmly and tied, each bundle shall be eight (8) inches in diameter. Maximum allowable variation is plus or minus two (2) inches.



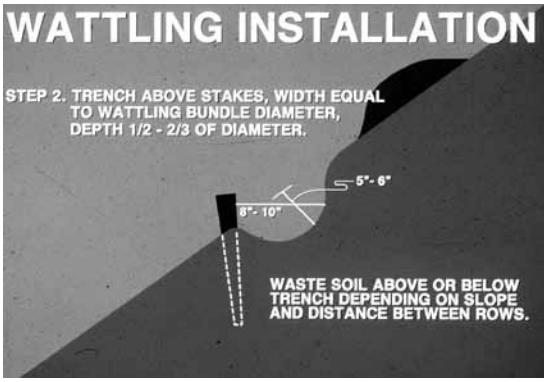
Bundle Construction: Stems shall be placed alternately and randomly so that approximately one-half (1/2) the butt ends are at each end of the bundle and the butts are staggered within the bundle.

Time Preparation: The timing of preparation of wattling bundles is vital when used with the expectation of rooting. Preparation and installation of wattling shall be during the season of vegetative dormancy, i.e. from the time the resting buds are set and vegetative growth has ceased in late summer until bud break and the beginning of vegetative growth in the late winter or spring. Where non-rooting or dead brush is desired, preparation and installation may be done any time of the year.

Bundles shall be prepared not more than two days in advance of installation except as noted below. If provisions are made for storing the bundles, submerged in water or sprinkled often enough to be kept moist as well as covered, preparation may be up to seven (7) days in advance of installation. Bundles may be kept in suitable cold storage for up to three (3) months. Such storage shall have humidity control to avoid desiccation of the plant material.

Layout Staking: Location of rows of wattling shall be staked, on contour, using an Abney or similar type level. The stakes used in installation may be used for layout. Care must be exercised to keep wattles level when traversing gullies to avoid diverting more water into these gullies.

Wattling Spacing: Vertical spacing of wattling rows shall be as on the drawings. [Spacing is a matter of judgment. It needs never be closer than three (3) feet and may be as much as twenty (20) feet vertical distance (not slope face). Some factors affecting spacing are length, steepness and stability of slope, erodibility of the soil, expected precipitation and run-off.]



Stakes: Stakes must be strong and long enough to penetrate to the undisturbed substrate. The minimum sized stake shall be at least two by two (2x2) inches at the midpoint. Two by fours (2x4's) cut on a diagonal are recommended. In rocky substrate, rebar or other metal stakes may be required. After

driving to a firm hold the rebar must be bent over the wattling to hold it in place. Live willow stems greater than one and one-half (1 ½) inch in diameter may also be used for staking.

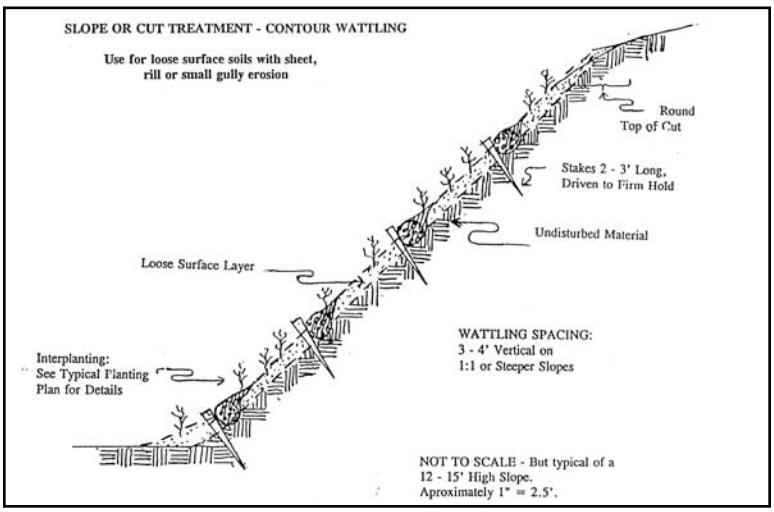
Stake Spacing: Bundles shall be staked firmly in place with one row of stakes on the downhill side of the wattling on not more than three (3) foot centers. A second row of stakes shall be placed through the bundles at not more than five (5) foot centers. Where bundles overlap there shall be two stakes to "tie" the bundles together, one downhill and one through the ends of each bundle and between the last two ties of each bundle.

Installation: Bundles shall be laid in trenches dug approximately one-half the bundle diameter, immediately above the bottom row of stakes. Ends of the bundles shall overlap at least 12 inches. The last ties of each bundle shall overlap sufficiently that a stake may be driven between the last two ties of each bundle.

Backfilling: Wattling shall be covered with site soils, filling voids within, behind and below the bundles and tamped thoroughly. Water may be used to aid in backfilling. Workers should be encouraged to walk on the covered wattling as other work on the slope is done. Heavy clay materials may need to be pulverized in order to attain suitable back filling. Successful rooting of the wattling will only be attained if the filling is done properly.

Progression of Work: Work shall progress from the bottom to the top of the slope. On large jobs, work might be underway on two or more rows of wattling at one time.

Prevention of drying: Exposure of the wattling to sun and wind must be minimized throughout the operation. Trenches shall be dug only as rapidly as placement and covering of the bundles is accomplished to minimize the drying of the brush and the soil removed from the trenches.

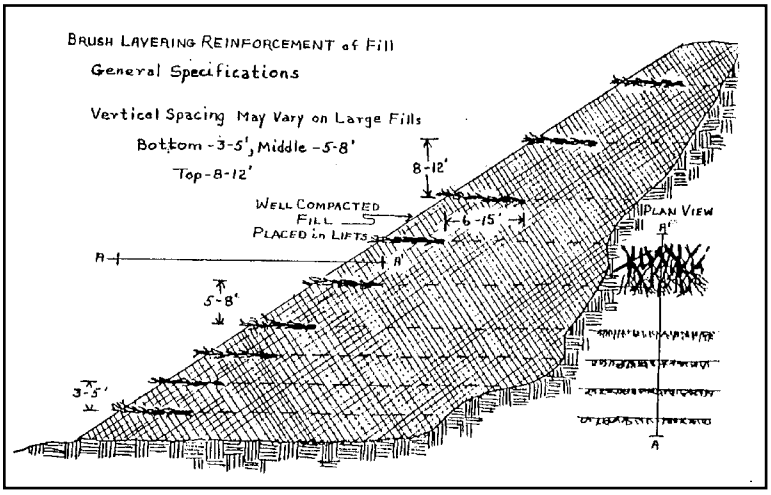


Brush Layering

Materials: Live brush of willow species shall be used. When there is a shortage of willow, up to 50 percent of the brush may be of non-rooting species. When non-rooting species are used they shall be mixed randomly with the rooting species.

Time of Work: Work shall be done during the planting season specified for woody plant species, i.e., fall and early spring.

Size of Brush: Length of brush shall vary according to the particular installation and shall be as shown on the Drawings. Hand trenched brush layering used for small gully repair shall be from 2 to 3 feet long.



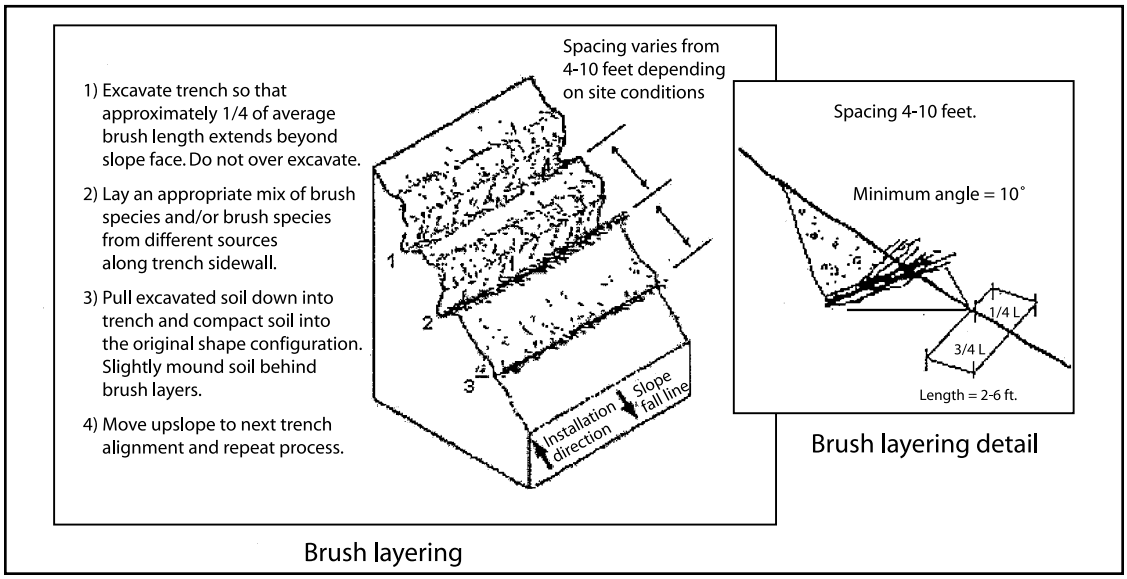
Vertical Spacing: Vertical spacing shall be as shown on the drawings.

Trenching: Hand trenching shall start at the bottom of the slope as in wattling placement. Trenches shall be dug 24 to 36 inches in to the slope, on contour, sloping downward from the face of the bank 10 to 20 degrees below horizontal.

Placement: Brush shall be placed with butts inward and no less than 6 inches or more than 18 inches of the tips extending beyond the fill face. Brush shall be 4 inches thick in hand trenched placement work and 6 inches thick in fill work. Thickness shall be measured after compression by the fill or covering soil.

Covering: Brush layers shall be covered with soil immediately following placement and the soil compacted firmly. Covering may be done by hand or with machinery.

Interplanting: Where required by the Drawings, interplanting of woody plants (transplants and /or unrooted willow cuttings) and grasses shall follow placement of the brush layering.



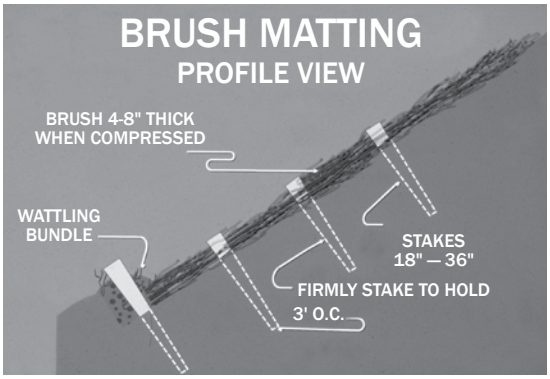
Brush matting channel protection

Materials: Live brush of willow, baccharis, dogwood or other species which will root shall be used. When species that will root are in short supply substitution of other species for up to 50 percent of the material may be approved. Wattling for the anchor trench will be constructed and handled as noted in Contour Wattling Specifications. Stakes shall be as described in the same specifications. Tie wire shall be single strand, galvanized, annealed 12 gauge wire such as fence wire, or various types of fencing as indicated in the drawings.

Time of Work: Timing of work will be as specified for contour wattling, i.e. the period of vegetative dormancy. When non-rooting or dead, rooting species are specified, work may be done at any time of the year.

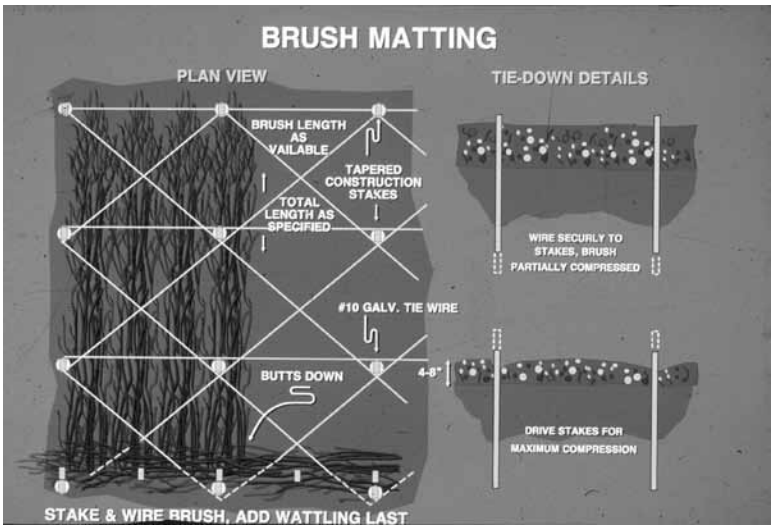
Slope Preparation: The slope shall be free of debris and more or less a flat slope from top to bottom but may be undulating in a horizontal plane within the area to be treated.

Anchor Trenching: A trench, eight (8) to twelve (12) inches deep shall be constructed just below the low water line and flush with (exterior to) the plane of the slope face.



Brush Placement: Brush shall be placed butt down in the trench, against the bank, and perpendicular to the base line. The layer of brush shall be placed to a thickness of two (2) to four (4) inches when compressed. See the drawings for the required thickness.

Anchoring: A single row of wattling, log or rock of suitable size will be placed on top of the butts and in the trench at/below low water line. Wattling or logs will be properly anchored. See Wattling Specifications for preparation, tying and anchoring wattling bundles.



Staking and Tying: Construction stakes as detailed in Wattling Specifications or other approved staking shall be to a firm hold on three (3) to four (4) foot centers, extending beyond the matting on either side and one (1) foot above the anchoring row to one (1) foot below the specified height of the mat. Stakes shall be of sufficient length to drive to a firm hold and shall be driven to within four (4) inches of the top of the matting when compressed.

The brush matting shall be tied down with twelve (12) gauge galvanized, annealed line wire in horizontal runs and then diagonally between each horizontal row of stakes. Ties to the stakes shall be of such manner that if wire breaks between two stakes the integrity of the rest of the system will remain intact.

Appendix E

Tree Removal and Tree Protection on Residential and Commercial Properties at Lake Tahoe

By Jesse Jones, TRPA

Introduction

Trees provide many environmental values to the Lake Tahoe ecosystem. They are not only beautiful, but they provide strong root systems that hold soil in place, preventing erosion. They are important sources of wildlife and bird habitat. Even dead trees contain many insects that are valuable food sources for woodpeckers and other birds. Because of these resource values and the necessity of restoring the Tahoe Basin ecosystem, the cutting of trees is regulated.

Resource managers want to prevent needless removal of trees that are serving a valuable erosion control or other purpose. On the other hand, when trees are over-crowded, a severe fire hazard, or simply in the way of an approved project, there are ways to get permission for removal. The following guidelines explain the specific details of the permitting process.

Tree removal at Lake Tahoe is regulated by the TRPA, which defines tree removal to include cutting, killing or damaging trees. Trees should not be removed or damaged without approval from TRPA or its partner agencies. Contractors should review plans and permits before undertaking work that requires a permit. Plans and permits are to be on site during work. Please see the Table below on *"Permits Required for Tree Removal From Private Property."*

Two Kinds of Tree Removal Approvals

Tree removals are approved via two general paths. One is through applying for a Tree Removal Permit, usually issued by TRPA's forester. (See sample application, page E4.) TRPA issued permits are for removal of unhealthy (diseased or infested), crowded or hazardous trees. These permits can be issued for trees on developed or undeveloped properties. When properties are in the process of being developed, tree removal permitting must be integrated with other activities and permits on the site. Local fire protection districts/departments also issue tree removal permits for defensible space or the removal of fire hazards.

The second kind of tree removal approval is that associated with permitted development. When obtaining a permit to develop a property (build a building, grade and pave a parking lot, etc.), plans should show all trees in the project area, and those trees which are to be removed should be designated with X's. These site plans must be approved by the local fire department before the reviewing agency will approve the plans. When the agency reviewing the application approves the plans, this constitutes preliminary approval of the proposed tree removals, after the required pre-grading inspection.

Generally, the trees permitted for removal for development are those within the "footprint" of construction or within 6 feet of new foundations. However, other trees may be affected by construction and permitted for removal, such as trees affected by slope cuts or by utility excavations. It is best to identify all of these tree issues as early as possible. Pre-grade inspection and subsequent inspections provide opportunities

to discuss tree removals with the official responsible for monitoring compliance with permit conditions and applicable regulations.

A project site may have trees outside the construction footprint which are crowded, unhealthy or unsafe. Project proponents must apply for a Tree Removal Permit for these trees. Because different agencies, or different staff within the agencies, are involved in these two types of permitting, the applicant should provide information to involved permitting agencies about ***all*** of the projects and activities being implemented together on the site. Site plans should show the location, species and current diameter (DBH) of each tree. The best time to obtain a Tree Removal Permit to address forest health and safety issues on a site is at the beginning of the site development planning process.

Temporary BMPs and Tree Protection

When implementing a project, it is important to avoid damage to trees which have not been approved for removal. Vegetation protection fencing and other vegetation protection measures (temporary BMP's) must be installed and maintained as shown on plans or as approved by the inspector, following TRPA's approved methods. Fencing beneath the dripline protects not only the trunk of the tree but also roots which feed the tree. Many roots are located within a foot of the soil surface and are vulnerable to the effects of soil compaction and change of grade. Vegetation protection fencing is to be located at or beyond the dripline unless this zone overlaps the footprint of permitted development. Where this occurs, additional root zone outside the development footprint should be protected to reduce

Permits Required for Tree Removal from Private Property

Proposed Activity or Project	TRPA Requirements
Removal of live trees 14" or smaller, dbh[1]	No permit required unless tree is in a Stream Environment Zone (SEZ) or shorezone, on a lakefront property, or it has been identified as a tree to be planted or retained as part of an approved project.
Removal of dead[2] trees[3]	No permit required.
Removal of live trees larger than 14", dbh[1]	Obtain a tree removal permit from TRPA or its partner agencies.
Removal of more than 100 live trees 10" dbh or larger	Contact TRPA regarding additional permitting requirements.
Cutting, trimming or removal of live lakeshore or SEZ vegetation[4] of any size	Requires written approval from TRPA.
Tree removal for development of buildings, parking areas, etc.	Tree removal for development is reviewed through the permit application process.

[1] dbh: Diameter at breast height, measured 4 1/2 feet above the ground on the uphill side of the tree.

[2] A dead tree is defined as a conifer totally lacking green limbs and needles throughout the crown, or a deciduous tree determined to be dead by a qualified forester.

[3] Removal of dead trees greater than 30" dbh outside urban areas or in SEZ's requires TRPA approval. In eastside forests (in Nevada and east of Carnelian Bay) the upper limit is 24" dbh.

[4] SEZ vegetation: willows, cottonwoods, aspen, alder and other vegetation associated with areas of wet soil conditions in early summer. Also lakeshore vegetaton and land capability "1b."

stress to the tree. Replacing the fencing after damaging the root zone does not mitigate the damage caused by failing to maintain protection. *Damaging or killing trees not approved for removal by failing to implement required tree protection is unauthorized tree removal.*

Chapter 4 of TRPA's Code of Ordinances exempts the removal of dead trees from tree removal permitting requirements. However, if trees are shown on approved project plans as being alive and to be retained, their removal from the project site may raise questions about whether they were dead or alive when removed and about the cause of death (failure to implement required protection measures?). Contact the responsible inspector and/or submit a TRPA tree removal application prior to removing any tree, dead or alive, which was shown on approved site plans as a live tree to be retained. When a safety emergency exists, contact agencies responsible for review or TRPA as soon as possible. If you must remove a tree in an emergency, prepare documentation of the nature of the emergency and submit it as soon as possible to the inspector in charge of the project or to TRPA. TRPA has the ability to update the approved site plans.

Permanent BMPs, BMP Retrofit, and Tree Removal

Installment of permanent BMP's may involve excavation which can damage or remove tree roots. BMP design should minimize potential for damage to trees. When installing permanent BMP's such as dripline trenches or infiltration wells, contractors should make reasonable efforts to avoid damaging or removing tree roots, especially tree roots larger than 4" in diameter. Often, minor adjustments can result in avoidance of impacts while maintaining BMP function. If you think installing a BMP will destabilize a tree, contact the project inspector or TRPA prior to inflicting such damage.

A Word about Defensible Space

Contact your local fire district/department regarding defensible space information and inspections. They can tell you what you need to do to create defensible space, and they can guide you to information on tree removal permitting.

How to obtain a permit

Tree Removal Permit applications can be obtained at the TRPA office, from the TRPA website, or by leaving your address or fax at (775) 588-4547. The cost for submitting the application is $53 and covers up to one hour of review. Larger projects require a fee of $53/hour. **The "Sample" Tree Removal Permit in this Appendix** is helpful in learning about the process beforehand. The TRPA website and the application contain additional information on tree removal. Submitting a completed application is usually the fastest way to get the forester to your site. Due to the large volume of tree removal permit applications in the Lake Tahoe Region, applications take an average of two weeks to process and are generally processed in the order received. If you have questions, you can contact TRPA's forester, Tahoe Regional Planning Agency, 128 Market Street, P.O. Box 5310, Stateline, NV 89449, (775) 588-4547.

(SAMPLE)

TAHOE REGIONAL PLANNING AGENCY

OFFICE
128 Market St.
Stateline, NV

Phone: (775) 588-4547
Fax: (775) 588-4527

MAIL
PO Box 5310
Stateline, NV 89449-5310

www.trpa.org

HOURS
Monday-Friday
9:00 am-5:00 pm
New Applications Until 4:00 pm

trpa@trpa.org

TREE REMOVAL APPLICATION

A $53.00 Filing Fee Must Be Submitted With This Application
(Cash, Check or Money Orders only please)

Owner _____

Mailing Address _____ City _____ State _____

Zip Code _____ Email _____ Phone _____ FAX _____

Authorized Agent _____

Mailing Address _____ City _____ State _____

Zip Code _____ Email _____ Phone _____ FAX _____

Project Location/Assessor's Parcel Number (APN) _____

Street Address _____ Subdivision _____ Lot # _____

County _____ Previous APN _____
(if changed by county assessor since 1987)

Cross-street _____

Any Development Projects at This Parcel?	☐ None ☐ Plans Not Submitted ☐ Plans Under Review ☐ Active Construction Permit	**If so, what Type?**	☐ New ☐ Rebuild ☐ Addition ☐ Grading ☐ Paving	**Reviewing Agency:**	☐ TRPA ☐ County ☐ City

Getting Started

☑ Prepare a description and reasons for tree removal. You may request that all trees be evaluated on a parcel **if** property boundaries are clearly described **and/or** property corners are staked or flagged. You may also describe specific tree(s) to be evaluated: for example, "cedar tree in front deck with red ribbon," or "fir tree with dead top near the right rear corner of house." Trees are approved for removal based on guidelines described in Chapter 71.4 of the TRPA Code of Ordinances.

☑ TRPA cannot permit tree removal on parcels other than your own. Trees near poorly-defined property boundaries may not be evaluated. Trees located on the property line require written consent from both property owners before the tree can be approved. Include a letter from the adjacent owner or a note of consent with this application granting permission to TRPA to evaluate the property line tree for removal.

☑ Attach a copy of site plans if there is an active construction project or plans under review on the parcel.

☑ Obtain necessary permits from other agencies. Review or permit may also be required from the California Department of Forestry (CDF) if in California or Nevada Division of Forestry (NDF) if in Nevada, or Lahontan Water Quality Control Board prior to removal of any trees. Contact the appropriate agency for additional information.

☑ Include fee with application: Payment of nonrefundable filing fee required at time of application. The filing fee applies to the first hour spent reviewing the project. An additional fee will apply for each additional half hour spent

reviewing the project. Check, cash and money orders only. Make checks payable to TRPA or Tahoe Regional Planning Agency.

☑ **Make sure you need this permit**. Tree removal within the footprint of permitted development (construction, new coverage, grading, paving, etc.) is reviewed and permitted through application for those projects and do not need additional applications for tree removal. This tree removal application is for forest health or hazardous reasons only. Below are the situations for tree removal that do require a permit.

- Small Trees: Removal of trees less than or equal to **14" diameter** at dbh* (approximately 4 ½ feet from the ground) **DOES NOT REQUIRE A PERMIT**. However, trees less than 14" dbh* that are required to be planted or retained as part of a permit, or that are located in a Stream Environment Zone or backshore area, cannot be removed without TRPA approval.

**DBH = DIAMETER AT BREAST HEIGHT, OR 4 ½ FEET ABOVE GROUND ON THE UPHILL SIDE OF THE TREE.*

- Dead Trees: A dead tree (snag) totally lacks green leaves/needles and shoots. Removal of dead trees from residential and commercial properties does not require a TRPA tree removal permit. However "Old Growth" dead trees provide wildlife habitat and therefore require approval if located in conservation or recreation zoned areas or SEZs including Shorezone in any land use zone. "Old Growth" is defined in TRPA's forest protection ordinances as being trees greater than 24" dbh* in Nevada and on the north shore east of Carnelian Bay and in the rest of California, greater than 30" dbh*. To have such trees inspected for removal, file the TRPA Exempt/Qualified Exempt application form.

- Substantial Trimming: Tree topping, removing live limbs from the upper 2/3 of the height of a tree, and other activities which materially damage trees, such as cutting roots greater than 4 inches diameter, requires TRPA approval.

- Heavy Equipment: A TRPA Tree Removal Permit does not authorize the use of heavy equipment during tree removal. Use of off-road vehicles and equipment in sensitive areas, including Stream Environment Zones (SEZs) and the Shorezone is prohibited. The use of tractors or heavy equipment is not allowed on slopes greater than 30%. Exceptions are to be reviewed and permitted by CDF, NDF and/or Lahontan Water Quality Control Board.

- Trimming and Pruning: TRPA approves, without review/permit, tree trimming necessary to provide for 10 feet of chimney outlet clearance and up to 10 feet of clearance for buildings and decks and to maintain 15 feet of clearance above driveways for fire truck access. Branches rubbing or pulling on utility lines within your property boundaries may be trimmed. Trimming must not exceed the necessary activity to accomplish these safety objectives using proper pruning techniques. Consult Sierra Pacific Power Company before removing or trimming trees located close to power lines.

- Sensitive Areas: The manipulation of live vegetation in Stream Environment Zones and on lakeshores, including cutting live trees, cutting shrubbery or herbaceous vegetation of any size, or planting and landscaping requires TRPA review. Please specify request for review of such activity. Dead vegetation may be removed from these areas, but heavy equipment use, which can damage wetland soils, requires TRPA approval.

- Stump excavation is not part of this permit. This activity may require a grading permit.

☑ For questions regarding tree health and care, consult the state forestry agency, a certified arborist, or TRPA forestry staff (application must be submitted for a site visit). The International Society of Arboriculture hosts an internet resource at http://www.treesaregood.com.

☑ Once review of your request is complete, TRPA staff will issue a Tree Removal Permit. Tree Removal Permits are valid for one year. The permit may be extended up to 2 additional years upon request to TRPA forestry staff. The permit will authorize the number and type of trees to be removed. The permit contains standard and/or special conditions of approval. Failure to comply with these conditions may result in penalties and revocation of the permit. All trees approved for removal will be marked with traceable paint. A TRPA Tree Removal Permit may be issued on site or mailed to the owner or agent. If trees are removed before a permit is issued, a remedial or monetary penalty may result. If no permit is issued, a letter of denial explaining the reasons will be issued.

(SAMPLE)

DESCRIPTION OF TREE REMOVAL REQUEST

Reason(s): ☐ Thinning ☐ Diseased ☐ Insect infestation ☐ Defensible Space ☐ Safety Hazard

☐ **Evaluate all trees on property, property corners are clearly marked.**

Describe property boundaries:_____

☐ **Evaluate specific tree(s)**: (Describe the location on property or sketch below)

Property Access Information (gates, dogs, etc):_____

Sketch (attach additional sheets if necessary)

TRPA staff may request additional information to review your request.

(SAMPLE)

DECLARATION:
I hereby authorize TRPA to access the property for the purpose of site visits. I hereby declare under penalty of perjury that this application and all information submitted as part of this application are true and accurate to the best of my knowledge. I am the owner of the subject property or I have been authorized in writing by the owner(s) of the subject property to represent this application and understand that should any information or representation be submitted in connection with this application be incorrect or untrue, TRPA may rescind any approval or take other appropriate action. I further understand that additional information may be required by TRPA to review this project.

Signature: (Original signature required. Faxed signatures or xerox copies will not be accepted.)

_____ At _____ Date: _____
Owner or Agent (if applicable) County

AUTHORIZATION FOR REPRESENTATION BY AGENT (Original signature required):

The following person(s) own the subject property (Assessor's Parcel Number(s)_____) or have sufficient interest therein to make application to TRPA:

Print Owner(s) Name(s):

_____

_____

I/We authorize _____ to act as my/our authorized agent in connection with this application to TRPA for the subject property and agree to be bound by said representative. I understand that additional information may be required by TRPA beyond that submitted by my representative to review this project. Any cancellation of this authorization shall not be effective until receipt of written notification of same by TRPA. I also understand that should any information or representation submitted in connection with this application be incorrect or untrue, TRPA may rescind any approval or take other appropriate action. I further accept that if this project is approved, I, as the permittee, will be held responsible for any and all permit conditions.

Owner(s) Signature(s)*:

_____ Date: _____

_____ Date: _____

*If the property is owned by an association or corporation, signature of board president or chairman is acceptable.

FOR OFFICE USE ONLY

Date Received: _____ By: _____

Fee: $_____ Pymt. Type: _____ Receipt No: _____

QE #: _____

Comments: _____

Notes:

Appendix F

Invasive Weeds in the Lake Tahoe Basin

Susan Donaldson, Water Quality Education Specialist
University of Nevada Cooperative Extension

Invasive weeds are plants that have been introduced into an environment outside of their native range, where they have few or no natural enemies to limit their spread. Invasive weeds affect us all — as contractors, homeowners, taxpayers, consumers, tourists, and land managers. Invasive weeds:

- Cost you money for control
- Decrease property values
- Ruin trails and parks
- Increase fire danger
- Destroy wildlife habitat
- Reduce opportunities for hunting, fishing, camping, and other recreational activities
- Damage water quality
- Ruin your view — and your enjoyment of your neighborhood
- Threaten naturally occurring plant species

How it happens

Weeds are spread in many ways. Any time people or their animals work or play in areas infested by invasive weeds, there is a chance they will move the infestation to a new area.

When a vehicle is driven through a weed-infested area, weed seeds may become lodged between the tire treads, in the coils of a winch, behind the license plate, or in cracks and crevices on the underside of the vehicle. Seeds may travel hundreds of miles before becoming dislodged in an area where weeds were not previously found. The source of many infestations has been traced to roads, trails, railroads and other transportation corridors.

Weeds are also spread during construction and maintenance activities, when contaminated fill, gravel, topsoil and other products are moved from an infested site to your neighborhood.

Do's and don'ts of weed control

- Take no action until you're sure the weed is correctly identified. Don't be afraid to ask for help.
- Avoid continually disturbing soil, or leaving expanses of bare soil. These actions encourage weed infestation. Clear only the area necessary for your project.
- Make sure any shipments of gravel, fill, or topsoil come from weed-free locations. If necessary, inspect the source.
- After earth-moving construction projects, monitor the site carefully to find and control weed infestations early.
- Make sure the plants you buy from nurseries for planting around your home are not on the attached list of unwanted invasive weeds such as Scotch broom
- Do not dump into local waters or flush down toilets aquatic plants from an aquarium.

Weeds of Concern in the Tahoe Basin

Group 1 Species: Watch For, Report, and Eradicate Immediately:

These species are:

a) Not currently present in the Lake Tahoe Basin and are documented in areas adjacent to the basin where potential for introduction is high OR

b) Present only as small, eradicable populations.

The letter following each species in Group 1 denotes the infestation type as detailed above. Educational programs target early detection and reporting of these species so that infestations can be controlled as early as possible.

1. Canada thistle (*Cirsium arvense*) – b
2. Diffuse knapweed (*Centaurea diffusa*) – b
3. Hoary cress (*Cardaria species*) – b
4. Musk thistle (*Carduus nutans*) – a
5. Rush skeletonweed (*Chondrilla juncea*) – b
6. Russian knapweed (*Centaurea repens*) – b
7. Scotch thistle (*Onopordum acanthium*) – a
8. Sulfur cinquefoil (*Potentilla recta*) – b
9. Teasel (*Dipsacus fullonum*) – b
10. Yellow starthistle (*Centaurea solstitialis*) – b
11. Tree of Heaven (*Ailanthus altissima*) – b
12. Tamarisk/saltcedar (*Tamarix* spp.) – a
13. Medusahead (*Taeniatherum caput-medusae*) – a
14. Stinkwort (*Dittrichia graveolens*) – a
15. Hydrilla (*Hydrilla veticillata*) – a

Group 2 Species: Manage Infestations With a Goal of Eradication

The management or control of populations of these species to prevent further spread in the Lake Tahoe Basin is strongly encouraged. Isolated populations will be targeted for eradication.

16. Bull thistle (*Cirsium vulgare*)
17. Curlyleaf pondweed (*Potamogeton crispus*)
18. Dalmatian toadflax (*Linaria dalmatica*)
19. Eurasian watermilfoil (*Myriophyllum spicatum*)
20. Klamathweed (*Hypericum perforatum*)
21. Oxeye daisy (*Chrysanthemum leucanthemum*)
22. Perennial pepperweed (*Lepidium latifolium*)
23. Scotch broom (*Cytisus scoparius*)
24. Spotted knapweed (*Centaurea biebersteinii*)
25. Yellow toadflax (*Linaria vulgaris*)

For additional details and photos of these invasive weeds, please see the University of Nevada Cooperative Extension publication, "Invasive Weeds of the Tahoe Basin", SP-09-06, or access the Lake Tahoe Basin Weed Coordinating Group's Web site at http://www.tahoeinvasiveweeds.org.

University of Nevada
Cooperative Extension

Fact Sheet FS-03-59

Measures to Prevent the Spread of Noxious and Invasive Weeds During Construction Activities

Steven Siegel, Environmental Scientist
Sierra Pacific Power Company

Susan Donaldson, Water Quality Education Specialist
University of Nevada Cooperative Extension

Invasive weeds are plants that have been introduced into an environment outside of their native range, where they have few or no natural enemies to limit their spread. Invasive weeds affect us all–as homeowners, taxpayers, consumers, tourists, and land managers. Some invasive weeds are designated as noxious in Nevada state law, requiring control by the property owner or manager.

The spread of invasive and noxious weeds is a significant issue in construction projects that involve land disturbance. Earth moving activities contribute to the spread of weeds, as does the use of contaminated construction fill, seed, or erosion-control products. Permits for construction projects may now require that measures be incorporated to identify and manage these weeds.

Experience has demonstrated that prevention is the least expensive and most effective way to halt the spread of noxious and invasive weeds. Preventing the establishment or spread of weeds relies upon:

- Educating workers about the importance of managing weeds on an ongoing basis;
- Properly identifying weed species;
- Avoiding or treating existing weed populations; and
- Incorporating measures into projects that prevent weed seeds or other plant parts from establishing new or bigger populations such as certification of weed-free products.

A search was conducted of Internet sites and published permit requirements that incorporate weed prevention measures to determine appropriate practices to prevent weed spread during projects involving land disturbance. These measures may not be applicable or appropriate for all projects, but the list below should contain at least a few useful measures for any project. The weed management process should include education, weed identification, avoidance or treatment and reclamation of bare or disturbed areas. Following the list of management practices, we have provided sample suggested language for inclusion in contracts for projects that may be impacted by weed invasion.

Construction and Property Maintenance

1. Incorporate a strategy of integrated weed management into construction layout, design, and project alternatives evaluation.
2. Remove or treat seed sources and other viable reproducing plant parts that could be spread by construction disturbance or by passing vehicles or foot traffic.
3. Avoid moving weed-infested gravel, rock and other fill materials to relatively weed-free locations. Gravel and fill should come from weed-free sources. Inspect gravel pits and fill sources to identify weed-free sources.
4. Identify existing noxious weeds along access roads and control them before construction equipment moves into relatively weed-free areas.
5. Clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts before moving into relatively weed-free areas.
6. Minimize the removal of roadside vegetation during construction, maintenance and other ground-disturbing activities.
7. Use only certified weed-free straw and mulch for erosion control projects. Consider the use of weed-free fiber roll barriers or sediment logs.
8. Minimize contact with roadside sources of weed seed that could be transported to other areas.
9. Keep active road construction sites that are in relatively weed-free areas closed to vehicles that are not involved with construction.
10. Road maintenance programs should include monitoring and treatment for noxious weeds.
11. Provide training to management and workers on the identification of noxious weeds, the importance of noxious weed control and measures to minimize their spread.
12. Quickly treat individual plants or small infestations before they become established, produce seed or are able to spread.

Seeding and Planting

1. Obtain soil components and mulches from weed-free sources.
2. Purchase and use only certified weed-free seed.
3. Reestablish vegetation on all bare ground (including areas denuded by fire) to minimize weed spread.
4. Ensure establishment and maintenance of vigorous, desirable vegetation to discourage weeds.
5. Minimize contact with sources of weed seed in areas not yet revegetated.
6. Monitor all seeded sites for weed infestation. Treat all weeds adjacent to newly seeded areas prior to planting and treat planted areas for weeds in the first growing season.
7. Mulch to minimize the amount of noxious weed seeds that will reach the soil surface and subsequently germinate.

Grazing and Livestock Management

1. Refrain from grazing or moving cattle through populations of noxious weeds while they are setting seed or when fruit is ripened.
2. Purchase only weed-free hay and other feed.
3. Keep cattle and other livestock out of newly planted areas.
4. Employ rotational grazing and other management strategies that minimize soil disturbance.
5. Purge animals with weed-free feed for five days before moving them from infested to non-infested areas.

General

1. Identify and map noxious weed populations on lands that you own or manage. Provide mapping information using the protocol for your state's weed mapping efforts. Contact the Natural Resources Conservation Service, 775-784-5863 ext. 118, for Nevada's protocol.
2. Suppress fires that may impact native plant populations. Clean vehicles that may contribute to the spread of weeds during fire fighting activities.
3. Minimize soil disturbances caused by water, vehicle, and animal traffic in weed infested areas.
4. Minimize transport of weed seeds or reproductive weed parts by irrigation water.

Suggested Construction Contract Wording for Weed Prevention

Note: This section is provided as an example of language that can be included in construction contracts when appropriate to help prevent the spread of weeds. Nevada Revised Statutes Chapter 555 advises that the control of noxious weeds is the responsibility of every landowner or occupant. This suggested contract wording can be modified as needed to fit individual projects.

Prior to any construction disturbance you will:

- Identify and map all noxious and invasive weed populations present in the project area
- Treat or contain any weed populations that may be impacted or disturbed by construction activity
- Flag all weed populations to be avoided
- Provide training to construction workers and equipment operators on the identification of weeds to be avoided
- Certify that all construction material sources used for supplies of sand, gravel, rock and mulch are weed-free prior to obtaining or transporting any material from them
- Obtain and use only certified weed-free straw or use fiber roll logs for sediment containment
- Wash and inspect all vehicles for weed seeds and plant parts prior to bringing them onto the job site
- Install stormwater Best Management Practices to prevent erosion of the job site and the potential transport of weedy material onto or off of the job site

During construction you will:

- Minimize ground disturbance and vegetation removal as much as possible and practical
- Wash, or using an air compressor, blow clean all vehicles (including tires and undercarriage) that may have entered weed-infested areas prior to entering uninfested areas of the job site
- Restrict vehicles or other traffic that may transport weed seeds or plant material from entering the job site unless they are first washed and inspected

After construction is complete you or the property owner will:

- Revegetate or otherwise prevent the establishment of weeds in all areas of the job site through a program of monitoring and post-construction weed treatment for the life of the project
- Revegetate using soil components and mulches obtained from non-weed infested sources
- Utilize seed and other plant materials that has been checked and certified as noxious weed-free and that has a weed content of 0.05 percent or less
- Revegetate using plant materials that have a high likelihood of survival
- Maintain all planted material and native vegetation located on the project site for the life of the project

---

References:

California Bureau of Land Management. 2003. Weed Management and Prevention Guidelines for Public Lands. http://www.ca.blm.gov/pa/weeds/weedprevent.html

Center for Invasive Plant Management. 2003. Guidelines for Coordinated Weed Management of Noxious Weeds: Development of Weed Management Areas, Section IV: Prevention and Early Detection and Appendix 1: Sample Contracts, Agreements and Memorandums of Understanding. http://www.weedcenter.org/management/guidelines/tableofcontents.html

Colorado Bureau of Land Management. 1991. Prototype Weed Prevention Measures. http://www.co.blm.gov/botany/lolostip.htm

Lewis County Noxious Weed Control Board. 2003. Weed Prevention. Washington State University Cooperative Extension. Lewis County, Washington.

Sheley, Roger and Kim Goodwin. 2000. Plan Now For Noxious Weed Invasion. Montana State University.

Sheley, R., M. Manoukian and G. Marks. 2000. Preventing Noxious Weed Invasion. Pages 69-72 in: Biology and Management of Noxious Rangeland Weeds, ed. R.L. Sheley and J.K. Petroff. Oregon State University Press, Corvalis, Oregon.

Trainor, Meghan and A.J. Bussan. 2000. Integrated Weed Management; Preventing Weed Invasion. Montana State University Extension.

For more information, contact:

University of Nevada Cooperative Extension
4955 Energy Way, Reno NV 89502
(775) 784-4848

Nevada Department of Agriculture
405 South 21st Street, Sparks, NV 89431
(775) 353-3673

Appendix G: Supplemental BMPs for an Integrated Landscape

BMPs include installing permanent conservation practices such as infiltration devices and paved driveways, but did you know that BMPs also include practicing low impact, environmentally sensitive management on your property? I'd like to ask you a few questions and see if we can provide additional assistance regarding other types of BMPs that will help save Lake Tahoe's clarity.

☐ ***Landscape Maintenance: Do you consider your landscape high maintenance (greater than 15 hours/month), medium maintenance (6-15 hours/month), low maintenance (2-6 hours/month) or ultra-low maintenance (0-2 hours/month)? Do you have native vegetation or natural areas in your landscape?***
Did you know that landscapes with lower maintenance requirements are actually better for the health of the Lake? Low maintenance landscapes tend to have more native vegetation and natural areas that need less water and fertilization than higher maintenance landscapes. Less water and fertilizer means less runoff and nutrients that wash into Lake Tahoe. Native plants are suited to the mountain environment and do not require fertilizer or watering once the plants are established. There is a list of native and adapted plants (including descriptions and pictures) in the *Home Landscaping Guide* in Chapter 7. (See also pages 12-13 in the *Home Landscaping Guide*.)

☐ ***Fertilizer: Do you fertilize your lawn or garden? What type of fertilizer do you use?***
Proper fertilization is very important to the health of the lake because the nutrients that feed your plants can wash off the soil's surface or leach through the groundwater and feed algae growth in the Lake. Proper fertilization practices include 1) using the correct amount, 2) applying only in the spring and late summer, and 3) avoiding application near streams or shore-zone areas. We also suggest using slow release fertilizers and checking the weather to be certain that a rain event is not expected in the forecast. (See pages 116 - 118 in *Home Landscaping Guide*.)

☐ ***Water Conservation: Did you know that irrigation accounts for up to 50 percent of a municipality's water demand? What kind of irrigation system do you use?***
A well-planned irrigation system is important to prevent inefficient watering, runoff and erosion. Many Tahoe soils can only infiltrate about a quarter inch of water an hour before it starts to run off the surface. Water demands increase in the summer months due to irrigation use. Most landscapes in Tahoe require only a total of an inch and a half to two inches of water a week during the hot dry days of summer. Plant water requirements are lower in early spring and fall, as plants can still access water from snowmelt or are beginning to go dormant. During these times, you can reduce irrigation schedules by almost half. Watering your landscape during a rain event wastes water and contributes additional runoff to Lake Tahoe. Contact a member of the BMP Retrofit Partners to schedule an outdoor irrigation audit on your property. Incline Village residents can call (775) 831-8603.

☐ ***Storm Drains: Did you know that our storm drain system goes directly into the Lake?***

We need to remind our neighbors of the importance of keeping pollutants out of our storm drains—things like motor oil, antifreeze, trash, dirt, paints, dog and cat manure, herbicides and pesticides. When it rains, the residues from herbicides and pesticides will wash into the streets, storm drains, streams, and into Lake Tahoe. Don't dump these harmful chemicals down your drain or in the storm drain! If you wash your car at home, consider washing it on areas covered in pine needles or sturdy turf, but not on bare soil areas. Contact your local refuse collection area for more information on how to safely and properly dispose of these chemicals. Look for "earth-friendly" products to use in and around your home instead. In Incline Village and Crystal Bay, call WASTE NOT at (775) 832-1284; in Kings Beach, Tahoe City and Truckee, call Tahoe Truckee Sierra Disposal at (530) 583-0148 and for South and West shores of Lake Tahoe call South Tahoe Refuse Company at (530) 541-5105.

☐ ***Recycling: Do you recycle? Did you know that recycling is only part of the "loop"?***

When you recycle you provide new materials at a cheaper cost to manufacturers to produce new products from post consumer materials like metal, paper and cardboard. But, the concept of recycling only works if there are consumers willing to buy those products made from recycled content material. "Close the Loop" by purchasing items made from at minimum 30 percent post consumer wastes. Reuse all things you can: clothes, cars, tires, glass jars, plastic ware, shopping bags etc… all the products that have been developed for disposability should be avoided or reused. In Incline Village and Crystal Bay, call WASTE NOT at (775) 832-1284; in Kings Beach, Tahoe City and Truckee, call Tahoe Truckee Sierra Disposal at (530) 583-0148 and for South and West shores of Lake Tahoe call South Tahoe Refuse Company at (530) 541-5105.

☐ ***Animals: Has a bear ever gotten into your or your neighbor's trash?***

We live on the edge of a vast, largely undisturbed forest. Many animals call this place home, and have long before we arrived to claim our Mountain dream home. It is important to be diligent when setting out trash. Double bag meats, cheese and other smelly items. At minimum, don't set your trash out until the morning. Optimally, all residents in the animal/human interface will acquire a bear resistant trash container. These can prevent the needless execution and/or displacement of our furry neighbors by eliminating the temptation of access to our trash.

☐ ***Defensible Space: Have you evaluated your residence for defensible space in the event of wildfire?***

Defensible space practices are recommended throughout the Tahoe Basin and the Sierra. Proper attention to the principles of Defensible space will reduce your fire hazard without increasing erosion potential on your property. It is recommended that property owners consider their defensible space needs as a part of their planning to implement required BMPs for water quality. There is a detailed discussion of defensible space practices in Chapter 6 of this manual and in the 2nd edition of "*Living with Fire, a Guide for the Homeowner - Lake Tahoe Basin*," available from local fire protection districts or at www.LivingWithFire.info/Tahoe. See also the fact sheet, "*Combine Defensible Space and Best Management Practices (BMPs)*," at www.unce.unr.edu/publications/files/nr/2008/fs0826.pdf

LAKE TAHOE STANDARD DRAWING

(FOR RESIDENTIAL USE ONLY)

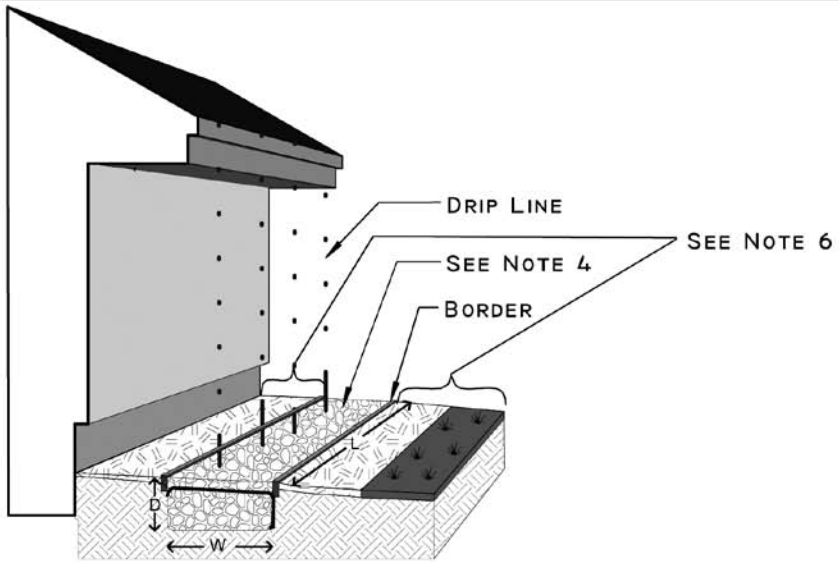
BEST MANAGEMENT PRACTICE

DRIP LINE INFILTRATION TRENCH

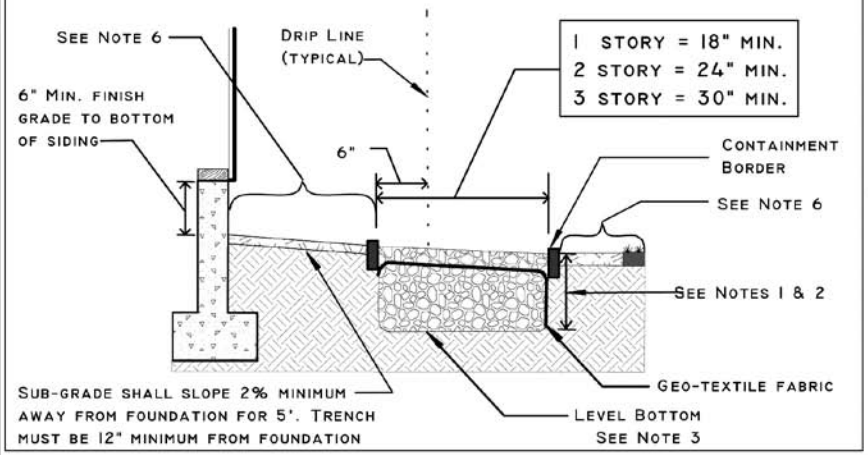
STANDARD DRAWING NO.

BMP-001.2

UPDATED: 4-4-11



INSTALLATION GUIDELINES



CONSTRUCTION NOTES

1. FOR SITE SPECIFIC TRENCH DIMENSIONS REQUIRED REFER TO THE BMP "SITE EVALUATION RECOMMENDED TREATMENTS" FORM OR BMP SIZING CALCULATIONS. REFER TO LAKE TAHOE STANDARD DRAWINGS FOR DETAILS. SEE BMP-002.0 FOR DETAILS OF TRENCHES LOCATED UNDER ROOF VALLEYS.
2. MAXIMUM TRENCH DEPTH RECOMMENDED IS 10". ADD OPTIONAL GEO-TEXTILE FABRIC LAYER 3" BELOW THE TRENCH SURFACE TO REDUCE MAINTENANCE. SEE BMP-060.2 FOR FILTER FABRIC DETAILS.
3. BOTTOM OF TRENCH MUST BE LEVEL. AN ALTERNATIVE PRACTICE IS TO CONSTRUCT A SWALE OR SUBSURFACE DRAIN TO COLLECT AND CONVEY THE RUNOFF TO AN INFILTRATION SYSTEM LOCATED A MINIMUM OF 10' AWAY FROM THE FOUNDATION. SEE BMP-004.0 AND BMP-005.1.
4. BACKFILL TRENCH WITH WASHED 3/4" TO 1 1/2" DRAIN ROCK. PRE-FABRICATED INFILTRATION SYSTEMS ARE AN ACCEPTABLE ALTERNATIVE. REFER TO MANUFACTURER'S INSTRUCTIONS AND SPECIFICATIONS.
5. CONTAINMENT BORDERS ARE REQUIRED. OPTIONS FOR MATERIALS INCLUDE PRESSURE TREATED LUMBER, RECYCLED COMPOSITES, BRICK, STONE, COBBLE, OR OTHER LANDSCAPE EDGING MATERIAL. COMBUSTIBLE MATERIALS SHALL NOT CONNECT TO ADJACENT STRUCTURES.
6. CONSULT WITH YOUR LOCAL FIRE PROTECTION DISTRICT WHEN LANDSCAPING NEAR STRUCTURES. VISIT WWW.LIVINGWITHFIRE.INFO FOR GUIDELINES ON THE DEFENSIBLE SPACE ZONE.
7. *REGULARLY SCHEDULED MAINTENANCE IS NECESSARY TO MAINTAIN FULL FUNCTION. MAINTENANCE INCLUDES INSPECTION, REMOVAL AND PROPER DISPOSAL OF DEBRIS, PINE NEEDLES AND ACCUMULATED SEDIMENT. REWORK TRENCH AND REPLACE GEO-TEXTILE FABRIC AS REQUIRED.*

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
IN COOPERATION WITH
TAHOE RESOURCE CONSERVATION DISTRICT, AND
NEVADA TAHOE CONSERVATION DISTRICT

DRAWN BY:	DATE	APPROVED BY:	DATE
DMGG/MPB	12-1-06		

THIS STANDARD DRAWING IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 570 - RUNOFF MANAGEMENT SYSTEM.
USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL TRAINED TO INTERPRET AND ADAPT TECHNOLOGY ACCORDING TO LOCAL CONDITIONS.
INFILTRATION SYSTEM SIZING IS CALCULATED BASED ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS ON SITE AND VOLUME OF RUNOFF BEING CAPTURED.

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LAKE TAHOE STANDARD DRAWING	(FOR RESIDENTIAL USE ONLY) BEST MANAGEMENT PRACTICE **ROOF VALLEY DRIP LINE TREATMENT**	STANDARD DRAWING NO. BMP-002.0 UPDATED: 6-17-10

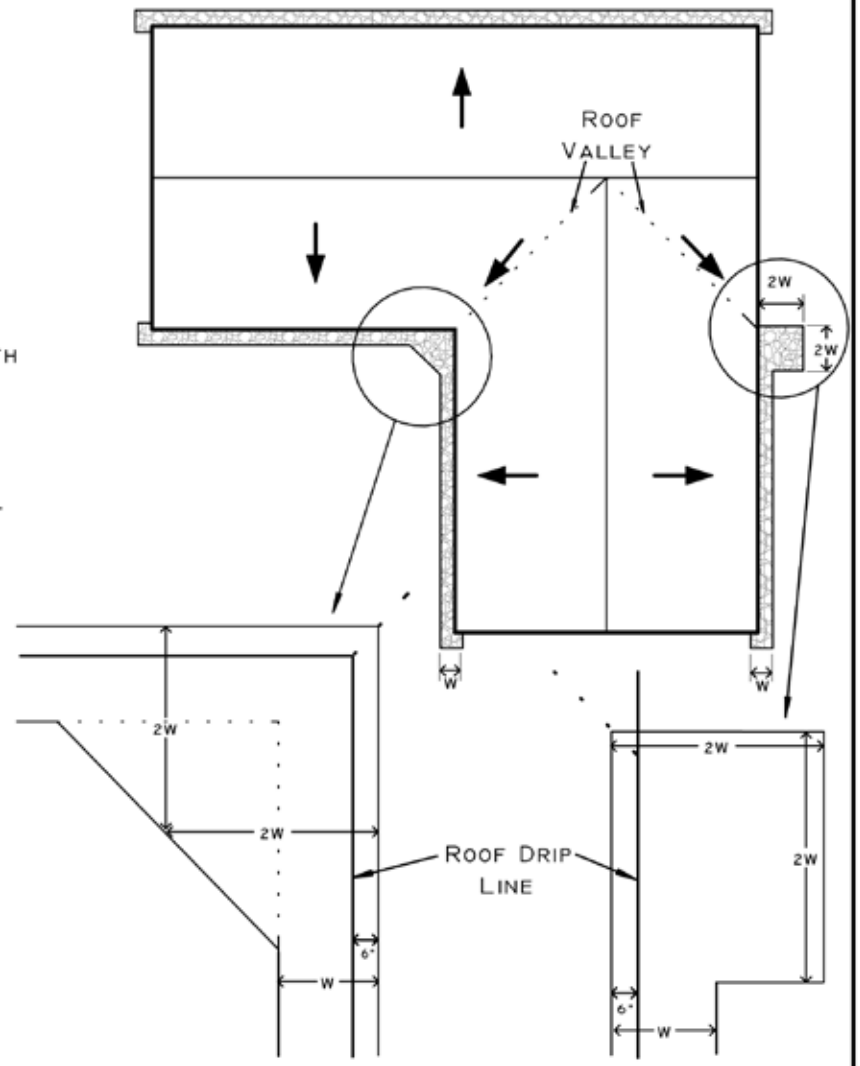
CONSTRUCTION NOTES

1. THIS DETAIL APPLIES TO ROOF DRIP LINES THAT REQUIRE ADDITIONAL ARMOR TO PROTECT THE SOIL WHERE ROOF VALLEYS CONCENTRATE FLOW AND PROJECT RUNOFF BEYOND THE STANDARD WIDTH TRENCH OR DRAIN ROCK ARMOR TREATMENT.

2. REFER TO APPLICABLE STANDARD DETAILS, BMP-001.2, DRIP LINE INFILTRATION TRENCH, OR BMP-009.3, ARMORED DRIP LINE, FOR MORE DETAIL.

3. "W" IS THE WIDTH OF THE DRIP LINE TREATMENT AS DEFINED IN THE INSTALLATION GUIDELINES. THE TYPICAL MINIMUM REQUIRED WIDTH DEPENDS ON THE NUMBER OF STORIES THE DRIP LINE IS ABOVE GROUND. INCREASE WIDTH OF ROCK TREATMENT AS NEEDED FOR LARGER ROOF AREAS.

4. WHEN ESTIMATING THE QUANTITY OF DRAIN ROCK REQUIRED, ACCOUNT FOR THE AREA BEYOND THE STANDARD WIDTH TREATMENT WITH A 3" MINIMUM LAYER OF 3/4" TO 1 1/2" DRAIN ROCK. OTHERWISE, USE APPROPRIATE DEPTH TO ESTIMATE QUANTITY OF LARGER ROCK MATERIAL SUCH AS RIPRAP.



LEGEND

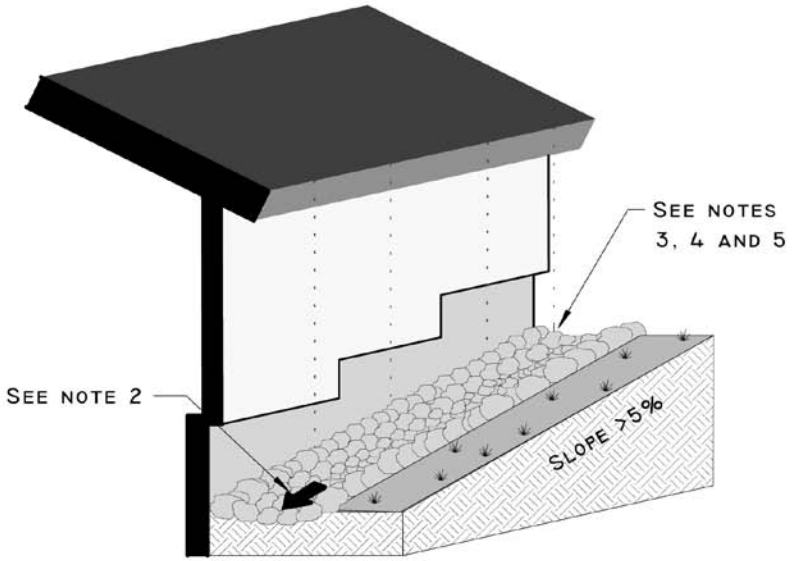
- IMPERVIOUS SURFACE/ STRUCTURE OUTLINE
- ROOF VALLEY
- IMPERVIOUS SURFACE FLOW
- DRAIN ROCK

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
IN COOPERATION WITH
TAHOE RESOURCE CONSERVATION DISTRICT, AND
NEVADA TAHOE CONSERVATION DISTRICT

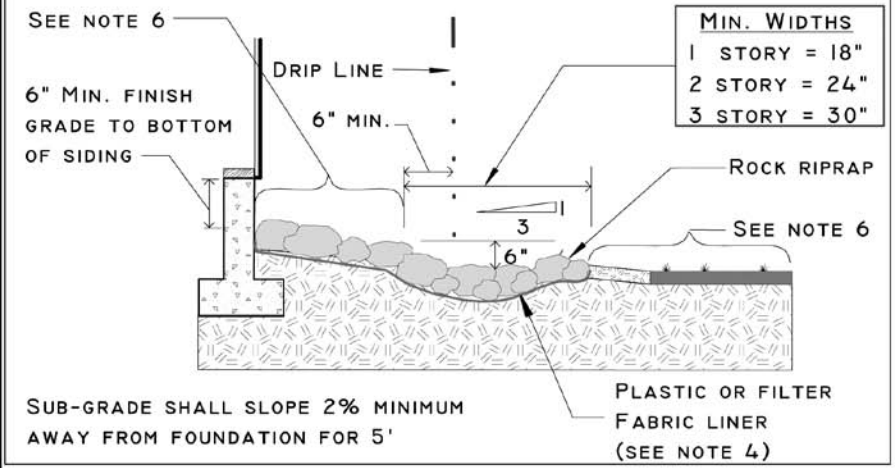
DRAWN BY:	DATE	APPROVED BY:	DATE
DGG/CT	4-27-10		

THIS STANDARD DRAWING IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 570 - RUNOFF MANAGEMENT SYSTEM.
USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL TRAINED TO INTERPRET AND ADAPT TECHNOLOGY ACCORDING TO LOCAL CONDITIONS.
INFILTRATION SYSTEM SIZING IS CALCULATED BASED ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS ON SITE AND VOLUME OF RUNOFF BEING CAPTURED.

LAKE TAHOE STANDARD DRAWING	(FOR RESIDENTIAL USE ONLY) BEST MANAGEMENT PRACTICE **DRIP LINE CONVEYANCE SWALE**	STANDARD DRAWING NO. BMP-004.0 UPDATED:



INSTALLATION GUIDELINES



CONSTRUCTION NOTES

1. DIMENSIONS AND SIZING REFLECT MINIMUMS FOR THE BMP RETROFIT ORDINANCE. REFER TO THE SITE EVALUATION RECOMMENDED TREATMENT FORM AND SITE PLAN FOR SITE SPECIFIC BMPS.
2. USE THIS TREATMENT ON SLOPES 5% AND STEEPER WHERE LEVEL BOTTOM INFILTRATION TRENCHES ARE IMPRACTICAL, AND TO CONVEY WATER AWAY FROM FOUNDATIONS. TREAT RUNOFF WATER IN AN INFILTRATION SYSTEM AT THE END OF THE SWALE.
3. EXCAVATE TO ACCOMMODATE KEYING IN THE LARGEST ROCKS PLUS A 6" DEEP CONCAVE SWALE WITH APPROXIMATELY 3:1 SIDE SLOPES.
4. LINE THE SWALE WITH 8 MIL PLASTIC BEFORE PLACING THE ROCK. FILTER FABRIC MAY REPLACE PLASTIC LINER WHERE INFILTRATED WATER WILL NOT AFFECT THE FOUNDATION.
5. ARMOR SOIL WITH 3" TO 10" ROCK RIPRAP. NATIVE ROCK CAN BE SUBSTITUTED IF AVAILABLE, BUT SHOULD BE ANGULAR TO SUBANGULAR. HAND PLACE ROCKS SECURELY BEDDING THEM FIRMLY IN CONTACT ONE TO ANOTHER WITHOUT BRIDGING. FILL SPACES BETWEEN LARGER ROCKS WITH SMALLER ROCKS.
6. CONSULT WITH YOUR LOCAL FIRE PROTECTION DISTRICT WHEN LANDSCAPING NEAR STRUCTURES. VISIT WWW.LIVINGWITHFIRE.INFO FOR GUIDELINES ON THE DEFENSIBLE SPACE ZONE.
7. *REGULARLY SCHEDULED MAINTENANCE IS NECESSARY TO MAINTAIN FULL FUNCTION. MAINTENANCE INCLUDES INSPECTION, REMOVAL AND PROPER DISPOSAL OF PINE NEEDLES AND ACCUMULATED SEDIMENT.*

US DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
FIELD OFFICE: SOUTH LAKE TAHOE, CA

DRAWN BY:	DATE	APPROVED BY:	DATE
DMGG	6-17-10		

THIS STANDARD DRAWING IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 570 - RUNOFF MANAGEMENT SYSTEM AND NRCS CONSTRUCTION SPECIFICATION 907 - ROCK RIPRAP
USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL, TRAINED TO INTERPRET AND ADAPT TECHNOLOGY ACCORDING TO LOCAL CONDITIONS.

LAKE TAHOE STANDARD DRAWING

(FOR RESIDENTIAL USE ONLY)

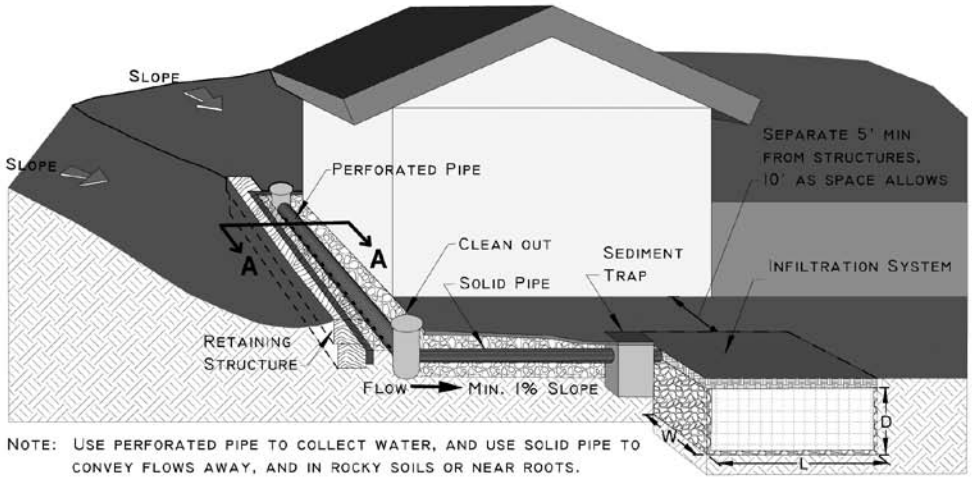
BEST MANAGEMENT PRACTICE

SUBSURFACE CONVEYANCE SYSTEM

STANDARD DRAWING NO.

BMP-005.1

UPDATED: 4-4-11

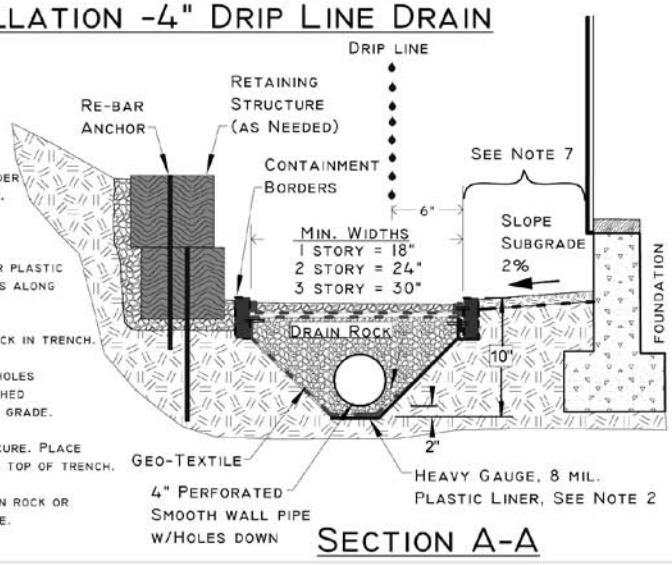


NOTE: USE PERFORATED PIPE TO COLLECT WATER, AND USE SOLID PIPE TO CONVEY FLOWS AWAY, AND IN ROCKY SOILS OR NEAR ROOTS.

TYPICAL INSTALLATION -4" DRIP LINE DRAIN

STEPS:

1. EXCAVATE AND GRADE 1%.
2. INSTALL BORDERS OR RETAINING STRUCTURE AS NEEDED.
3. MEASURE AND PLACE PLASTIC LINER IF REQUIRED. STAPLE PLASTIC TO BORDER AND LINE FOUNDATION SIDE OF TRENCH. ALTERNATIVELY, EXTEND PLASTIC TO FOUNDATION.
4. MEASURE GEOTEXTILE AND PLACE OVER PLASTIC LINER. OVERLAP 12" MIN. PLACE EXCESS ALONG TRENCH.
5. PLACE 2" LAYER OF WASHED DRAIN ROCK IN TRENCH.
6. PLACE PERFORATED DRAIN PIPE WITH HOLES FACING DOWN AND BACKFILL WITH WASHED DRAIN ROCK WITHIN 2" TO 3" OF FINAL GRADE.
7. WRAP GEOTEXTILE OVER ROCK AND SECURE. PLACE SEPARATE LAYER OF GEOTEXTILE OVER TOP OF TRENCH.
8. FILL REMAINDER OF TRENCH WITH DRAIN ROCK OR OTHER DESIRED STONE TO FINISH GRADE.



SECTION A-A

CONSTRUCTION NOTES

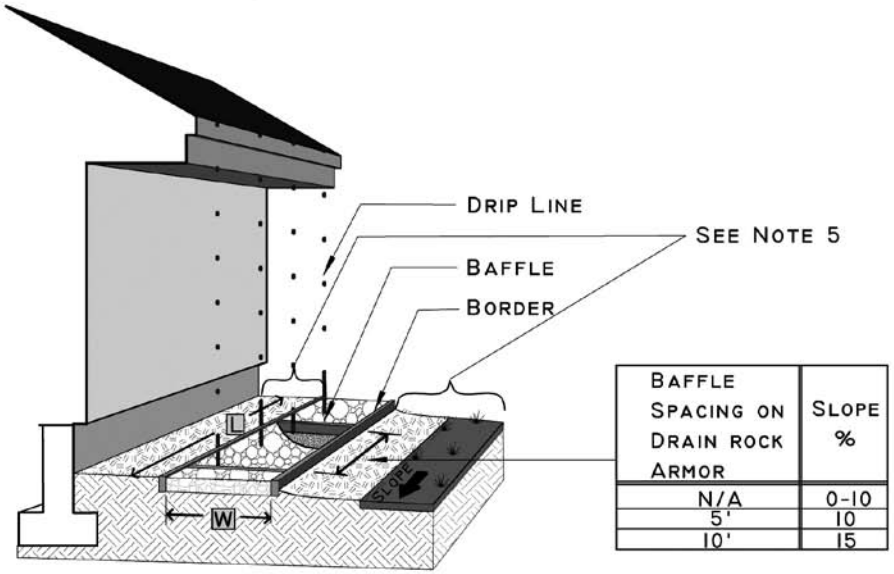
1. REFER TO SITE SPECIFIC BMP RECOMMENDATIONS FOR THE INFILTRATION SYSTEM DIMENSIONS BASED ON THE SOILS' HYDRAULIC CONDUCTIVITY AND THE VOLUME OF RUNOFF.
2. INSTALLATION OF GEOTEXTILE FABRIC IS RECOMMENDED ON TOP OF DRIP LINE TRENCH TO REDUCE MAINTENANCE. LINE TRENCH WITH 8 MIL PLASTIC TO INTERCEPT AND PREVENT WATER MOVEMENT TOWARD FOUNDATION.
3. USE SUBSURFACE CONVEYANCE SYSTEMS IN CONJUNCTION WITH AN INFILTRATION SYSTEM WHEN THE SLOPE COMING DOWN TO THE STRUCTURE IS > 5% AND THE SLOPE PARALLEL TO THE STRUCTURE IS <10%.
4. 3/4" TO 1 1/2" DRAIN ROCK IS RECOMMENDED FOR ALL INFILTRATION SYSTEMS. NATIVE ROCK CAN SUPPLEMENT DRAIN ROCK IF AVAILABLE.
5. CONTAINMENT BORDERS ARE REQUIRED UNDER DRIP LINES. OPTIONS FOR MATERIALS INCLUDE PRESSURE TREATED LUMBER, RECYCLED COMPOSITES, BRICK, STONE, COBBLE, OR OTHER LANDSCAPE EDGING MATERIAL. ALTERNATIVELY, STABILIZE WITH RETAINING STRUCTURES.
6. CLEAN-OUTS SHOULD BE INSTALLED AT THE UPPER AND LOWER END OF EACH PIPE SECTION, AND AT ALL BENDS AND ABRUPT CHANGES IN SLOPE. PRE-TREATMENT IS REQUIRED ON FLOW TO INFILTRATION SYSTEM WITH SEDIMENT TRAP.
7. CONSULT WITH YOUR LOCAL FIRE PROTECTION DISTRICT WHEN LANDSCAPING NEAR STRUCTURES. VISIT WWW.LIVINGWITHFIRE.INFO FOR GUIDELINES ON THE DEFENSIBLE SPACE ZONE.

US DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
FIELD OFFICE: SOUTH LAKE TAHOE, CA

DRAWN BY:	DATE	APPROVED BY:	DATE
DMGG	2-16-06		

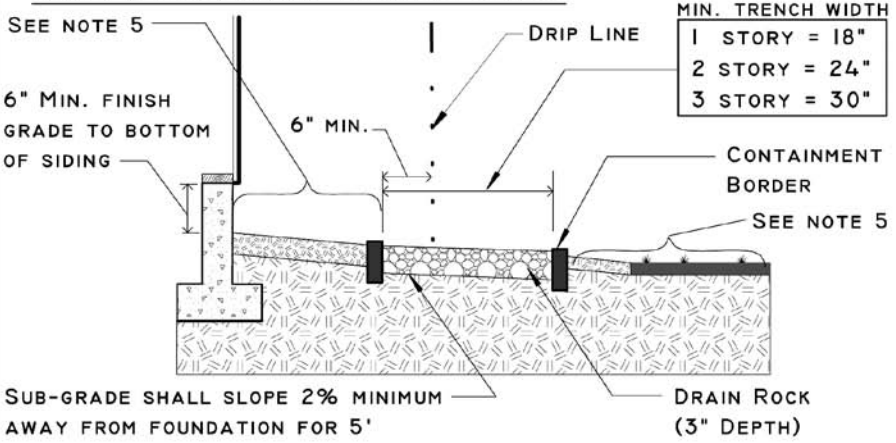
THIS STANDARD DRAWING IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 570 - RUNOFF MANAGEMENT SYSTEMS AND 606A - SUBSURFACE DRAIN. USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL TRAINED TO INTERPRET AND ADAPT TECHNOLOGY ACCORDING TO LOCAL CONDITIONS. THIS PRACTICE APPLIES TO COLLECTING SURFACE RUNOFF ONLY, AND IS NOT DESIGNED TO DRAIN LATERALLY MOVING SUBSURFACE WATER AWAY FROM STRUCTURES.

LAKE TAHOE STANDARD DRAWING	(FOR RESIDENTIAL USE ONLY) BEST MANAGEMENT PRACTICE **ARMORED DRIP LINE**	STANDARD DRAWING NO. BMP-009.3 UPDATED: 6-17-10



BAFFLE SPACING ON DRAIN ROCK ARMOR	SLOPE %
N/A	0-10
5'	10
10'	15

INSTALLATION GUIDELINES



CONSTRUCTION NOTES

1. DIMENSIONS AND SIZING REFLECT MINIMUM REQUIREMENTS FOR THE BMP RETROFIT ORDINANCE. SEE BMP-002.0 FOR DETAILS OF TRENCHES LOCATED UNDER ROOF VALLEYS.
2. ARMOR SOIL WITH A 3" MINIMUM CONTINUOUS LAYER OF ROCK. WASHED 3/4" TO 1 1/2" DRAIN ROCK IS RECOMMENDED. NATIVE ROCK CAN BE SUBSTITUTED IF AVAILABLE.
3. ON SLOPED DRIP LINES OVER 10%, CONTAIN THE DRAIN ROCK WITH BAFFLES AS SHOWN OR SUBSTITUTE LARGER RIPRAP FOR DRAIN ROCK. AN ALTERNATIVE PRACTICE IS TO CONSTRUCT A SWALE OR SUBSURFACE DRAIN TO COLLECT AND CONVEY RUNOFF TO AN INFILTRATION SYSTEM LOCATED A MINIMUM OF 10' AWAY FROM THE FOUNDATION. SEE BMP-004.0.
4. CONTAINMENT BORDERS ARE REQUIRED. OPTIONS FOR MATERIALS INCLUDE PRESSURE TREATED LUMBER, RECYCLED COMPOSITES, BRICK, STONE, COBBLE, OR OTHER LANDSCAPE EDGING MATERIAL. COMBUSTIBLE MATERIALS SHALL NOT CONNECT TO ADJACENT STRUCTURES.
5. CONSULT WITH YOUR LOCAL FIRE PROTECTION DISTRICT WHEN LANDSCAPING NEAR STRUCTURES. VISIT WWW.LIVINGWITHFIRE.INFO FOR GUIDELINES ON THE DEFENSIBLE SPACE ZONE.
6. *REGULARLY SCHEDULED MAINTENANCE IS NECESSARY TO MAINTAIN FULL FUNCTION. MAINTENANCE INCLUDES INSPECTION, REMOVAL AND PROPER DISPOSAL OF PINE NEEDLES AND ACCUMULATED SEDIMENT.*

US DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE IN COOPERATION WITH NEVADA TAHOE CONSERVATION DISTRICT TAHOE RESOURCE CONSERVATION DISTRICT			
DRAWN BY:	DATE	APPROVED BY:	DATE
DGG/MPB	12-01-06		

THIS STANDARD DRAWING IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 570 - RUNOFF MANAGEMENT SYSTEMS. USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL TRAINED TO INTERPRET AND ADAPT CONSERVATION PRACTICES ACCORDING TO LOCAL CONDITIONS. INFILTRATION SYSTEM SIZING IS CALCULATED BASED ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS ON SITE AND VOLUME OF RUNOFF BEING CAPTURED.

LAKE TAHOE STANDARD DRAWING

(FOR RESIDENTIAL USE ONLY)

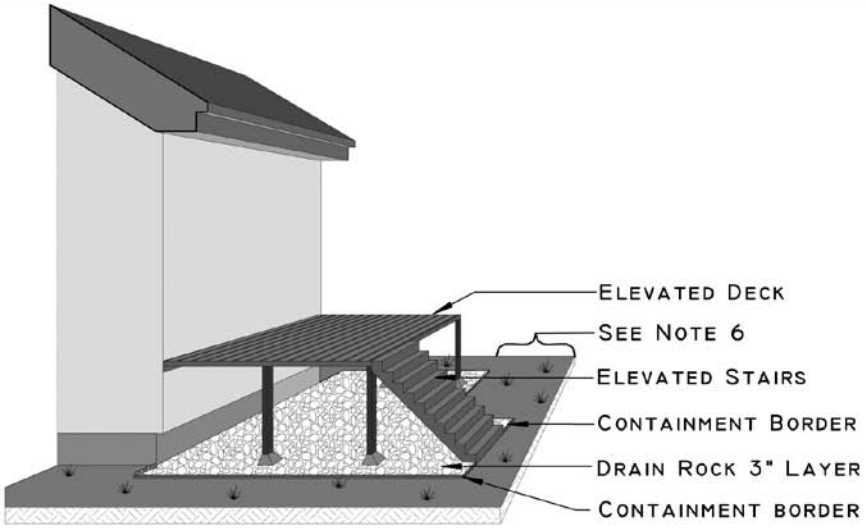
BEST MANAGEMENT PRACTICE
EROSION CONTROL FOR ELEVATED STRUCTURES

(DECKS, OPEN STAIRCASES, WALKWAYS, AND ELEVATED DRIVEWAYS)

STANDARD DRAWING NO.

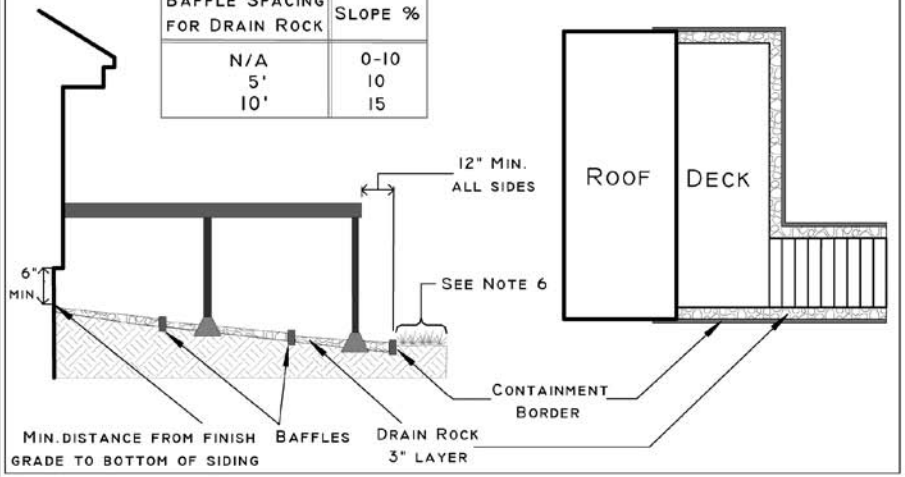
BMP-010.2

UPDATED: 6-17-10



INSTALLATION GUIDELINES

BAFFLE SPACING FOR DRAIN ROCK	SLOPE %
N/A	0-10
5'	10
10'	15



CONSTRUCTION NOTES

1. DRAIN ROCK SHOULD BE INSTALLED BELOW THE ENTIRE DECK FOOTPRINT WITH A 1' EXTENSION BEYOND THE PERIMETER. INACCESSIBILITY MAY LIMIT APPLICATION OF DRAIN ROCK UNDER ENTIRE FOOTPRINT.

2. 3/4" TO 1 1/2" DRAIN ROCK OR COBBLE IS RECOMMENDED FOR SLOPES BETWEEN 0 AND 15%. INSTALL BAFFLES AS SHOWN TO CONTAIN ROCK ON SLOPES BETWEEN 10% AND 15%. NATIVE ROCK CAN BE SUBSTITUTED IF AVAILABLE. USE 3" TO 10" DIAMETER ROCK RIPRAP ON STEEPER SLOPES.

3. CONTAINMENT BORDERS ARE REQUIRED. OPTIONS FOR MATERIALS INCLUDE PRESSURE TREATED LUMBER, REDWOOD, RECYCLED COMPOSITES, BRICK, STONE, COBBLE, OR OTHER LANDSCAPE EDGING MATERIAL. COMBUSTIBLE MATERIALS SHALL NOT CONNECT TO ADJACENT STRUCTURES.

4. SUB-GRADE SHALL SLOPE AWAY FROM THE FOUNDATION FOR AT LEAST 5' WITH A MINIMUM SLOPE OF 2%.

5. FINISH GRADE OF ROCK SHALL BE AT LEAST 6" BELOW WOOD SIDING TO MAINTAIN WOOD AND EARTH SEPARATION REQUIRED BY LOCAL BUILDING CODES.

6. CONSULT WITH YOUR LOCAL FIRE PROTECTION DISTRICT WHEN LANDSCAPING NEAR STRUCTURES. VISIT WWW.LIVINGWITHFIRE.INFO FOR GUIDELINES ON THE DEFENSIBLE SPACE ZONE.

7. REMOVE PINE NEEDLES AND ACCUMULATED SEDIMENT TO MAINTAIN FULL FUNCTION. KEEP AREA CLEAR OF STORED MATERIALS SUCH AS FIREWOOD, LUMBER, HOUSEHOLD ITEMS, ETC.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
IN COOPERATION WITH
TAHOE RESOURCE CONSERVATION DISTRICT, AND
NEVADA TAHOE CONSERVATION DISTRICT

DRAWN BY:	DATE	APPROVED BY:	DATE
DMGG	12-5-06		

THIS STANDARD DRAWING IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 570 - RUNOFF MANAGEMENT SYSTEM.
USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL TRAINED TO INTERPRET AND ADAPT CONSERVATION PRACTICES ACCORDING TO LOCAL CONDITIONS. INFILTRATION SYSTEM SIZING IS CALCULATED BASED ON THE HYDRAULIC CONDUCTIVITY OF THE SOILS ON SITE AND VOLUME OF RUNOFF BEING CAPTURED.
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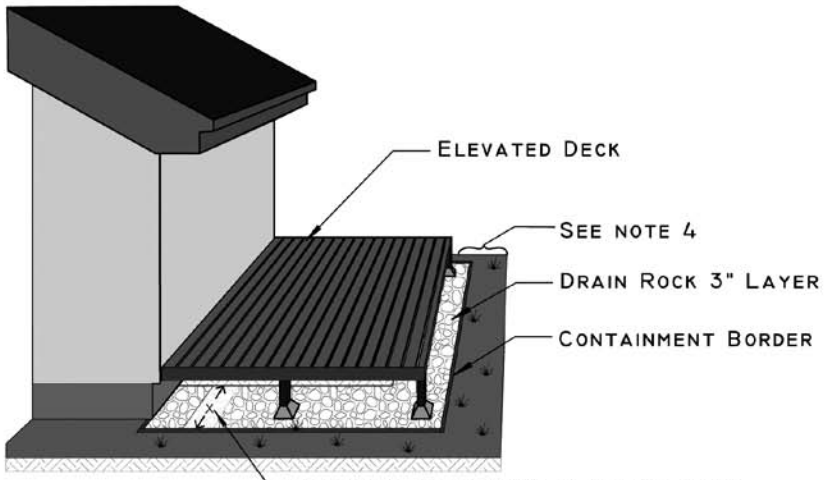
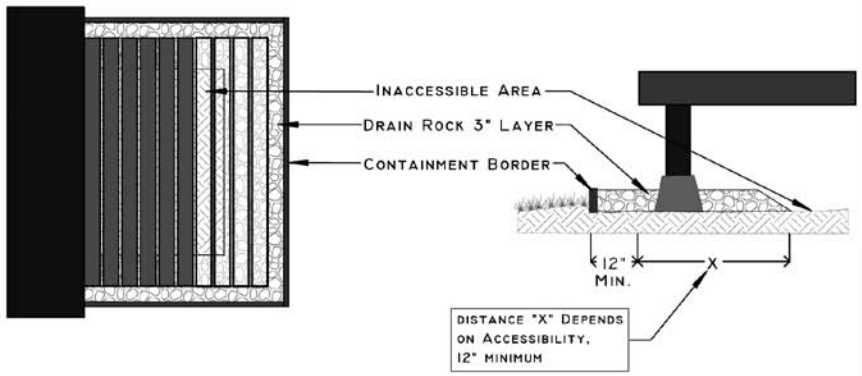
LAKE TAHOE STANDARD DRAWING	(FOR RESIDENTIAL USE ONLY) BEST MANAGEMENT PRACTICE EROSION CONTROL FOR LOW ELEVATED STRUCTURES	STANDARD DRAWING NO. BMP-011.2 UPDATED: 6-18-10



INSTALLATION GUIDELINES



CONSTRUCTION NOTES

1. DRAIN ROCK SHOULD BE INSTALLED AS FAR BACK UNDER THE LOW ELEVATED STRUCTURE AS POSSIBLE. DISTANCE DEPENDS ON ACCESSIBILITY UNDER THE STRUCTURE. THE DRAIN ROCK SHOULD EXTEND 12" PAST THE EDGE OF THE STRUCTURE.

2. WASHED 3/4" TO 1 1/2" DRAIN ROCK OR COBBLE IS RECOMMENDED FOR THIS TREATMENT. NATIVE ROCK CAN BE SUBSTITUTED IF AVAILABLE. UTILIZE RIP RAP ON STEEPER SLOPES.

3. CONTAINMENT BORDERS ARE REQUIRED. OPTIONS FOR MATERIALS INCLUDE PRESSURE TREATED LUMBER, REDWOOD, RECYCLED COMPOSITES, BRICK, STONE, COBBLE, OR OTHER LANDSCAPE EDGING MATERIAL. COMBUSTIBLE MATERIALS SHALL NOT CONNECT TO ADJACENT STRUCTURES.

4. CONSULT WITH YOUR LOCAL FIRE PROTECTION DISTRICT WHEN LANDSCAPING NEAR STRUCTURES. VISIT WWW.LIVINGWITHFIRE.INFO FOR GUIDELINES ON THE DEFENSIBLE SPACE ZONE.

5. FINISH GRADE OF DRAIN ROCK SHALL BE AT LEAST 6" BELOW WOOD SIDING TO MAINTAIN WOOD AND EARTH SEPARATION REQUIRED BY LOCAL BUILDING CODES.

6. *REMOVE PINE NEEDLES AND ACCUMULATED SEDIMENT TO MAINTAIN FULL FUNCTION. KEEP AREA CLEAR OF STORED MATERIALS SUCH AS FIREWOOD, LUMBER, HOUSEHOLD ITEMS, ETC.*

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
IN COOPERATION WITH
TAHOE RESOURCE CONSERVATION DISTRICT, AND
NEVADA TAHOE CONSERVATION DISTRICT

DRAWN BY:	DATE	APPROVED BY:	DATE
DMGG	12-5-06		

THIS SPECIFICATION IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 570 - RUNOFF MANAGEMENT SYSTEMS. USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL, TRAINED TO INTERPRET AND ADAPT TECHNOLOGY ACCORDING TO LOCAL CONDITIONS. DIMENSIONS AND SIZING ON THIS DOCUMENT RELAY MINIMUM REQUIREMENTS FOR THE BMP RETROFIT ORDINANCE.

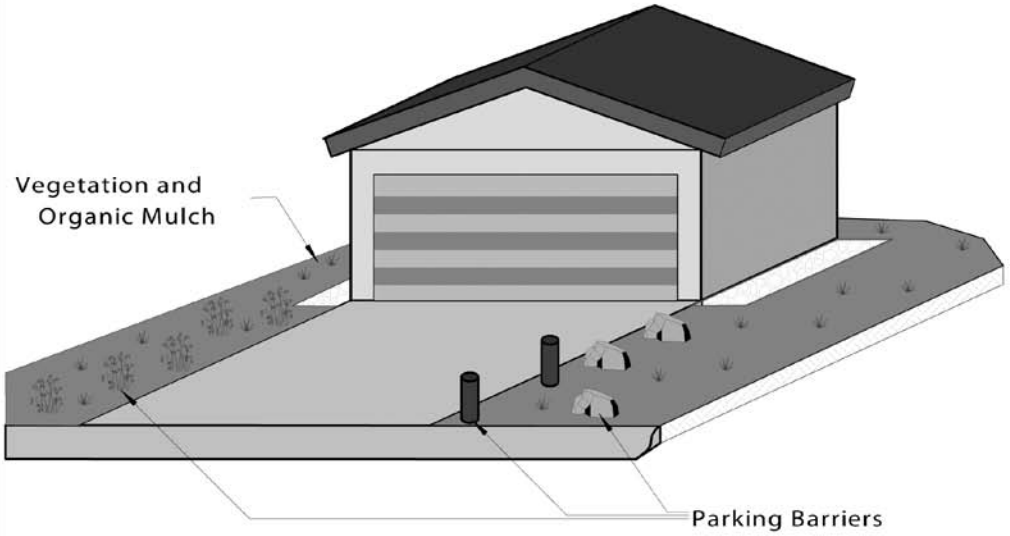
USDA IS AN EQUAL OPPORTUNITY PROVIDER AND EMPLOYER

Lake Tahoe Standard Drawing

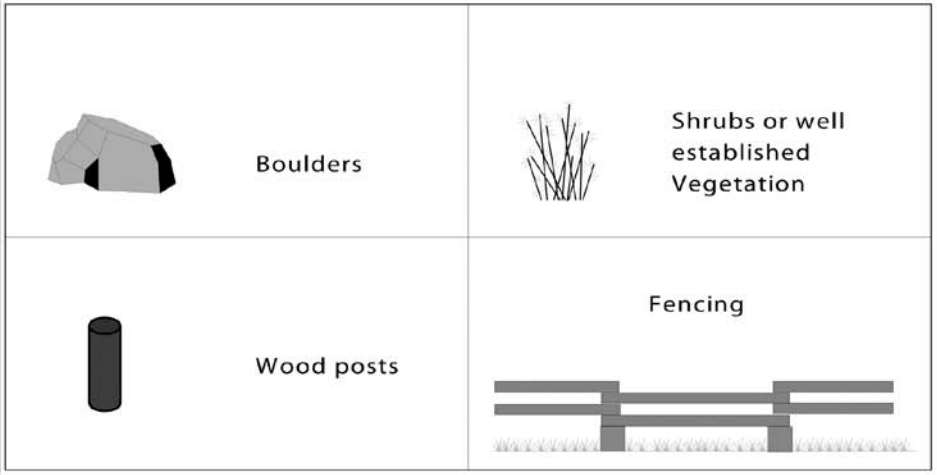
For Residential use Only
Best Management Practice

Parking Barriers

Standard Drawing No.
BMP–026.1
Updated: 1–22–07



Typical Parking Barriers



Construction Notes

1. Parking barriers shall be placed to restrict vehicular access on disturbed soil areas

   Boulders:
   Boulders shall be greater than 18" diameter and be keyed in to the soil a minimum of 6"

   Posts:
   Wood posts shall be a minimum of 2' above grade, and anchored in a concrete footing

   Shrubs or well established vegetation:
   This parking barrier is not recommended in areas used for snow storage

   Fencing
   posts shall be anchored in a concrete footing.

2. Information on rehabilitating disturbed soil areas can be found on the NRCS "direct seeding of disturbed areas" tip sheet.

3. Regularly scheduled maintenance including service, repair, or replacement of components is necessary to maintain full function

U.S. Department of Agriculture
Natural Resources Conservation Service
in cooperation with
Tahoe Resource Conservation District, and
Nevada Tahoe Conservation District

Drawn By:	Date	Approved By:	Date
SKB	8–18–06		

This specification is based on a reference to the NRCS standard practice 561 – Heavy Use Area Protection Systems.
Users of these drawings and associated information shall be qualified personnel, trained to interpret and adapt technology according to local conditions.

LAKE TAHOE STANDARD DRAWING

(FOR RESIDENTIAL USE ONLY)
BEST MANAGEMENT PRACTICE

FILTER FABRIC FOR INFILTRATION SYTEMS

STANDARD DRAWING NO.
BMP-060.2
UPDATED: 6-11-10

MATERIAL: GEO-TEXTILE FABRIC (AKA FILTER FABRIC) SHALL BE **NON-WOVEN NEEDLE PUNCHED** IN ACCORDANCE WITH NRCS CONSTRUCTION STANDARD 905.

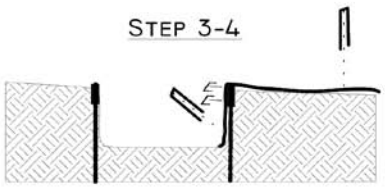
INSTALLATION INSTRUCTIONS

STEP 1-2

1. EXCAVATE TO SPECIFIED DIMENSIONS

2. INSTALL BORDERS AND STAKE FIRMLY INTO PLACE. 1/2" DIAM. REBAR MAY BE DRIVEN THROUGH PRE-DRILLED 2X MATL. HOLD BORDER 1/2" BELOW PAVEMENT WHERE RUNOFF SHEET FLOWS INTO TRENCH.

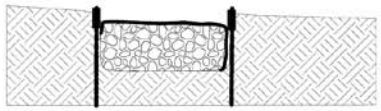
STEP 3-4



3. CUT FILTER FABRIC TO SIZE:
   WIDTH = TRENCH DEPTH + TRENCH WIDTH + 4"
   LENGTH = TRENCH LENGTH + 8"

4. PLACE FABRIC ALONG THE SIDE OF THE TRENCH WHERE SUBSURFACE FLOW IS MOST LIKELY TO OCCUR (USUALLY AWAY FROM STRUCTURES). TEMPORARILY LAY FABRIC ON ADJACENT SOIL. STAPLE FABRIC TO BORDER OR USE "U" SHAPED PINS TO PREVENT SHIFTING OR MOVEMENT DURING BACKFILL.

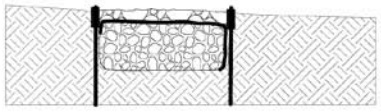
STEP 5-6



5. OVERLAP ENDS OF FABRIC 12".

6. BACKFILL TRENCH WITH WASHED DRAIN ROCK WITHIN 2" TO 3" OF FINAL GRADE. COVER THE ROCK WITH FABRIC AND SECURE EDGE OF FABRIC BY TUCKING IT BETWEEN ROCK AND SOIL OR BORDER.

STEP 7



7. FILL REMAINDER OF TRENCH WITH DRAIN ROCK OR OTHER DESIRED STONE TO FINISH GRADE. WHERE RUNOFF IS INTENDED TO SHEET FLOW INTO THE SYSTEM, HOLD FINAL LAYER 1" BELOW THE SURROUNDING GRADE.

MAINTENANCE INSTRUCTIONS

INFILTRATION SYSTEMS COLLECT STORM WATER RUNOFF THAT TRANSPORTS SEDIMENT AND OTHER ORGANIC MATERIAL. UNLESS REGULAR MAINTENANCE IS PERFORMED TO REMOVE THIS MATERIAL, THE SYSTEM WILL BECOME INEFFECTIVE FOR INFILTRATING STORMWATER.

GEO-TEXTILE FABRIC WHEN PLACED AS SHOWN WILL REDUCE THE TOTAL AMOUNT OF LABOR, BUT REQUIRES MORE FREQUENT INSPECTIONS. THE PERMEABLE BARRIER ALLOWS INFILTRATION SYSTEMS TO COLLECT STORM WATER RUNOFF WITHOUT FILLING THE ENTIRE SYSTEM WITH SEDIMENT.

IT IS BEST TO INSPECT BMPS IN THE SPRING, FALL, AND AFTER A HEAVY RAIN EVENT. AN EASY TEST IS TO RUN A GARDEN HOSE FOR 10 MINUTES AND MONITOR THE FLOW. IF THE WATER OVERFLOWS THE BMP DURING THE TEST, IT IS TIME TO CLEAN THE SYSTEM. FOLLOW THE STEPS BELOW.

1. REMOVE PINE NEEDLES AND LEAVES REGULARLY. THEY DECAY AND CLOG THE SYSTEM. A PRESSURE WASHER OR HOSE WITH A HIGH PRESSURE NOZZLE AIMED AT A LOW ANGLE WORKS WELL.

2. WHEN NEEDED, REMOVE AND SIFT THE TOP LAYER OF DRAIN ROCK (ABOVE THE OVERLAPPING PORTIONS OF FABRIC).

3. DISPOSE OF THE COLLECTED SEDIMENT IN A LOCATION THAT WILL NOT BE WASHED AWAY IN FUTURE STORMS. GOOD LOCATIONS ARE PLANTING BEDS, OR UNDER A LAYER OF PINE NEEDLE DUFF.

4. IF THE TOP LAYER OF FABRIC IS DIRTY, SHAKE THE FABRIC TAKING CARE NOT TO LET THE SEDIMENT FALL INTO THE CLEAN DRAIN ROCK BELOW. TEST TO SEE IF WATER PASSES THROUGH THE FABRIC AND RINSE IT BY RUNNING WATER IN THE OPPOSITE DIRECTION THAN IT WAS INSTALLED. REPLACE FABRIC WHEN REQUIRED BY CUTTING OFF THE TOP LAYER. CUT NEW FABRIC TO FIT AND ALLOW 12" FOR OVERLAP.

5. REPLACE THE CLEANED DRAIN ROCK ON THE NEW OR CLEANED FABRIC.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
IN COOPERATION WITH
TAHOE RESOURCE CONSERVATION DISTRICT, AND
NEVADA TAHOE CONSERVATION DISTRICT

DRAWN BY:	DATE	APPROVED BY:	DATE
DMGG	11-30-06		

THIS SPECIFICATION IS BASED ON A REFERENCE TO THE NRCS STANDARD PRACTICE 905 - GEOTEXTILE FABRIC. USERS OF THESE DRAWINGS AND ASSOCIATED INFORMATION MUST BE QUALIFIED PERSONNEL, TRAINED TO INTERPRET AND ADAPT TECHNOLOGY ACCORDING TO LOCAL CONDITIONS. DIMENSIONS AND SIZING ON THIS DOCUMENT RELAY MINIMUM REQUIREMENTS FOR THE BMP RETROFIT ORDINANCE.

NRCS Natural Resources Conservation Service

TAHOE RESOURCE CONSERVATION DISTRICT

Nevada Tahoe Conservation District

TAHOE REGIONAL PLANNING AGENCY

BMP Final Inspection Checklist

APN _____ Site Address _____ County _____

Inspector _____ Agency _____ Date ___/___/___

This form assists inspectors to assess whether Best Management Practice (BMP) treatments are complete and functioning. Previous Tahoe Regional Planning Agency and Resource Conservation District Site Evaluations will be considered in recommendations for pass/fail determinations. "Yes" answers indicate correct BMP installation. "No" answers indicate a missing or incorrect BMP installation. "N/A" answers indicate that the question does not apply to the property. Any property that passes final inspection with a "No" must have an explanation in the comments section. If the property does not pass a final inspection, evaluators shall document any necessary corrective steps in the comments section.

Date of Site Evaluation ___/___/___ Evaluator_____ Agency_____

BMP Treatments designed by:

☐ RCD ☐ Contractor/Consultant ☐ Property Owner ☐ Other: _____

Open Space, Yard and Landscape Areas	**Yes**	**N/A**	**No**
1. Have all visual signs of erosion (eroding slopes, rills, gullies, unstable flow channels, etc.) been addressed through appropriate stabilization methods (vegetation, mulch, terraces, retaining walls, riprap, or other appropriate method)? **Comments:**	☐	☐	☐
2. Have compacted bare soil areas been aerated (tilled or ripped), vegetated and/or mulched, and, if appropriate, blocked from vehicular access? **Comments:**	☐	☐	☐

Driveways	**Yes**	**N/A**	**No**
3. Are driveways paved with runoff conveyance and infiltration systems Installed and, if required or applicable, are infiltration systems installed with containment borders, filter fabric, and a sediment trap? **Comments:**	☐	☐	☐
4. Was a water test conducted (for at least 10 minutes with a hose) to verify runoff conveyance and infiltration systems are connected and functioning? **Comments:**	☐	☐	☐

Appendix I ~ BMP FInal Inspection Checklist

Storage Areas	**Yes**	**N/A**	**No**
5. Are storage areas (boats, trailers, snow, automobiles, etc.) stabilized with appropriate vegetation and/or mulch? **Comments:**	☐	☐	☐

Roof Drip Lines and Decks	**Yes**	**N/A**	**No**
6. Is all stormwater runoff from roof drip lines mitigated by an appropriate treatment system (rock, prefabricated, or vegetated systems with containment borders where applicable)? When applicable, are the associated conveyance systems such as gutters and downspouts functional? **Comments:**	☐	☐	☐
7. Is the soil under decks, walkways, and elevated structures adequately protected from erosion with appropriate BMPs? Are containment borders included around drain rock treatments? **Comments:**	☐	☐	☐

BMP Maintenance	**Yes**		**No**
8. Are all BMPs maintained and functioning correctly (conveyance and infiltration systems, soil and slope stabilizations, etc.)? **Comments:**	☐	☐	☐

Installation Verification

9. What type of documentation was provided to or by the inspector to verify proper installation?
☐ Photos ☐ Calculations ☐ As-built drawings ☐ Design alterations
Comments:

Certification	**Yes**	**No**
IS THE PROPERTY ELIGIBLE FOR A **BMP CERTIFICATE OF COMPLETION**? **Comments:**	☐	☐
IS THE PROPERTY ELIGIBLE FOR A **BMP SOURCE CONTROL CERTIFICATE**? **Comments:**	☐	☐