NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FOREST TRAILS AND LANDINGS

(Acre)

CODE 655

DEFINITION

A route, travel-way, or cleared area within a forest.

PURPOSES

- Provide access to forest stands for management.
- Provide access to forested areas for recreation.
- To allow for removal and collection of a forest product while minimizing onsite and off-site damage to resources.

CONDITIONS WHERE PRACTICE APPLIES

On forested areas.

CRITERIA

On forest land the Forest Practices Act sets standards for all management activities. Standards can vary depending upon location, forest type, harvesting methods, etc. Always contact the Department of Forestry forest practices officer before making any road, harvest trail or landing specifications on forest lands

Timing and use of equipment will be commensurate with site and soil conditions to maintain site productivity and minimize soil erosion, displacement and compaction.

Trails and landings will be of a size, gradient, number and location to economically and efficiently accomplish the intended purpose and expected users and equipment. They shall be configured to minimize adverse onsite and off-site impacts such as accelerated erosion, riparian zone degradation, stream channel and streambank damage, hydrology modification, other water resource damage, aesthetics or unacceptable damage to advance regeneration, residual growing stock, wildlife habitat, fragmentation, or restrict wildlife movement.

Slash, debris and vegetative material left on the site after harvesting will not present an unacceptable fire or pest hazard or interfere with the intended purpose. Excess slash material will be piled and burned, lopped and scattered over the harvest site, or salvaged for firewood.

Water bars, rolling dips, culverts, bridges, rock plunge pools, and other drainage measures for trails shall be of sufficient size, intervals and gradient for adequate drainage and erosion control.

Trails and landings shall be sufficiently revegetated to control erosion. Selection of native plant species will be considered, if applicable. Plant species selection will be based on the plants shade tolerance, erosion control effectiveness and resistance to vehicular traffic (See Field Office Technical Guide – Vegetative Guide for species).

Comply with applicable laws and regulations, including the state's Best Management Practices (BMPs).

Designing Stream Crossings

There are three methods for crossing natural drainageways: fords, culverts, and bridges. Factors influencing the appropriate crossing include construction and maintenance costs, equipment and supplies available, debris potential, stream size, expected road use and life, foundation conditions, and position of the road relative to the stream.

1. Stream crossing activities which are in conjunction with a Timber Harvest Plan (THP) will meet standards established in the Forest Practice Rules. This will also include California Fish and Game Code Section 1601 and 1603 compliance.
2. Stream and water crossings shall be designed to accommodate runoff from a 50-year frequency storm.
3. Locate crossings at stream reaches showing signs of stability as evidenced by well-vegetated banks,

absence of bank cutting, absence of meander, and areas of exposed bedrock.

4. Sediment traps or drainage diversions must be placed above water crossings to reduce sediment entering streams and drainageways.

5. Watercourses that support fish shall utilize drainage structures that allow for unrestricted fish passage.

   Fish passage will be planned for when selecting location, date of installation, and type of structure or crossing. To allow for fish passage:

   a. Provide resting pools just above and below obstacles

   b. Keep individual jumps as low as possible as specified for the species and/or from Department of Fish and Game personnel.

   c. Keep water depth and speed within the fish's ability to swim.

   d. Avoid sudden changes in water velocity.

6. Installation of circular, arched, or elliptical corrugated metal pipe shall comply with construction specification 587A - Structure For Water Control - Corrugated Metal Pipe. Wherever possible the center of the fill section shall be filled to an elevation slightly lower than the sides. In case of a plugged culvert or blow out only the culvert and fill area will be removed instead of a portion of the road.

When dust abatement is required, chemicals will be applied according to label instructions and with adequate training.

Forest Land Harvest

The Forest Practice Rules, as prescribed by the Forest Practice Act, including county rules, must be observed through a timber harvest plan prepared by a registered professional forester, and approved by the California Board of Forestry. Timber operations mean the cutting or removal or both of timber or other solid wood forest products, including Christmas trees and firewood, from timberlands for commercial purposes. This also includes construction and maintenance of roads, fuelbreaks, firebreaks, stream crossings, landings, skid trails, beds for the felling of trees, and fire hazard abatement, but excluding preparatory work such as tree marking, surveying, or road flagging.

Discuss alternative logging practices based on erosion hazard rating for soils.

The selection of the most desirable harvest system depends on the physical condition of the timber and land resources, the economic condition of the market and the landowner, and the interpretation of the forest practice rules by the registered professional forester preparing the timber harvest plan.

Discuss the establishment of buffer zones along streams and around mountain meadows. The width of stream and lake protection zones is specified in the Forest Practice Rules.

Discuss proper slash disposal, either by lopping and scattering, chipping, piling and burning, or by controlled burns.

Additional Criteria

Access Roads. Guidance for construction and maintenance of the main roads to access the forest trails and landings is contained in NRCS Conservation Practice Standard – Access Road – 560.

CONSIDERATIONS

An adequate road system must be developed or in place to assure safe ingress and egress to site. If the harvest site is land-locked by other landowners, easements must be obtained or agreements worked out to allow logging equipment ingress and egress privileges.

Develop an adequate, but permanent road system keeping in mind the erosion hazard of the soils

Locate landings and trails to preserve the aesthetic quality. Police landings and trails to remove refuse and garbage.

Trails may be closed for erosion control, safety and liability, and reduced maintenance costs.

Landings and trails may be used for wildlife food and cover plantings.

Consider cultural resources and environmental concerns such as threatened and endangered species of plants and animals, natural areas and wetlands.

Timberlands located near the coast may be subject to the more stringent regulations prescribed in the Coastal Commission's Special Treatment Areas.

Quality of water as it comes from timberland is monitored and regulated by the Department of Water Resources through state water quality laws, and 208 non-point source legislation.

Existing soils information should be utilized for the forestry interpretations pertaining to the soils in the forest.

Planning considerations

As a part of the conservation planning process, the landowner's objectives, values, and land capabilities need to be discussed to determine whether or not a forest land or woodland enterprise is desired by the landowner.

Erosion control based on soils data should be a major consideration in any forest harvesting operation. In addition to the requirements specified in the California Forest Practice Rules, attention should be given to incorporating access roads and critical area planting to minimize soil loss as predicted by soil loss equations.

Roads, skid trails and landings have been identified as major sources of sediment from forestland. Consider the following measures for soil protection: (1) maintaining a high level of organic matter on the soil surface; (2) seeding/mulching disturbed areas in a timely fashion; (3) limiting concentration of water, (4) not locating roads and landings in slide areas; (5) reducing water energy at culvert outlets; (6) keeping stream crossings to a minimum and (7) maintaining adequate stream side buffers.

Access roads should be located along ridge tops and upper one-third of the slope. Avoid or minimize road construction in the riparian zone. Avoid construction on slopes exceeding 60 percent. Timely maintenance should be incorporated into operation plans to minimize the potential for high rates of erosion which can occur the first few years after construction.

Season of use, amount and kind of traffic, grade and soils also effect erosion from roads and must be considered. Surfacing the road may be a more practical solution to reduce erosion to acceptable limits from the travel way.

On steep slopes the method of road construction has a direct impact on the associated costs of erosion control. Sidecast road construction techniques and its associated costs to control erosion should be carefully weighed against the costs of trench, keyed embankment, and full bench or endhaul road construction techniques and their associated costs for erosion control.

Geotextile products may be utilized in a number of situations to reduce erosion, improve water quality or make impassible areas passable. Because of the cost of the materials and the requirement for proper installation these prospective sites require an onsite investigation and site specific recommendations for the use of these materials.

Avoidance by equipment of critical areas that can produce erosion control problems, including geologically fragile areas, is an essential part of forestland planning. Use of soil surveys, geological hazard maps, observing and locating known areas of mass movement, locating roadways away from watercourses and steep areas can help prevent erosion and resulting sediment. Consult geologic hazards maps for slides, slips and debris flow potentials. Debris flows, also called debris avalanche, debris torrent, and mudflow, are difficult to detect in heavily forested areas. In fragile mountainous terrain ground reconnaissance may be required.

Harvest trails (skid trails) are a necessary part of a harvest operation. Skidding by ground based equipment can cause severe and unacceptable damage if left unchecked. If a system is not planned, up to 40 percent of the area may be covered with skid trails during a single entry. Multiple entries can raise the percent of area damaged another 10-15 percent.

Soil compaction and disturbance problems can be reduced by limiting the area covered by skid trails during a harvest operation. Compaction from equipment can lead to less productivity in the forest. Severe compaction has been shown that individual tree diameter growth can be reduced up to 40 percent.

A goal of less than 15 percent of the harvest area in skid trails, including landings but excluding haul roads, is considered reasonable.

When requiring skid trails to be used, advance planning and clearly flagging trails is required. When laying out skid trails leave a strip of undisturbed vegetation parallel to all waterways, or other sensitive areas to reduce delivery of sediment (See filter strips under Erosion Control section).

Skid trails should be regarded as a permanent part of forest landscape. They will be used for later entries into the forest, thereby reducing additional impact to the site.

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Limit skid trail width to 12 feet or less.

Locating Harvest Trails

Generally, harvest (skid) trails are spaced from 75 to 150 feet apart. The closer distance will be on more sloping terrain and the farther spacing on flatter terrain.

On steeper, broken, or highly dissected terrain expect a higher percentage of skid trails to occur.

Skid trails have two common pattern systems, branching and parallel. Branching is more commonly used on flatter terrain. It has one or more main trails with side trails branching off it. Parallel skid trail systems are used on steeper slopes and run parallel to the slope as much as possible.

Skid trails on less than 20 percent side slopes do not require trail excavation. Side slopes beyond 20 percent may require excavating one to two feet of soil, at the trail center, to establish the skid trail. This is necessary because a loaded vehicle tends to slide down hill. Erosion control measures should be planned and applied under these situations.

Spacing	% Area in Skid Trail
75 ft	14%
100 ft	11%
150 ft	07%

When planning skid trail layout consider the following for trail alignment:

1. Make trails as straight as possible for as long a distance as possible.
2. Remove all trees from the skid trail and cut all stumps down to ground level.
3. Make intersections at 45^{o} angles or less with respect to travel toward the landing.
4. Parallel the contour of the terrain and make up slope skid trails follow the ridge crest.
5. To reach long corners of a unit use short trail branches.
6. Do not place branching side trails directly opposite each other on the main trail.
7. Avoid sharp curves at the bottom of steep downhill segments.

Skid Trail Grade

The grade (slope) of a skid trail effects the productivity of the operation. Skidding down hill is preferred in all ground-based systems. For main trails an adverse (generally uphill) grade needs to be no greater than 10 percent and favorable (down hill) grades not greater than 20 percent. Short steep uphill grades, up to 20 percent and 100-200 feet long, are feasible if the trail is straight and ground is firm enough for good traction.

On steeper side slopes where skid trails run up and down slope the vehicle runs perpendicular to the slope and maintains greater stability. With this operation increased protection from soil erosion will be required on the skid trails.

Tree Felling for Skid Trails

Felling trees that make them accessible from designated skid trail is the key to a successful harvest operation.

Trees must be felled toward the skid trail or alternately away in the opposite direction. This is called "felling to lead". This allows for the winch line to be pulled directly to the tree (see figure 4).

When a tree is felled in the wrong direction, winched trees might be damaged or trees felled on top may be damaged. Review of the skidding plan should be done with those who are felling the trees to head off any problems.

When harvesting small trees either the tops or butts are suitable for winching. Winching large diameter trees,

with the butt of the tree facing the skid trail, may lead to extra soil disturbance due to it digging into the soil.

Felling trees at approximately a 45^{o} angle to the skid trail, and towards the main road leads to easier removal.

Felling trees may obliterate skid trail markings. Felling the trees first, where the trails will be, can help in directing the felling of the remaining trees.

Skid Trails not Feasible

When skid trails are not feasible or practical, for one reason or another, off trail skidding may be used when:

1. Low-pressure ground equipment (10 lb. PSI or less) is used.

2. The number of passes over any area is limited.

3. Slash, litter or other vegetation is dense enough to support harvest equipment, 10 inches minimum.

4. The ground is covered with 2 feet or more of snow.

5. The ground is frozen to a depth of 4 inches or more.

Landings

Avoid locating landings on flood plains, slide areas, steep slopes, erosive soils or wet meadows.

Landings should be located first when laying out the skid trail system. Landing locations should involve the least amount of excavation or filling, but be efficient for skidding and loading operations. Landings should be large enough to handle the loader, trucks and log decks.

Landings can be spaced up to 1200-1500 feet apart, but shorter distances are more efficient. Distances of 800 feet or less are more efficient and cost effective. If additional environmentally safe landings can be located and used, the efficiency of the operation can be improved.

Erosion Control

Where concentrated flow is unavoidable a number of materials are available to slow water velocity and to divert concentrated flows. These include natural vegetation, duff areas, stumps, stable channels, or flat areas. Lopping and scattering tops and limbs and crushing, where possible, in skid trails and other disturbed areas filters sediment. Protect discharge areas by the use of stones and rocks, grass, slash, brush, logs, or anything that will reduce water velocity. (Stones and rocks are defined as anything greater than 3 inches and less than 24 inches in diameter. Observations have noted rocks and stones that are not round tend to stay in place longer than ones which are well rounded).

Erosion control measures on skid trails and landings will be part of the skid trail system design. Skid trails can have slash distributed on them, seeded with grass, water bars installed or any combination to minimize erosion and sediment reaching streams.

Slash material, tops and limbs, may be lopped and scattered on skid trails and landings to filter sediment, slow water velocity and divert concentrated flows to stable areas. Do not place slash materials in drainage ways with perennial water or in watercourses unless being used as vegetative rip-rap for bank stabilization and installed according to NRCS specifications.

Deflector logs (small logs) can be placed across the slope and anchored to trap sediment, reduce water velocity, and divert concentrated flows to more stable areas.

Filter strips are needed to filter out sediment before water reaches a watercourse. The width of filter strips can be calculated using the following formula:

Filter Strip Width = 50' + 2 x percent slope (of area next to stream). Under no circumstances shall the filter strip width be less than what is required by the Forest Practices Act for riparian areas (WLPZ).

Water bars can be installed on all skid trails and roads where infrequent traffic is expected.

Space water bars frequently enough to prevent erosion and to remove water from disturbed or unstable soil areas. Spacing will depend upon soil type, slope, and onsite conditions. Suggested guidelines are included in Table 1 "Water Bar Spacing Guide". Decrease spacing by 1/4 when a road parallels a stream for more than 300 feet.

Place a water bar about 15 feet up from where roads or skid trails cross drainage ways to prevent sedimentation of the drainage.

Insure that water flowing from a water bar does not flow directly into streams or onto lower parallel roads or skid trails. Place water bars about 15 feet up from

where the centerline grade steepens to prevent accumulated water from flowing down steeper portions of roads or skid trails.

Place water bars above intersections of roads, skid trails and landings.

Avoid placing water bars in low areas where water has no escape.

Inspect and maintain water bars annually prior to and during the rainy season. Rebuild berms, clean ditches and outlets as needed. Build additional water bars, as needed.

Other guidance for controlling erosion on forest and woodland is contained in local or regional guides available from a number of local, state, or federal sources.

Include additional practices that will minimize soil erosion and give maximum watershed protection, such as:

1. Keep maximum road grades under 8 percent on granitic soils, 10 percent on sedimentary soils and 12 percent on soils derived from basic igneous rock.
2. Keep roads out of streams bottoms as specified in the Forest Practice Rules.
3. Provide adequate road drainage.
4. Install berms or water barriers across roads when needed, but do not leave berms on edges of roads through the winter unless necessary for drainage patterns or safety.
5. Skid logs away from water courses.
6. Scatter limbs and brush on skid trails and other areas subject to soil erosion.
7. Outslope roads where this practice is feasible.

Cultural Resources Considerations

Determine if installation of this practice with any others proposed will have any effect on any cultural resources. NRCS' objective is to avoid any effect to cultural resources and protect them in their original location. GM 420, Part 401, the California Environmental Handbook and the training for the California Environmental Assessment Worksheet specify how the NRCS must account for cultural resources. The Field Office Technical Guide, Section II contains general information, with Web sites for additional information, about cultural resources. The Environmental Handbook is online at www.ca.nrcs.usda.gov/rts/rts.html.

Endangered Species Considerations

Determine if installation of this practice with any others proposed will have any effect on any federal or state listed Rare, Threatened or Endangered species or their habitat. NRCS's objective is to benefit these species and others of concern or at least not have any adverse effect on a listed species.

If the Environmental Evaluation indicates the action may adversely affect a listed species or result in adverse modification of habitat of listed species which has been determined to be critical habitat, NRCS will advise the land user of the requirements of the Endangered Species Act and recommend alternative conservation treatments that avoid the adverse effects. Further assistance will be provided only if the landowner selects one of the alternative conservation treatments for installation; or at the request of the landowners, NRCS may initiate consultation with the Fish and Wildlife Service, National Marine Fisheries Service and/or California Department of Fish and Game. If the Environmental Evaluation indicates the action will not affect a listed species or result in adverse modification of critical habitat, consultation generally will not apply and usually would not be initiated. Document any special considerations for endangered species in the Practice Requirements Worksheet.

Some species are year-round residents in some streams, such as, freshwater shrimp. Other species, such as steelhead and salmon, utilize streams during various seasons. Be aware that critical periods, such as spawning, eggs in gravels, and rearing of young may preclude activities in the stream that may directly affect the stream habitat during those periods. For example there should be no disturbance of stream gravel beds that may have eggs in them. That could include any equipment in the stream or even walking in the stream or work upstream that may result in sediment depositing in the gravel beds. Document any special considerations for endangered species in the Practice Requirements Worksheet.

Water Quantity

In regions where large tracts are heavily harvested, there may be a temporary to prolonged increase in surface runoff and a decrease in infiltration.

Water Quality

This practice may cause a temporary increase in erosion rates and sediment yield due to harvesting operation. Also there may be a temporary increase in organic loading (BOD) and a temperature increase in the surface waters which will lower the dissolved oxygen content of the receiving waters. California Forest Practice Rules require restocking. If the harvested area is to be reseeded or replanted, pesticides and nutrients may contaminate surface and ground waters if these chemicals are used. Sixty percent of the tree's nitrogen content is contained in the slash.

This practice will improve the quality of surface waters by controlling erosion and reducing the amount of sediment and substances. The construction effects of a practice may have a temporary impact on surface water quality because the surface is disturbed and compacted at this time. Any runoff event which occurs at this time may transport a heavy load of sediment into the receiving waters if component practices are not applied concurrently.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

Specifications guide

Document the following:

- Field location of trails and landings
- Length and width of trails and landings
- Slope calculations
- Design calculations (culverts, water crossings, etc.)
- Location and spacing of waterbars and/or broad based dips.

Harvest Trails:

- Will be flagged in the field
- Dust control measures will be identified if required

Erosion Control

A. Seeding of Disturbed Areas

Erosion control measures will be identified

To establish vegetation on disturbed areas such as roads, firebreaks, burned areas, skid trails and landings (See Practice Standard 342-Critical Area Planting).

B. Use of Vegetation and Slash For Erosion Control

1. Slash as Mulch (See Practice Standard 484-Mulching).

2. Filter Strips (See Practice Standard 393-Filter Strip).

3. Sediment traps

C. Water Control Measures

1. Surface drainage.

2. Rolling dips or drainage dips.

3. Water bars.

4. Relief Culverts.

5. Water and Sediment Control Basins.

6. Grade Stabilization Structures. (See Practice Standard 410-Grade Stabilization Structure).

7. Diversions.

D. Suggested Water Bar Spacing Guide

Water bar spacings are based upon the road running surface in an unsurfaced condition, the slope, and the soil factor K. Factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is based primarily on the percentage of silt, very fine sand, and organic matter (up to 4 percent) and on soil structure and permeability. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value the more susceptible the soil is sheet and rill erosion by water. Spacings are Table 1 and 2.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance):

Watercourses and water quality shall be protected during and after removal and transport of trees. Upon completion of harvest, landings and trails will be left in a stable condition.

Periodic inspections of landings and trails will be conducted with necessary repairs applied.

Landings and trails utilized as firebreaks will be properly maintained to accomplish this purpose.

Landings and trails may be closed for erosion control, safety and liability, and reduced maintenance costs.

Landings and trails no longer needed can be "put to bed" by removing high maintenance structures, such as culverts and bridges, and can be restored to a vegetative cover by planting and seeding.

Table 1 - K factor greater than 0.35.

% slope	Distance (ft) Between Water Bars
0-2	500
5	200
10	100
15	75
20	50
25	40
30	35
35	30
40 +	25

Table 2 - K factor less than 0.35

% slope	Distance (ft) Between Water Bars
0-2	1000
5	400
10	200
15	150
20	100
25	80
30	65
35	55
40	50
45	45
50	40
55	35
60	30

REFERENCES