

**APPENDIX C:**

## California Board of Forestry and Fire Protection 2013 Road Rules and Technical Addendum No. 5: Guidance on hydrologic disconnection, road drainage, minimization of diversion potential and high risk crossings

The California Board of Forestry and Fire Protection (CAL FIRE) is responsible for the development of forest practice standards and enforcement of the California Forest Practice Rules (CFPR), under Title 14, Chapter 4 of the California Code of Regulations, and includes regulations for timber harvesting and road construction, maintenance, and decommissioning activities on privately owned lands. The CFPR are intended to ensure that logging and forest management is done in a manner that protects public resources, including fisheries, wildlife, forests, and streams. The rules pertaining to logging roads, landings, and logging road watercourses are organized into the “Road Rules” package of the CFPR and were recently updated in 2013.

In addition to the Road Rules package, CAL Fire developed “Technical Addendum No. 5: Guidance on hydrologic disconnection, road drainage, minimization of diversion potential, and high risk crossings,” a document that provides guidance for Registered Professional Foresters, Licensed Timber Operators, timberland owners, and agency personnel for proper logging road drainage and hydrologic disconnection. The document provides (1) an explanation of hydrologic connectivity and disconnection; (2) guidance on the proper location of drainage facilities and structures, energy dissipaters, road surface outsloping, and rolling dip placement; (3) a description of diversion potential and correct critical dip placement; and (4) potential approaches for handling high risk crossings.

The *Handbook for Forest, Ranch, and Rural Roads* is consistent with the CAL FIRE road rules and guidance objectives stated in Technical Addendum No. 5. The handbook is

also consistent with CFPR terminology, with the exception of the term “abandonment.” According to CFPR, road abandonment refers to what the handbook terms as road decommissioning. The handbook also differs slightly from the CFPR where the CFPR has generalized language regarding road construction, decommissioning, and maintenance. In these cases, the Handbook provides more detailed guidelines and specific recommendations consistent with the goals of the Z’berg-Nejedly Forest Practice Act and the CFPR.

### A. C-I. 2013 ROAD RULES

#### 14 CCR § 895.1. DEFINITIONS.

**Abandoned Road** means a logging road on which proactive measures have been applied to effectively remove it from the permanent road network.

**Abandonment** means implementing measures to effectively remove an existing logging road, landing, or logging road watercourse crossing from the permanent road network.

**Appurtenant Road** means a logging road under the ownership or control of the timber owner, timberland owner, timber operator, or plan submitter that will be used for log hauling.

**Berm** means a curb, dike, or linear mound of earth that is constructed to control water and direct roadway runoff waters or that has developed through road grading activities.

**Connected Headwall Swale** means a geomorphic feature consisting of a concave depression with convergent slopes, typically of 65 percent or greater steepness that is connected to a watercourse or lake by way of a continuous linear depression and that has been sculpted over geologic time by shallow landslide events. The slope profile is typically smooth and unbroken by benches, but may be interrupted by recent landslide deposits or scars. Emergent groundwater and wet areas may exist at the base of the swale. Soil and colluvium depth is typically greatest at the axis of the swale, thinning to either side.

**Critical Dip** means a constructed dip or low point across a logging road surface down grade from, or over, a logging road watercourse crossing that functions to prevent crossing overflow from draining down the road and minimizes fill erosion.

**Crowning** means creating a road surface with a convex cross sectional profile that drains runoff toward both sides of the road.

**Deactivated Road** means a logging road that is part of the permanent road network where measures have been implemented to prevent active use by logging trucks and standard production four-wheel drive highway vehicles.

**Deactivation** means implementing measures necessary to prevent the active use of an existing logging road, landing, or logging road watercourse crossing.

**Excess Material** means excavated material that is not used as a functional part of the road or a landing. Excess material is synonymous with spoils.

**Extended Wet Weather Period** means the period from October 15 to May 1.

**Fill** means material that is mechanically placed and built up in compacted lifts to form a roadbed or landing surface. Fill includes the material placed around culverts and related drainage structures at logging road watercourse crossings.

**Ford** means a logging road watercourse crossing where the road grade dips through the watercourse channel.

**Harvest Area** means the area where trees are felled and removed.

**Hydrologic Disconnection** means the removal of direct routes of drainage or overland flow of road runoff to a watercourse or lake.

**Insloping** means shaping the logging road or landing surface to drain toward a cutbank or inside ditch.

**Outsloping** means shaping the road surface to drain toward the outside edge of the logging road or landing.

**Permanent Road** means a logging road that is part of the permanent road network and is designed for year-round use. These roads have a surface that is suitable for maintaining a stable operating surface throughout the year.

**Permanent Road Network** means the permanent, seasonal, and temporary, and deactivated roads, including appurtenant roads, that provide the infrastructure necessary for timber operations and forest management. Abandoned roads are not part of the permanent road network.

**Permanent Watercourse Crossing** means a watercourse crossing that will remain in place when timber operations have been completed.

**Prescribed Maintenance Period** means the time period, beginning with filing of the work completion report, provided that the report is subsequently approved, during which erosion controls that are required and constructed as part of timber operations must be maintained in a functional condition.

**Public Road** means a road open to the general public which is: (a) in the State or County road system, or (b) a road on which a public agency has deeded, unlimited easement.

**Reconstructed Roads** means those existing roads that are to be restored or improved to make useable for hauling forest products; “reconstructed” does not include road maintenance or rehabilitation that does not require substantial change in the original prism of the road.

**Road Approach** means the portion of the logging road surface that drains overland water flow to the watercourse crossing.

**Road Maintenance** means activities that do not require substantial change to the logging road prism to maintain stable operating surfaces, functioning logging road drainage facilities and structures, and stable cutbanks and fill slopes. Examples of road maintenance may include rocking a road surface; localized shaping or outsliping; installation and maintenance of rolling and critical dips; restoring functional capacity of inboard ditches, cross drains, or culverts; and repairing water bars.

**Road Prism** means all parts of a road including cut banks, ditches, road surfaces, road shoulders, and road fills.

**Seasonal Road** means a logging road that is part of the permanent road network that is not designed for year-round use. These roads have a surface that is suitable for maintaining a stable operating surface during the period of use.

**Sidecast** means excess earthen material pushed or dumped over the side of a roads or landing.

**Significant Sediment Discharge** means soil erosion that is currently, or may be in the future, discharged to watercourses or lakes in quantities that violate Water Quality Requirements or result in significant individual or cumulative adverse impacts to the beneficial uses of water. One indicator of a Significant Sediment Discharge is a visible increase in turbidity to receiving Class I, II, III, or IV waters.

**Significant Existing or Potential Erosion Site** means a location where soil erosion is currently, or may be in the future, discharged to watercourses or lakes in quantities that violate Water Quality Requirements or result in significant individual or cumulative adverse impacts to the beneficial uses of water.

**Temporary Road** means a logging road that is to be used only during timber operations and that will be deactivated or abandoned upon completion of use.

**Through Cut** means a section of road that lies below the adjacent ground level on both sides of the road.

### 14 CCR § 914.7 [934.7, 954.7]. TIMBER OPERATIONS, WINTER PERIOD.

During the winter period:

**(a)** Mechanical site preparation and timber harvesting, shall not be conducted unless a winter period operating plan is incorporated in the timber harvesting plan and is followed, or unless the requirements of subsection (c) are met. Cable, helicopter and balloon yarding methods are exempted.

**(b)** The winter period operating plan shall include the specific measures to be taken in the winter operating period to avoid or substantially lessen erosion, soil movement into watercourses and soil compaction from timber operations. A winter period operating plan shall address the following subjects:

- (1)** Erosion hazard rating.
- (2)** Mechanical site preparation methods.
- (3)** Yarding system (constructed skid trails and tractor road watercourse crossings).
- (4)** Operating Period.
- (5)** Erosion control facilities timing.
- (6)** Consideration of form of precipitation-rain or snow.
- (7)** Ground conditions (soil moisture condition, frozen).
- (8)** Silvicultural system-ground cover.
- (9)** Operations within the WLPZ.
- (10)** Equipment use limitations.
- (11)** Known unstable areas.
- (12)** Logging roads and landings.

**(c)** In lieu of a winter period operating plan, the RPF can specify the following measures in the THP:

- (1)** Tractor yarding or the use of tractors for constructing logging roads, landings, watercourse crossings, layouts, fire-breaks or other tractor roads shall be done only during dry, rainless periods and shall not be conducted on saturated soils conditions that may produce significant sediment discharge.

### § 914.8 [934.8, 954.8] TRACTOR ROAD WATERCOURSE CROSSING

**(d)** Tractor road watercourse crossing facilities shall be removed and stabilized before the beginning of the winter period to the standards of 14 CCR § 923.9 [943.9, 963.9], subsections (p)(1)–(4), or as specified in the winter period operating plan. The RPF may propose an exception if explained and justified in the plan, and found by the Director to be in conformance with this article.

### CCR § 915.1 [935.1, 955.1]. USE OF HEAVY EQUIPMENT FOR SITE PREPARATION.

- (a)** Use of heavy equipment for site preparation shall comply with the provisions set forth in 14 CCR 914.2 [934.2, 954.2].
- (b)** Heavy equipment shall not be used for site preparation under saturated soil conditions that may produce significant sediment discharge; or when it cannot operate under its own power due to wet conditions.

§ 916.3 [936.3, 956.3].  
**GENERAL LIMITATIONS  
 NEAR WATERCOURSES,  
 LAKES, MARSHES, MEADOWS  
 AND OTHER WET AREAS**

(c) The timber operator shall not construct or use tractor roads in Class I, II, III or IV watercourses, in the WLPZ, marshes, wet meadows, and other wet areas unless when explained and justified in the plan by the RPF, and approved by the Director, except as follows:

- (1) At prepared tractor road crossings as described in 14 CCR § 914.8(b) [934.8(b), 954.8(b)].
- (2) Crossings of Class III watercourses that are dry at the time of use.
- (3) At new and existing tractor and road crossings approved as part of the Fish and Game Code process (F&GC 1600 et seq.).

916.4 [936.4, 956.4].  
**WATERCOURSE AND  
 LAKE PROTECTION.**

(a) The RPF or supervised designee shall conduct a field examination and map all lakes and Class I, II, III, and IV watercourses.

- (1) As part of this field examination, the RPF or supervised designee shall evaluate areas near, and areas with the potential to directly impact, watercourses and lakes for sensitive conditions including, but not limited to, existing and proposed roads, skid trails and landings, unstable and erodible watercourse banks, unstable upslope areas, debris, jam potential, inadequate flow capacity, migrating channels, overflow channels, flood prone areas,

and riparian zones wherein the values set forth in 14 CCR §§ 916.4 [936.4, 956.4, subsection(b) are impaired.

§ 916.9 [936.9, 956.9].  
**PROTECTION AND  
 RESTORATION OF THE  
 BENEFICIAL FUNCTIONS  
 OF THE RIPARIAN ZONE IN  
 WATERSHEDS WITH LISTED  
 ANADROMOUS SALMONIDS.**

In addition to all other district Forest Practice Rules, the following requirements shall apply in any watershed with listed anadromous salmonids. Requirements of 14 CCR § 916.9 [936.9, 956.9] precede other sections of the FPRs.

**Geographic scope**—Requirements for watersheds with listed anadromous salmonids differ depending on the geographic location of the watershed and geomorphic characteristics of the watercourse. Unique requirements for watersheds with listed anadromous salmonids are set forth for 1) watercourses in the coastal anadromy zone with confined channels, 2) watercourses with flood prone areas or channel migration zones, and 3) watercourses with confined channels located outside the coastal anadromy zone.

Watersheds which do not meet the definition of “watersheds with listed anadromous salmonids” are not subject to this section except as follows: The provisions of 14 CCR 916.9 [936.9, 956.9], subsections (k)–(q), also apply to planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids for purposes of reducing significant adverse impacts from transported fine sediment. Projects in other watersheds further upstream that flow into watersheds with listed anadromous salmonids, not otherwise designated above, may be subject to these provisions based on an assessment consistent with cumulative impacts assessment

requirements in 14 CCR §§ 898 and 912.9 [932.9, 952.9] and Technical Rule Addendum No. 2, Cumulative Impacts Assessment. These requirements do not apply to upstream watersheds where permanent dams attenuate the transport of fine sediment to downstream watercourses with listed anadromous salmonids.

**(f) Class I watercourses—**

**(1)** For Class I watercourses, where fish are always or seasonally present or where fish habitat is restorable, any plan involving timber operations within the WLPZ shall contain the following information:

**(A)** Clear and enforceable specifications of timber operations within the Class I WLPZ, including a description of how any disturbance, or log or tree cutting and removal shall be carried out to conform with 14 CCR §§ 916.2 [936.2, 956.2], subsection (a) and 916.9 [936.9, 956.9], subsection (a).

**(B)** Documentation of how proposed harvesting in the WLPZ contributes to the objectives of each zone stated in 14 CCR § 916.9 [936.9, 956.9], subsection (c) and other goals in 14 CCR § 916.9 [936.9, 956.9], subsection (a) (1)–(8). Documentation shall include the examinations, analysis, and other requirements listed in 14 CCR § 916.4 [936.4, 956.4], subsection (a).

**(3) Class I watercourses with flood prone areas or channel migration zones:**

**(E) Preferred Management Practices in the Inner Zone A and B of Flood Prone Areas**

**4. Avoid Slash concentration and site preparation:** or pile burning.

**5. Delineate Zone on the Ground:** Locations of all WLPZ zones and CMZs shall be designated on the ground.

**6. Avoid Use of Water Drafting Sites:** or stream alteration permits.

**7. Avoid Disturbance to Critical Flood Prone Area Habitat:** and down large woody debris.

**(F) Outer Zone:**

**(k) Year-round tractor road use limitations.**

**(1)** Tractor roads shall not be used when operations may result in significant sediment discharge.

**(l) Extended Wet Weather Period—**No timber operations shall take place unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § 914.7 [934.7, 954.7], subsection (b).

**(1)** Unless the winter period operating plan proposes operations during an extended wet weather period with low antecedent soil wetness, no tractor roads shall be constructed, reconstructed, or used on slopes that are over 40 percent and within 200 feet of a Class I, II, or III watercourse, as measured from the watercourse or lake transition line.

**(n) Treatments to stabilize soils—**Within the WLPZ, and within any ELZ

or EEZ designated for watercourse or lake protection, treatments to stabilize soils, minimize soil erosion, and prevent significant sediment discharge, shall be described in the plan as follows.

**(1)**

**(C)** Any other area of disturbed soil that threatens to discharge sediment into waters in amounts that would result in a significant sediment discharge.

**(2)** Soil stabilization treatment measures may include, but need not be limited to, removal, armoring with rip-rap, replanting, mulching, installing commercial erosion control devices to manufacturer's specifications, or chemical soil stabilizers.

### § 923 [943,963]. INTENT FOR LOGGING ROADS, LANDINGS, AND LOGGING ROAD WATERCOURSE CROSSINGS.

**(a)** All logging roads, landings, and logging road watercourse crossings in the logging area shall be planned, constructed, reconstructed, used, maintained, removed, abandoned, and deactivated in a manner that:

**(1)** Is consistent with long-term enhancement and maintenance of the forest resource.

**(2)** Accommodates appropriate yarding systems.

**(3)** Is economically feasible.

**(b)** Such planning, construction, reconstruction, use, maintenance, removal, abandonment, and deactivation shall occur in a manner that considers safety and

avoids or substantially lessens significant adverse impacts to, among other things:

**(1)** Fish and wildlife habitat and listed species of fish and wildlife.

**(2)** Water quality and the beneficial uses of water.

**(3)** Soil resources.

**(4)** Significant archeological and historical sites.

**(5)** Air quality.

**(6)** Visual resources.

**(7)** Fire hazard.

**(c)** The RPF may propose exceptions to the rules of this Article if explained and justified in the plan and found by the Director not to result in a significant adverse impact on the environment.

**(d)** Exceptions may also be provided through application of Fish and Game Code Sections 1600 et seq. and shall be made an enforceable part of the plan in accordance with 14 CCR §§ 1039, 1040, 1090.14, 1092.26, or 1092.27, as appropriate.

**(e)** For watersheds with listed anadromous salmonids and for planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids all logging roads, landings, and logging road watercourse crossings shall be planned, designed, constructed and reconstructed, used, maintained, abandoned, deactivated, and removed in accordance with 14 CCR § 916.9 (a) and (c) [936.9 (a) and (c), 956.9 (a) and (c)].

**(f)** The provisions of Articles 12 [Article 11 for Northern District] that apply in watersheds with listed anadromous salmonids and in planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids shall not apply to a plan that is subject to:

- (1)** A valid incidental take permit issued by CDFW pursuant to Section 2081(b) of the Fish and Game Code that addresses anadromous salmonid protection; or
- (2)** A federal incidental take statement or incidental take permit that addresses anadromous salmonid protection, for which a consistency determination has been made pursuant to Section 2080.1 of the Fish and Game Code; or
- (3)** A valid natural community conservation plan that addresses anadromous salmonid protection approved by CDFW under section 2835 of the Fish and Game Code; or
- (4)** A valid Habitat Conservation Plan (HCP) that addresses anadromous salmonid protection, approved under Section 10 of the federal Endangered Species Act of 1973; or
- (5)** Project revisions, guidelines, or take avoidance measures pursuant to a memorandum of understanding or a planning agreement entered into between the plan submitter and CDFW in preparation of obtaining a natural community conservation plan that addresses anadromous salmonid protection.

### § 923.1[943.1, 963.1]. PLANNING FOR LOGGING ROADS AND LANDINGS.

Logging roads and landings shall be planned and located within the context of a systematic layout pattern that considers 14 CCR § 923(b), uses existing logging roads and landings where feasible and appropriate, and provides access for fire and resource protection activities.

**(a)** Logging roads and landings shall be planned and located to minimize the following:

- (1)** Duplicative roads and total road mileage.
- (2)** The number of logging road watercourse crossings.
- (3)** Construction and reconstruction near watercourses, lakes, marshes, wet meadows, and other wet areas.
- (4)** Construction and reconstruction across steep areas that lead without flattening to Class I, II, III, or IV watercourses and lakes.
- (5)** Construction and reconstruction on unstable areas or in connected headwall swales.
- (6)** Construction and reconstruction near nesting sites of rare, threatened, or endangered bird species.
- (7)** Construction and reconstruction near populations of rare, threatened, or endangered plants.
- (8)** Ground disturbance and the size of cuts and fills.

**(9)** The potential for affecting surface hydrology, including but not limited to, concentrating or diverting runoff or draining the logging road or landing surface directly into a watercourse or lake.

**(10)** Maintenance needs while being compatible with the logging road classification and long-term road usage.

**(b)** No logging roads or landings shall be planned for construction (i) within 150 feet of the Class I watercourse transition line, (ii) within 100 feet of the Class II watercourse transition line on slopes greater than 30%, (iii) within Class I, II, III, or IV watercourses or lakes, (iv) within a WLPZ, or (v) in marshes, wet meadows, and other wet areas, except as follows:

**(1)** At existing logging road watercourse crossings.

**(2)** At logging road watercourse crossings to be constructed or reconstructed that are approved as part of the Fish and Game Code process (F&GC 1600 et seq.)

**(3)** At logging road watercourse crossings of Class III watercourses that are dry at the time of use.

**(c)** No logging roads or landings shall be planned for reconstruction (i) within Class I, II, III, or IV watercourses or lakes, (ii) within a WLPZ, or (iii) in marshes, wet meadows, and other wet areas, except as follows:

**(1)** At existing logging road watercourse crossings.

**(2)** At logging road watercourse crossings to be constructed or reconstructed that are approved as

part of the Fish and Game Code process (F&GC 1600 et seq.)

**(3)** At logging road watercourse crossings of Class III watercourses that are dry at the time of use.

**(d)** Logging roads and landings shall be planned and located to avoid unstable areas and connected headwall swales. The Director may approve an exception if those areas are unavoidable and site-specific measures to minimize slope instability due to logging road or landing construction or reconstruction are described and justified in the plan.

**(e)** As part of the planning and use of logging roads, landings, and watercourse crossings in the logging area, the RPF or supervised designee shall: (i) locate and map significant existing and potential erosion sites and (ii) specify feasible treatments to mitigate significant adverse impacts from the road or landing.

**(1)** The RPF shall evaluate all logging roads and landings in the logging area, including appurtenant roads, for evidence of significant existing and potential erosion sites.

**(2)** For significant existing and potential erosion sites identified per 14 CCR § 923.1 [943.1, 963.1] subsection (e) (1), the RPF shall consider the following key factors as part of developing necessary treatments:

**(A)** Type of road (permanent, seasonal, or temporary road), road location, expected log truck haul routes, and traffic use (e.g. volume and season) of each road segment during the life of the plan.

- (B)** Age of road and the history of sediment delivery from existing roads.
- (C)** Beneficial uses of the watercourse or lake and sensitive conditions potentially affected by the road including, but not limited to, watercourse classification and presence of listed anadromous salmonids.
- (D)** The hillslope grade, road grade of crossing approaches and the gradient of the stream channel.
- (E)** The erodibility of hillslope material exposed by the road.
- (F)** The length of hydrologic connectivity of a road segment, the physical properties of the connected segment and the presence or absence of an effective sediment filter strip.
- (G)** Site-specific information regarding the condition of and location of all existing or potential sediment sources including, but not limited to: watercourse crossings, road approaches, ditch relief culverts, road surfaces, road cuts, road fills, inboard ditches, through-cuts, and landings.
- (3)** The RPF shall submit a list of the significant existing and potential erosion sites identified per 14 CCR § 923.1 [943.1, 963.1], subsection (e) (1) which have feasible treatments with the plan. This list shall include the following information:
- (A)** A map showing the location(s) of significant existing and potential erosion site(s) with a unique identifier for each site.
- (B)** Brief description of present condition of the mapped significant existing or potential erosion site.
- (C)** Brief description of proposed treatments for the mapped significant existing or potential erosion site.
- (D)** Items (B) and (C) above can be provided in tabular form as part of the plan.
- (4)** The RPF shall disclose and map the significant existing and potential erosion sites identified per 14 CCR § 923.1 [943.1, 963.1], subsection (e) (1), for which no feasible treatment measures exist.
- (5)** Where feasible treatments for significant existing or potential erosion site are proposed, the RPF shall describe in the plan a logical order of treatment.
- (f)** When selecting feasible alternatives (see 14 CCR §§ 897 and 898) during the planning phase of logging roads and landings, the RPF shall consider the location and planned use of logging roads and landings and whether such logging roads and landings will be abandoned or deactivated.
- (g)** In watersheds with listed anadromous salmonids and in planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids, where logging road or landing construction or reconstruction is proposed, the plan shall identify:

**(1)** How the proposed operations will fit into the systematic layout pattern.

**(2)** What, if any, offsetting mitigation measures, including but not limited to, abandonment of logging roads and landings, are needed to minimize potential adverse impacts to watersheds from the road system.

**(h)** In watersheds with listed anadromous salmonids no logging roads or landings shall be planned for construction or reconstruction in the CMZ or Core Zone of a Class I watercourse except those listed in 14 CCR § 916.9(e)(1)(A)–(E) [936.9(e)(1)(A)–(E), 956.9(e)(1)(A)–(E)] or pursuant to 14 CCR § 916.9(v) [936.9(v), 956.9(v)], or within 150 feet of a Class I watercourse transition line.

**(i)** In watersheds with listed anadromous salmonids within the Inner Zone A and B of flood prone areas of Class I watercourses the following Preferred Management Practices should be considered for inclusion in the plan by the RPF and by the Director:

**(1)** Constructed and reconstructed logging roads and landings should not be planned for location within these zones.

**(2)** When feasible, planned use of existing logging roads and landings should be minimized in the flood prone area.

**(3)** Exceptions include the use of roads and landings to accomplish actions to improve salmonid habitat conditions stated in 14 CCR § 916.9(f) (3) (E) (1) [936.9(f) (3) (E) (1), 956.9(f) (3) (E) (1)].

## § 923.2 [943.2, 963.2]. DESIGN AND LOCATION FOR LOGGING ROADS AND LANDINGS

Constructed and reconstructed logging roads and landings shall be designed and located in accordance with their proposed use, maintenance requirements, and the approved plan:

**(a)** All logging roads and landings shall:

**(1)** Avoid or mitigate potential impacts to public safety.

**(2)** Avoid unstable areas and connected headwall swales to the extent feasible and minimize activities that adversely affect them.

**(3)** Minimize the size of cuts and fills to the extent feasible.

**(4)** Be outsloped where feasible and drained with waterbreaks and/or rolling dips in conformance with other applicable Forest Practice Rules.

**(5)** Be hydrologically disconnected from watercourses and lakes to the extent feasible to minimize sediment delivery from road runoff to a watercourse, and reduce the potential for hydrologic changes that alter the magnitude and frequency of runoff delivery to a watercourse. Guidance on methods for hydrologic disconnection may be found in the Board's Technical Rule Addendum Number 5.

**(6)** Include adequate drainage structures and facilities necessary to avoid concentrating and diverting runoff, to minimize erosion of roadbeds, landing surfaces, drainage ditches, sidecast and fills, to minimize the potential for soil erosion and sediment transport,

and to prevent significant sediment discharge. Guidance on methods for conformance with this rule section may be found in the Board's Technical Rule Addendum Number 5.

**(7)** Avoid crossing, or locations on, 100 feet or more of lineal distance over any slopes greater than 65 percent or within 100 feet of the boundary of a WLPZ on slopes greater than 50 percent that drain toward the zoned watercourse or lake. Where logging road or landing construction or reconstruction is proposed in these areas, specific measures to minimize movement of soil and the discharge of concentrated surface runoff shall be incorporated in the plan. The Director may waive inclusion of such measures where the RPF can show that slope depressions, drainage ways, and other natural retention and detention features are sufficient to control overland transport of eroded material.

**(b)** The Director may require removal of deposits of excess material if the deposits are in a position to adversely affect the beneficial uses of water.

**(c)** Excess material excavated during logging road and landing construction shall not be transported to locations where it may result in significant sediment discharge.

**(d)** In addition to the requirements of subsection (a) above, all logging roads to be constructed or to be reconstructed shall:

**(1)** Be no wider than a single-lane compatible with the largest type of equipment specified for use on the logging road, with adequate turnouts provided as required for safety, except where

wider road dimensions are required by existing contracts with a federal agency.

**(2)** Avoid grades greater than 20% or grades greater than 15% that extend greater than 500 continuous feet. Exceptions may be approved where there is no other feasible access for harvesting of timber or where use of a gradient greater than 20% will serve to reduce soil disturbance.

**(e)** In addition to the requirements of subsection (a) above, all landings to be constructed or to be reconstructed shall:

**(1)** Be consistent with the yarding and loading system to be used.

**(2)** Be no larger than one-half acre.

**(3)** Avoid construction on slopes greater than 40 percent where the landing will exceed one-quarter acre in size.

### § 923.3 [943.3, 963.3]. MAPPING AND IDENTIFICATION FOR LOGGING ROADS AND LANDINGS.

The following mapping and identification standards shall apply to logging roads and landings:

**(a)** For logging road- and landing-related mapping requirements refer to 14 CCR §§ 1034(x)(4)(A)–(E) and (5)(A)–(G), 1090.5(w)(4)(A)–(E) and (5)–(6), 1090.5(gg), 1090.7(n)(4)–(6), and 1092.09(l)(5)(A)1.–5. and (6)(A)–(G).

**(b)** The RPF shall identify in the field, for use by the LTO, all logging roads and landings to be constructed or to be reconstructed:

**(1)** Across slopes greater than 65 percent for 100 lineal feet or more.

**(2)** Across slopes greater than 50 percent for 100 lineal feet or more within 100 feet of the boundary of a WLPZ that drains toward the zoned watercourse or lake.

**(c)** The location of all logging roads to be constructed or to be reconstructed shall be flagged or otherwise identified on the ground prior to the pre-harvest inspection. Exceptions may be explained and justified in the plan and agreed to by the Director if flagging is unnecessary as a substantial aid to examining: (1) compatibility between logging road location and yarding and silvicultural systems, or (2) possible significant adverse effects of logging road location on the factors listed under 14 CCR § 923(b) [943(b), 963(b)].

### § 923.4 [943.4, 963.4]. CONSTRUCTION AND RECONSTRUCTION FOR LOGGING ROADS AND LANDINGS

Logging roads and landings shall be constructed or reconstructed in accordance with the approved plan and the following requirements. If a change in designation of logging road classification is made after the plan is approved, the change shall be reported in accordance with 14 CCR §§ 1039, 1040, 1090.14, 1092.26 or 1092.27, as appropriate.

**(a)** Logging roads and landings shall be hydrologically disconnected from watercourses and lakes to the extent feasible to minimize sediment delivery from road runoff to a watercourse, and reduce the potential for hydrologic changes that alter the magnitude and frequency of runoff delivery to a watercourse. Guidance on methods for hydrologic disconnection may be found in the Board's Technical Rule Addendum Number 5.

**(b)** No logging roads or landings shall be constructed (i) within 150 feet of the Class I watercourse transition line, (ii) within 100 feet of the Class II watercourse transition line on slopes greater than 30%, (iii) within Class I, II, III, or IV watercourses or lakes, (iv) within a WLPZ, or (v) in marshes, wet meadows, and other wet areas, except as follows:

**(1)** At existing logging road watercourse crossings.

**(2)** At logging road watercourse crossings to be constructed or reconstructed that are approved as part of the Fish and Game Code process (F&GC 1600 et seq.)

**(3)** At logging road watercourse crossings of Class III watercourses that are dry at the time of use.

**(c)** No logging roads or landings shall be reconstructed (i) within Class I, II, III, or IV watercourses or lakes, (ii) within a WLPZ, or (iii) in marshes, wet meadows, and other wet areas, except as follows:

**(1)** At existing logging road watercourse crossings.

**(2)** At logging road watercourse crossings to be constructed or reconstructed that are approved as part of the Fish and Game Code process (F&GC 1600 et seq.)

**(3)** At logging road watercourse crossings of Class III watercourses that are dry at the time of use.

**(d)** Logging roads and landings shall not be constructed or reconstructed across unstable areas or connected headwall swales except as specified in the Plan.

- (e)** Logging roads and landings shall not be constructed with overhanging banks.
- (f)** Any tree over 12 inches dbh with more than 25 percent of the root surface exposed by logging road or landing construction shall be felled concurrently with the timber operations.
- (g)** On slopes greater than 40 percent, the organic layer of the soil shall be removed prior to fill placement.
- (h)** Waste organic material, such as uprooted stumps, cull logs, accumulations of limbs and branches, and unmerchantable trees, shall not be buried in logging road or landing fills. Wood debris or cull logs and chunks may be placed and stabilized at the toe of fill to restrain excavated soil from moving downslope.
- (i)** Slash and other debris from road construction shall not be bunched against residual trees, which are required for silvicultural or wildlife purposes, nor shall it be placed in locations where it could be discharged into Class I or II watercourses or lakes.
- (j)** Where constructed fills will exceed three feet in vertical thickness, fill slopes shall be inclined no greater than 65 percent.
- (k)** Logging roads or landings shall not be constructed or reconstructed under saturated soil conditions that may produce significant sediment discharge, except that construction may occur on isolated wet spots arising from localized ground water such as springs, provided measures are taken to prevent significant sediment discharge.
- (l)** Construction or reconstruction of logging roads or landings shall not take place during the winter period unless the approved plan incorporates a complete winter period operating plan pursuant to 14 § CCR 914.7 [934.7, 954.7] that specifically addresses such logging road or landing construction or reconstruction.
- (m)** On slopes greater than 50 percent for greater than 100 lineal feet, fills greater than four feet in vertical height at the outside shoulder of the logging road or landing shall be:
- (1)** Constructed on a bench that is excavated at the proposed toe of the fill and is wide enough to compact the first lift.
  - (2)** Compacted in approximately one-foot lifts from the toe to the finished grade or retained by an engineered structure.
- (n)** Logging roads and landings approved for construction or reconstruction across 100 feet or more of lineal distance on any slope greater than 65 percent or within 100 feet of the boundary of a WLPZ on slopes greater than 50 percent that drain toward the zoned watercourse or lake shall be constructed to the specific construction techniques or measures as described in the plan.
- (o)** Fills shall not be constructed on slopes greater than 65 percent.
- (p)** On slopes greater than 65 percent, sidecast from logging road and landing construction shall be minimized to the degree feasible.
- (q)** Excess material transported from logging road or landing construction or reconstruction shall be deposited and stabilized in a manner and in areas that avoid potential adverse impacts to locations that could deliver significant sediment discharge.

**(r)** In watersheds with listed anadromous salmonids, no logging roads or landings shall be constructed or reconstructed within the CMZ or Core Zone of a Class I watercourse except for those listed in 14 CCR § 916.9 [936.9, 956.9], subsections (e)(1)(A)–(F) or pursuant to 14 CCR § 916.9 [936.9, 956.9], subsection (v).

**(s)** In watersheds with listed anadromous salmonids and in planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids, the following shall apply:

**(1)** On slopes greater than 50 percent that have access to a watercourse or lake:

**(A)** Specific provisions for the protection of salmonid habitat shall be identified and described for all logging road construction.

**(B)** Where cutbank stability is not an issue, logging roads may be constructed as a full-benched cut (no fill). Spoils not utilized in logging road construction shall be disposed of in stable areas with less than 30 percent slope outside of any WLPZ, EEZ, or ELZ designated for watercourse or lake protection. The Director, with concurrence from other responsible agencies, may waive inclusion of these measures where the RPF can show that slope depressions and other natural retention and detention features are sufficient to control overland transport of eroded material.

**(C)** Logging roads may be constructed with balanced cuts and fills:

**(i)** If properly engineered, or,

**(ii)** If fills are removed and the slopes recontoured prior to the winter period.

**(2)** During the extended wet weather period, no timber operations shall take place unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § 914.7(b) [934.7(b), 954.7(b)]. The winter period operating plan shall specifically address, where applicable, proposed logging road and landing construction, and reconstruction.

### § 923.5 [943.5,963.5]. EROSION CONTROL FOR LOGGING ROADS AND LANDINGS.

The following erosion control standards shall apply to logging roads and landings:

**(a)** All logging road and landing surfaces shall be adequately drained through the use of logging road and landing surface shaping in combination with the installation of drainage structures or facilities and shall be hydrologically disconnected from watercourses and lakes to the extent feasible.

Guidance on methods for hydrologic disconnection may be found in the Board's Technical Rule Addendum Number 5.

**(b)** Drainage facilities and structures shall be installed along all logging roads and all landings that are used for timber operations in sufficient number to minimize soil erosion and sediment transport and to prevent significant sediment discharge.

**(c)** Ditch drains, associated necessary protective structures, and other features associated with the ditch drain shall:

**(1)** Be adequately sized to convey runoff.

**(2)** Minimize erosion of logging road and landing surfaces.

**(3)** Avoid discharge onto unprotected fill.

**(4)** Discharge to erosion resistant material.

**(5)** Minimize potential adverse impacts to slope stability.

**(d)** Waterbreaks and rolling dips installed across logging roads and landings shall be of sufficient size and number and be located to avoid collecting and discharging concentrated runoff onto fills, erodible soils, unstable areas, and connected headwall swales.

**(e)** Where logging roads or landings do not have permanent and adequate drainage, and where waterbreaks are to be used to control surface runoff, the waterbreaks shall be cut diagonally a minimum of six inches into the firm roadbed and shall have a continuous firm embankment of at least six inches in height immediately adjacent to the lower edge of the waterbreak cut. On logging roads that have firmly compacted surfaces, waterbreaks may be installed by hand methods and need not provide the additional six-inch embankment provided the waterbreak ditch is constructed so that it is at least six inches deep and six inches wide on the bottom and provided there is ample

evidence based on slope, material, amount of rainfall, and period of use that the waterbreaks so constructed will be effective in diverting water flow from the logging road surface without the embankment.

**(f)** Distances between waterbreaks shall not exceed the following standards and consider erosion hazard rating and road gradient:

**(g)** Where outsloping and rolling dips are used to control surface runoff, the dip in the logging road grade shall be sufficient to capture runoff from the logging road surface. The steepness of cross-slope gradient in conjunction with the logging road or landing gradient and the estimated soil erosion hazard rating shall be used to determine the rolling dip spacing in order to minimize soil erosion and sediment transport and to prevent significant sediment discharge. Guidance on rolling dip spacing may be found in the Board's Technical Rule Addendum Number 5.

**(h)** Drainage facilities and structures shall discharge into vegetation, woody debris, or rock wherever possible. Where erosion-resistant material is not present, slash, rock, or other energy dissipating material shall be installed below the drainage facility or drainage structure outlet as necessary to minimize soil erosion and sediment transport and to prevent significant sediment discharge. Guidance on energy dissipaters

**MAXIMUM DISTANCE BETWEEN WATERBREAKS**

Estimated Hazard Rating	Logging Road 10 or less	Gradient in Percent 11–25	>25
	Feet	Feet	Feet
Extreme	100	75	50
High	150	100	75
Moderate	200	150	100
Low	300	200	150

for drainage structures may be found in the Board's Technical Rule Addendum Number 5.

**(i)** Where logging road and landing surfaces, road approaches, inside ditches and drainage structures cannot be hydrologically disconnected, and where there is existing or the potential for significant sediment discharge, necessary and feasible treatments to prevent the discharge shall be described in the plan.

**(j)** All logging roads and landings used for timber operations shall have adequate drainage upon completion of use for the year or by October 15, whichever is earlier. An exception is that drainage facilities and drainage structures do not need to be constructed on logging roads and landings in use during the extended wet weather period provided that all such drainage facilities and drainage structures are installed prior to the start of rain that generates overland flow.

**(k)** Where logging road or landing construction or reconstruction takes place during the extended wet weather period, drainage facilities and drainage structures shall be installed concurrent with construction or reconstruction operations.

**(l)** Bare soil on logging road or landing cuts, fills, transported spoils, or sidecast that is created or exposed by timber operations shall be stabilized to the extent necessary to minimize soil erosion and sediment transport and to prevent significant sediment discharge. Sites to be stabilized include, but are not limited to:

**(1)** Sidecast or fill exceeding 20 feet in slope distance from the outside edge of a logging road or a landing that has access to a watercourse or lake.

**(2)** Cut and fills associated with approaches to logging road watercourse crossings of Class I or II waters or Class III waters where an ELZ, EEZ, or a WLPZ is required.

**(3)** Bare areas exceeding 800 continuous square feet within a WLPZ.

**(m)** Soil stabilization measures shall be described in the plan pursuant to 14 CCR 923.5(l) [943.5(l),963.5(l)], and may include, but are not limited to, removal, armoring with rip-rap, replanting, mulching, seeding, installing commercial erosion control devices to manufacturer's specifications, or chemical stabilizers.

**(n)** Where the natural ability of ground cover within a WLPZ is inadequate to protect the beneficial uses of water by minimizing soil erosion or by filtering sediments, the plan shall specify protection measures to retain and improve the natural ability of the ground cover to filter sediment and minimize soil erosion.

**(o)** Soil stabilization treatments shall be in place upon completion of operations for the year of use or prior to the extended wet weather period, whichever comes first. An exception is that bare areas created during the extended wet weather period shall be treated prior to the start of rain that generates overland flow, or within 10 days, whichever is sooner, or as agreed to by the Director.

**(p)** Overhanging or unstable concentrations of slash, woody debris or soil along the downslope edge or face of landings shall be removed or stabilized when it is located on slopes greater than 65 percent, within 100 feet of the boundary of a WLPZ on slopes greater than 50 percent that drain toward the zoned watercourse or

lake, or when it may result in significant sediment discharge. Removed materials shall not be placed at disposal sites that could result in a significant sediment discharge.

**(q)** In watersheds with listed anadromous salmonids and in planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids, the following shall apply:

**(1)** Constructed and reconstructed logging roads shall be outsloped where feasible and drained with waterbreaks or rolling dips.

**(2)** In addition to the provisions listed under 14 CCR § 923.2(d)(2) [943.2(d)(2), 963.2(d)(2)], all permanent and seasonal logging roads with a grade of 15 percent or greater that extend 500 continuous feet or more shall have specific erosion control measures stated in the plan.

**(3)** Within the WLPZ, and within any ELZ or EEZ designated for watercourse or lake protection, treatments to stabilize soils, minimize soil erosion, and prevent significant sediment discharge shall be described in the plan as follows:

**(A)** In addition to the requirements of subsections (l)–(o), soil stabilization is required for the following areas:

**(i)** Areas exceeding 100 continuous square feet where timber operations have exposed bare soil, and

**(ii)** Disturbed logging road and landing cut banks and fills, and

**(iii)** Any other area of disturbed soil that threatens to cause significant sediment discharge.

**(B)** Where straw mulch is used, the minimum straw coverage shall be 90 percent, and any treated area that has been reused or has less than 90 percent surface cover shall be treated again by the end of timber operations.

**(C)** Where slash mulch is applied, a minimum of 75% of the area shall be covered by slash in contact with the ground.

**(D)** For areas disturbed outside of the extended wet weather period, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface that could result in significant sediment discharge.

**(E)** For areas disturbed during the extended wet weather period, treatment shall be completed prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days of disturbance, whichever is earlier.

**(F)** Where the natural ability of ground cover is inadequate to protect the beneficial uses of water by minimizing soil erosion or by filtering sediments within any ELZ or EEZ designated for watercourse or lake protection, the plan shall specify protection measures to retain and improve the natural ability of the ground cover to filter sediment and minimize soil erosion.

## § 923.6 [943.6, 963.6]. USE OF LOGGING ROADS AND LANDINGS

The following use standards shall apply to logging roads and landings:

**(a)** Logging roads and landings shall be used in a manner that is consistent with their design and construction specifications.

**(b)** Logging roads and landings shall not be used during any time of the year when operations may result in significant sediment discharge to watercourse or lakes, except in emergencies to protect the road, to reduce erosion, to protect water quality, or in response to public safety needs.

**(c)** During the extended wet weather period, Log hauling or other heavy equipment uses shall be limited to logging roads and landings that exhibit a stable operating surface in conformance with (b) above. Routine use of logging roads and landings shall not occur when equipment cannot operate under its own power.

**(d)** When burning permits are required pursuant to PRC § 4423, logging roads and landings that are in use shall be kept in passable condition for fire trucks.

**(e)** Roadside berms that impede logging road drainage, concentrate logging road surface flow, or lead to hydrologic connection shall be removed or breached before the beginning of the winter period, with the exception of berms needed for erosion control.

**(f)** Temporary roads shall be blocked or otherwise closed to standard production four-wheel drive highway vehicles prior to the winter period, or upon completion of use as specified in an approved

winter period operating plan pursuant to 14 CCR § 914.7(b) [934.7(b), 954.7(b)].

**(g)** Logging roads and landings used for log hauling or other heavy equipment uses during the winter period shall occur on a stable operating surface and, where necessary, be surfaced with rock to a depth and quantity sufficient to maintain such a surface. Use is prohibited on roads that are not hydrologically disconnected and exhibit saturated soil conditions. Exceptions may be proposed by the RPF, when locations are disclosed and justified in the THP, consistent with 14 CCR 923 (c), and approved by the Director.

**(h)** In watersheds with listed anadromous salmonids and in planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids, the following shall apply:

**(1)** Existing logging roads or landings shall not be used within the CMZ of a Class I watercourse except as listed in 14 CCR § 916.9 916.9 [936.9, 956.9] subsection (e) (1) (A)–(F) or pursuant to 14 CCR § 916.9(v) [936.9(v), 956.9(v)].

**(2)** When feasible, minimize use of existing logging roads and landings located within Inner Zones A and B of flood prone areas. Exceptions include the use of roads and landings to accomplish actions to improve salmonid habitat conditions stated in 14 CCR § 916.9 916.9(f) (3) (E) (1.) [936.9(f) (3) (E) (1.), 956.9(f) (3) (E) (1.)]

**(3)** Log hauling on logging roads and landings shall be limited to those which are hydrologically disconnected from watercourses to the extent feasible, and exhibit a stable operating surface in conformance with (b) above. Exceptions

may be proposed by the RPF, when locations are disclosed and justified in the THP, consistent with 14 CCR 923 (c), and approved by the Director.

**(4)** Concurrent with use for log hauling, all road approaches to logging road watercourse crossings shall be treated for erosion control as needed to minimize soil erosion and sediment transport and to prevent significant sediment discharge to watercourses or lakes.

**(5)** Concurrent with use for log hauling, all traveled surfaces of logging roads in a WLPZ, and ELZ or EEZ designated for watercourse or lake protection, shall be treated for erosion control as needed to minimize soil erosion and sediment transport and to prevent significant sediment discharge to watercourses or lakes.

**(6)** No timber operations shall take place during the extended wet weather period unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § 914.7(b) [934.7(b), 954.7(b)] that specifically addresses, where applicable, proposed logging road or landing use.

### § 923.7, 943.7, 963.7 MAINTENANCE AND MONITORING FOR LOGGING ROADS AND LANDINGS

The following maintenance and monitoring standards shall apply to logging roads and landings:

**(a)** Logging road and landing surfaces shall be monitored and maintained during timber operations and throughout the prescribed maintenance period to ensure hydrologic disconnection from watercourses

and lakes to the extent feasible, minimize soil erosion and sediment transport, and to prevent significant sediment discharge.

**(b)** Logging roads that are used in connection with stocking activities shall be maintained throughout such use, even if this extends beyond the prescribed maintenance period.

**(c)** During timber operations, road running surfaces in the logging area shall be treated as necessary to prevent excessive loss of road surface materials by methods including, but not limited to, rocking, watering, paving, chemically treating, or installing commercial erosion control devices to manufacturer's specifications.

**(d)** Grading of logging roads or landings to obtain a drier running surface more than one time before reincorporation of any resulting berms back into the road surface is prohibited.

**(e)** Drainage facilities and drainage structures, including associated necessary protective structures, shall be maintained to allow free flow of water, and minimize soil erosion and slope instability. Drainage facilities and structures shall be repaired, replaced, or installed as needed to protect the quality and beneficial uses of water.

**(f)** Soil stabilization treatments on logging road or landing cuts, fills, and sidecast shall be maintained as needed to reduce the potential for slope instability, minimize soil erosion and sediment transport, and to prevent significant sediment discharge.

**(g)** Heavy equipment shall not be used in a WLPZ for maintenance during wet weather, except in emergencies to protect the road, to reduce erosion, to protect water quality, or in response to public safety needs.

- (h)** Where there is evidence of significant sediment discharge along a logging road or landing used for timber operations, additional measures shall be implemented to minimize soil erosion and sediment transport, and to prevent significant sediment discharge.
- (i)** The prescribed maintenance period for erosion controls on logging roads and associated landings and drainage structures, including appurtenant, abandoned, and deactivated logging roads and landings, shall be at least one year. The Director may prescribe a maintenance period extending up to three years in accordance with 14 CCR § 1050.
- (j)** In watersheds with listed anadromous salmonids and in planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids, the prescribed maintenance period for deactivated or abandoned roads shall be one year unless otherwise prescribed by the Director pursuant to 14 CCR § 1050. The prescribed maintenance period for logging roads and associated landings, including appurtenant roads, shall be three years.
- (k)** All logging roads, including abandoned, deactivated, and appurtenant roads, landings, and associated drainage structures used for timber operations shall be monitored as needed to comply with 14 CCR § 1050. Monitoring inspections shall be conducted, when access is feasible during the prescribed maintenance period, a sufficient number of times during the extended wet weather period, particularly after large winter storm events and at least once annually, to evaluate the function of drainage facilities and structures. The Department shall also conduct monitoring inspections at least once during the

prescribed maintenance period to assess logging road and landing conditions.

- (1)** Inspections shall include checking drainage facilities and structures for evidence of downcutting, plugging, overtopping, loss of function, and sediment delivery to Class I, II, or III watercourses and lakes. If evidence of sediment delivery or potential sediment delivery is present, and the implementation of feasible corrective measures could reduce the potential for significant sediment discharge, such additional measures shall be implemented when feasible.
- (2)** Inspections conducted pursuant to California Regional Water Quality Control Board requirements may be used to satisfy the inspection requirements of this section.
- (l)** In watersheds with listed anadromous salmonids, water drafting for timber operations shall:
- (1)** Comply with Fish and Game Code Section 1600, et seq. Timber operations conducted under a Fish and Game Code Section 1600 Master Agreement for Timber Operations that includes water drafting may provide proof of such coverage for compliance with 14 CCR 923.7(l).
- (2)** Describe the water drafting site conditions and proposed water drafting activity in the plan, including:
- (A)** A general description of the conditions and proposed water drafting;
- (B)** The watercourse classification;

- (C)** The drafting parameters including the months the site is proposed for use; estimated total volume needed per day; estimated maximum instantaneous drafting rate and filling time; and disclosure of other water drafting activities in the same watershed;
- (D)** The estimated drainage area (acres) above the point of diversion;
- (E)** The estimated unimpeded streamflow, pumping rate, and drafting duration,
- (F)** a discussion of the effects on aquatic habitat downstream from the drafting site(s) of single pumping operations, or multiple pumping operations at the same location, and at other locations in the same watershed;
- (G)** A discussion of proposed alternatives and measures to prevent adverse effects to fish and wildlife resources, such as reducing hose diameter; using gravity-fed tanks instead of truck pumping; reducing the instantaneous or daily intake at one location; describing allowances for recharge time; using other dust palliatives; and drafting water at alternative sites;
- (H)** The methods that will be used to measure source streamflow prior to the water drafting operation and the conditions that will trigger streamflow to be measured during the operation.

**(3)** All water drafting for timber operations are subject to each requirement below unless the Department of

Fish and Game modifies the requirement in the Lake or Streambed Alteration agreement that authorized the drafting operation, or unless otherwise specified below:

- (A)** All intakes shall be screened to prevent impingement of juvenile fish against the screen. The following requirements apply to screens and water drafting on Class I waters:
  - (i)** Openings in perforated plate or woven wire mesh screens shall not exceed 3/32 inches (2.38 millimeters). Slot openings in wedge wire screens shall not exceed 1/16 inches (1.75 millimeters).
  - (ii)** The screen surface shall have at least 2.5 square feet of openings submerged in water.
  - (iii)** The drafting operator shall regularly inspect, clean, and maintain screens to ensure proper operation whenever water is drafted.
  - (iv)** The approach velocity (water moving through the screen) shall not exceed 0.3 feet/second.
  - (v)** The diversion rate shall not exceed 350 gallons per minute.
- (B)** Approaches and associated drainage features to drafting locations within a WLPZ or channel zone shall be surfaced with rock or other suitable material to minimize generation of sediment.

**(C)** Barriers to sediment transport, such as straw wattles, logs, straw bales or sediment fences, shall be installed outside the normal high water mark to prevent sediment delivery to the watercourse and limit truck encroachment.

**(D)** Water drafting trucks parked on streambeds, floodplains, or within a WLPZ shall use drip pans or other devices such as adsorbent or absorbent blankets, sheet barriers or other materials as needed to prevent soil and water contamination from motor oil or hydraulic fluid leaks.

**(E)** Bypass flows for Class I watercourses shall be provided in volume sufficient to avoid dewatering the watercourse and maintain aquatic life downstream, and shall conform to the following standard:

**(i)** Bypass flows in the source stream during drafting shall be at least 2 cubic feet per second.

**(ii)** Diversion rate shall not exceed 10 percent of the surface flow.

**(iii)** Pool volume reduction shall not exceed 10 percent.

**(F)** The drafting operator shall keep a log that records for each time water is drafted, the date, total pumping time, pump rate, starting time, ending time, and volume diverted. Logs shall be filed with the Department of Forestry and Fire Protection at the end of seasonal operations and maintained with the plan record. This requirement may be modified in the approved plan that covers the water drafting,

but only with concurrence from the Department of Fish and Game.

**(G)** Before commencing any water drafting operation, the RPF and the drafting operator shall conduct a pre-operations field review to discuss the water drafting measures in the plan and/or Lake or Streambed Alteration Agreement.

### **§ 923.8[943.8, 963.8]. ABANDONMENT AND DEACTIVATION OF LOGGING ROADS AND LANDINGS.**

All logging roads and landings that are proposed to be removed from the permanent road network shall be abandoned. All temporary logging roads and landings that are to remain a part of the permanent road network shall be deactivated annually prior to the winter period or upon completion of timber operations as specified in an approved winter period operating plan pursuant to 14 CCR § 914.7(b) [934.7(b), 954.7(b)]. Other logging roads and landings proposed to be deactivated shall comply with the standards specified in this section. Where abandonment or deactivation is required or proposed, specific measures to prevent significant sediment discharge that apply the following general requirements shall be described in the plan:

**(a)** All abandoned and deactivated logging roads and landings shall be left in a condition that provides for long-term, maintenance-free function of drainage and erosion controls.

**(b)** Soil exposed by abandonment or deactivation operations shall be removed or stabilized as needed to minimize soil erosion and sediment transport.

**(c)** Logging road watercourse crossings, other drainage structures, and associated fills shall be removed and stabilized in accordance with 14 CCR § 923.9 [943.9, 963.9], subsections (p)(1)–(4).

**(d)** Logging roads to be abandoned or deactivated shall be blocked prior to the winter period, or upon completion of timber operations as specified in an approved winter period operating plan pursuant to 14 CCR § 914.7(b) [934.7(b), 954.7(b)], so that standard production four wheel-drive highway vehicles cannot pass the point of closure at the time of abandonment or deactivation. If the logging road is to be abandoned, then the blockage design shall be described in the plan.

### § 923.9 [943.9, 963.9]. WATERCOURSE CROSSINGS [ALL DISTRICTS]

Watercourse crossing drainage structures on logging roads shall be planned, constructed, reconstructed, and maintained or removed according to the standards provided in this rule section.

**(a)** The planning for and use of logging road watercourse crossings shall include the evaluation and documentation of significant existing and potential erosion sites consistent with 14 CCR § 923.1(e) [943.1(e), 963.1(e)].

**(b)** The number of crossings shall be kept to a feasible minimum. Existing logging road watercourse crossing locations shall be utilized where feasible and appropriate.

**(c)** All new drainage structures and facilities on watercourses that support fish or listed aquatic species shall allow for unrestricted passage of all life stages that may be present, and allow for the natural

movement of bedload to form a continuous bed through the crossing. Such structures and facilities shall be fully described in the plan in sufficient clarity and detail to allow evaluation by the review team and the public, provide direction to the LTO for implementation, and provide enforceable standards for the inspector.

**(d)** In watersheds with listed anadromous salmonids, a description of all existing permanent Class I watercourse crossings shall be provided, where fish are always or seasonally present or where fish passage is restorable. Where it is determined that current crossing conditions may be adversely affecting fish passage at any life stage, the RPF shall disclose such conditions in the plan and propose measures, if feasible, to address these conditions subject to the Director's review and determination.

**(e)** The location of all new permanent constructed and reconstructed, and temporary logging road watercourse crossings, including those crossings to be abandoned or deactivated, shall be shown on a map. If the structure is a culvert intended for permanent use, the minimum diameter of the culvert and the method(s) used to determine the culvert diameter shall be specified in the plan.

**(1)** The location of all logging road watercourse crossings to be constructed or reconstructed shall be flagged or otherwise identified on the ground prior to the pre-harvest inspection, if necessary, or prior to logging road watercourse crossing construction or reconstruction. Exceptions may be explained and justified in the plan and agreed to by the Director if flagging is unnecessary as a substantial aid to examining possible significant adverse effects of the

crossing location on the factors listed under 14 CCR § 923(b) [943(b), 963(b)].

**(f)** All permanent watercourse crossings that are constructed or reconstructed shall accommodate the estimated 100-year flood flow, including debris and sediment loads.

**(g)** All culverts used for new and replacement logging road watercourse crossings shall be installed at or as close as practical and feasible to the natural watercourse grade. Culverts shall be installed in alignment with the watercourse channel to the extent feasible, and of the appropriate length to prevent fill erosion.

**(h)** Logging road watercourse crossings shall not discharge water onto erodible fill or other erodible material without the installation of energy dissipaters and other necessary protective structures.

**(i)** Fills for constructed and reconstructed logging road watercourse crossings shall be thoroughly compacted in approximately one-foot lifts during installation. The face of crossing fills shall be no greater than 65 percent (1.5:1, horizontal to vertical). Excavated material and cut banks resulting from construction or reconstruction which has access to a watercourse shall be sloped back from the channel to prevent slumping, to minimize soil erosion, and to prevent significant sediment discharge.

**(j)** Critical dips shall be incorporated into the construction or reconstruction of logging road watercourse crossings utilizing culverts, except where diversion of overflow is addressed by other methods stated in the plan.

**(k)** Watercourse crossings and associated fills and approaches shall be constructed and maintained to prevent diversion of

stream overflow down the road, and to minimize fill erosion should the drainage structure become obstructed. Methods to mitigate or address diversion of stream overflow at logging road watercourse crossings shall be stated in the plan.

**(l)** Any necessary protective structures associated with logging road watercourse crossings such as wing walls, rock armored headwalls, and downspouts shall be adequately sized to transmit runoff, minimize erosion of crossing fills, and prevent significant sediment discharge. Rock used to stabilize the outlets of crossings shall be adequately sized to resist mobilization, with the range of required rock dimensions described in the plan.

**(m)** The following drainage standards shall apply to logging road watercourse crossings:

**(1)** Adequate surface drainage at logging road watercourse crossings shall be provided through the use of logging road surface shaping in combination with the installation of drainage facilities, ditch drains, or other necessary protective structures to hydrologically disconnect the road from the crossing to the extent feasible.

**(2)** Consistent with 14 CCR § 923.5(a)–(i) [943.5(a)–(i), 963.5(a)–(i)], drainage facilities and ditch drains shall be installed adjacent to logging road watercourse crossings, as needed, to hydrologically disconnect to the extent feasible the logging road approach from the crossing, to minimize soil erosion and sediment transport, and to prevent significant sediment discharge during and upon completion of timber operations. Guidance on hydrologic disconnection may be found in the Board’s Technical Rule Addendum Number 5.

**(3)** Drainage structures and facilities installed adjacent to logging road watercourse crossings shall be located to avoid discharging concentrated runoff onto fills, erodible soils, unstable areas, and connected headwall swales to the extent feasible.

**(n)** Where a significant volume of sediment is stored upstream from a logging road watercourse crossing that is proposed to be reconstructed or removed, the stored sediment shall be removed or stabilized, to the extent feasible, as described in the plan and in conformance with the conditions of required CDFW 1600 agreements, where applicable.

**(o)** Where crossing fills over culverts are large, or where logging road watercourse crossing drainage structures and erosion control features historically have a high failure rate, such drainage structures and erosion control features shall be oversized, designed for low maintenance, reinforced, or removed before the completion of timber operations or as specified in the plan. Guidance on reducing the potential for failure at high risk watercourse crossings may be found in the Board's Technical Rule Addendum Number 5.

**(p)** All logging road watercourse crossings that are proposed by the plan submitter to be removed, including temporary crossings and those along abandoned or deactivated roads, shall be removed as described in the plan and shall apply the following standards:

**(1)** Fills shall be excavated to form a channel that is as close as feasible to the natural watercourse grade and orientation, and that is wider than the natural channel as observed upstream and downstream of the logging road watercourse crossing to be removed.

**(2)** The excavated material and any resulting cut bank shall be no greater than 65 percent (1.5:1, horizontal to vertical) from the outside edge of the constructed channel to prevent slumping, and to minimize soil erosion and sediment transport, and to prevent significant sediment discharge. Exposed soil located between the watercourse crossing and the nearest adjacent drainage facility or hydrologic divide, whichever is closer, including cut banks and excavated material, shall be stabilized by seeding, mulching, rock armoring, replanting, or other suitable treatment to prevent soil erosion and significant sediment discharge.

**(3)** Where it is not feasible to remove a logging road watercourse crossing or its associated fill to the above standards, the plan shall identify how soil erosion and significant sediment discharge will be prevented.

**(4)** All logging road watercourse crossings proposed for removal shall be removed upon completion of use, prior to the winter period or as specified in the applicable CDFW 1600 agreement, whichever is earlier, or as otherwise specified in the plan.

**(q)** Logging road watercourse crossings shall not be constructed or reconstructed under saturated soil conditions or when such activities could result in significant sediment discharge.

**(r)** Temporary logging road watercourse crossings shall be removed and stabilized prior to the winter period or as specified in the plan.

**(s)** In watersheds with listed anadromous salmonids and in planning watersheds

immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids, where construction or reconstruction is proposed during the extended wet weather period, no timber operations shall take place unless the approved plan incorporates a complete winter period operating plan pursuant to 14 CCR § 914.7(b) [934.7(b), 954.7(b)] that specifically addresses such construction or reconstruction.

**(t)** The following stabilization standards shall apply to logging road watercourse crossings:

**(1)** Soil stabilization measures shall be described in the plan and may include, but are not limited to, removal, armoring with rip-rap, replanting, mulching, seeding, installing commercial erosion control devices to manufacturer's specifications, or chemical stabilizers.

**(2)** Bare soil on fills or sidecast associated with logging road watercourse crossings that are created or exposed by timber operations shall be stabilized to the extent necessary to minimize soil erosion and sediment transport and to prevent significant sediment discharge. Erosion control measures for the traveled surface of roads and landing surfaces are specified in 14 CCR §§ 923.5 [943.5, 963.5] and 923.7 [943.7, 963.7]. Sites to be stabilized include, but are not limited to, sidecast or fill exceeding 20 feet in slope distance from the outside edge of the road surface at the logging road watercourse crossing.

**(3)** Soil stabilization treatments shall be in place upon completion of operations for the year of use or prior to the extended wet weather period,

whichever comes first. An exception is that bare areas created during the extended wet weather period shall be treated prior to the start of rain that generates overland flow, or within 10 days, whichever is sooner, or as agreed to by the Director.

**(4)** In watersheds with listed anadromous salmonids and in planning watersheds immediately upstream of, and contiguous to, any watershed with listed anadromous salmonids, treatments to stabilize soils, minimize soil erosion, and prevent significant sediment discharge within the WLPZ and within any ELZ or EEZ designated for watercourse or lake protection, shall be described in the plan as follows:

**(A)** In addition to the requirements of 14 CCR § 923.9(p) (1)–(3) [943.9(p) (1)–(3), 963.9(p) (1)–(3)], soil stabilization is required for the following:

**(i)** Areas exceeding 100 continuous square feet where timber operations have exposed bare soil.

**(ii)** Disturbed logging road watercourse crossing cut banks and fills, and

**(iii)** Any other area of disturbed soil that threatens to cause significant sediment discharge.

**(B)** Where straw mulch is used, the minimum straw coverage shall be 90 percent, and any treated area that has been reused or has less than 90 percent surface cover shall be treated again by the end of timber operations.

**(C)** Where slash mulch is applied, slash coverage in contact with the ground surface shall be a minimum of 75 percent.

**(D)** For areas disturbed outside the extended wet weather period, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface that could result in significant sediment discharge.

**(E)** For areas disturbed during the extended wet weather period, treatment shall be completed prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days of disturbance, whichever is earlier.

**(u)** Logging road watercourse crossings shall be monitored and maintained during timber operations and throughout the prescribed maintenance period as needed, to comply with 14 CCR § 1050. The prescribed maintenance period is specified in 14 CCR § 923.7(i)–(j) [943.7(i)–(j), 963.7(i)–(j)]. Monitoring inspections shall be conducted, when access is feasible during the prescribed maintenance period, a sufficient number of times during the extended wet weather period, particularly after large winter storm events and at least once annually, to evaluate watercourse crossing function. The Department shall also conduct monitoring inspections at least once during the prescribed maintenance period to assess watercourse crossing conditions.

**(1)** Inspections shall include checking watercourse crossings for evidence of downcutting, plugging, overtopping, loss of function, and sediment delivery to Class I, II, or III watercourses and lakes. If evidence

of sediment delivery or potential sediment delivery is present, and the implementation of feasible corrective measures could reduce the potential for significant sediment discharge, such additional measures shall be implemented when feasible.

**(2)** Inspections conducted pursuant to California Regional Water Quality Control Board requirements may be used to satisfy the inspection requirements of this section.

**(v)** Logging road watercourse crossings shall be maintained as designed, constructed, and reconstructed during timber operations and throughout the prescribed maintenance period. Crossings used in connection with stocking activities shall be maintained throughout such use, even if this extends beyond the prescribed maintenance period.

## B. BOARD OF FORESTRY TECHNICAL RULE ADDENDUM NO. 5

### GUIDANCE ON HYDROLOGIC DISCONNECTION, ROAD DRAINAGE, MINIMIZATION OF DIVERSION POTENTIAL, AND HIGH RISK CROSSINGS

#### Purpose

The purpose of this technical rule addendum is to provide guidance to Registered Professional Foresters (RPFs), Licensed Timber Operators (LTOs), Timberland Owners, and agency personnel on hydrologic disconnection of road segments and logging road drainage, as required by the Forest Practice Rules pursuant to 14 CCR § 923 et seq. [943 et seq., 963 et seq.]. Logging roads cannot be completely disconnected from watercourses in all locations. This addendum provides assistance in understanding where disconnection is necessary and where site-specific field observations indicate that key areas and problem indicators combine to result in significant existing or potential erosion sites. The information contained herein is designed to be integrated with site-specific evaluation of logging road conditions in the field.

Part I of this addendum presents an introduction to the concept of hydrologic disconnection, a method to evaluate existing hydrologic connectivity, and treatment measures available to achieve hydrologic disconnection. Part II contains guidance on the appropriate location of drainage facilities and structures, installation of energy dissipators, road surface outsloping, and placement of rolling dips. Part III describes diversion potential at watercourse crossings and the importance of critical dip installation. Part IV describes crossings with higher risk of failure and potential approaches that can be used to reduce the risk of catastrophic failure. Part V concludes

with a table and several figures that illustrate the concepts discussed in the text of the addendum.

#### I. Hydrologic Disconnection

As defined in 14 CCR § 895.1, hydrologic disconnection means the removal of direct routes of drainage or overland flow of road runoff to a watercourse or lake. The goal of hydrologic disconnection is to minimize sediment delivery and hydrologic change derived from road runoff being routed to a watercourse (Refer to **Figure 1**). Hydrologic disconnection is achieved by creating a road surface and drainage configuration that directs water to discharge from the road in a location where it is unlikely to directly flow into a watercourse. Hydrologic disconnection can be accomplished by directing road runoff onto effective filter strips. Filter strips should have high infiltration capacity and dense vegetation and/or obstructions (e.g., woody debris, slash) to dissipate energy, facilitate percolation, and resist or prevent erosion and channelization. Hydrologic connectivity increases the potential for the road segment to deliver road-derived sediment and road chemicals, including spills, to a watercourse. When roads are connected to watercourses, this effectively increases the drainage density of the watershed, producing hydrologic changes that can alter the magnitude and frequency of runoff delivery to watercourses. The proportion of road prisms that are hydrologically connected is strongly controlled by road location, road design, road maintenance, local topography, geology, and factors that control the amount of road runoff (e.g., the amount of annual precipitation).

Hydrologically connected roads can deliver water and sediment via inside ditches that drain to a watercourse crossing; by a connected road drainage structure or facility (i.e., ditch drain culvert, rolling dip, waterbreak, or lead-off inside ditch that delivers runoff to a watercourse channel); or by direct runoff from the road running surface to a watercourse

at road crossings (Refer to **Figure 1**). **In the western U.S., road-watercourse crossings account for the majority of the connected road length**, followed by gullies formed by concentrated runoff at drainage structure or facility outlets. Evidence of connection below a road drainage structure or facility is provided by: (1) indication of surface flow between the drainage structure outlet and a defined channel or a flood prone area; (2) a channel that extends from a road drainage structure outlet to the high water line of a defined channel or a flood prone area; (3) a sediment deposit that reaches the high water line of a defined channel or a flood prone area; (4) observation of turbid water reaching the watercourse during runoff events; or (5) indications of channel widening and/or incision below a drainage structure resulting from increases in flow.

Primary mechanisms for decreasing hydrologic connectivity are: (1) installation of a “disconnecting” drainage facility or structure close to the watercourse crossing; (2) increasing the frequency of ditch drain (relief) culvert spacing for roads with inside ditches; (3) converting crowned, or insloped roads with inside ditches, to outsloped roads with rolling dips; (4) removing or breaching outside berms on crowned or outsloped roads to facilitate effective drainage; (5) applying treatments to dissipate energy, disperse flows, and minimize erosion at road drainage outlets not connected to watercourses; and (6) avoiding concentration of flows onto unstable areas. In particular, the distance between a watercourse crossing and the first upslope adequately functioning and sized road drainage facility or structure is of high importance because this distance has a large influence on the volume of water and sediment delivered to a watercourse.

Not all road segments are hydrologically connected and complete hydrologic disconnection is not possible for most roads. For example, insloped road segments with an inside ditch

will generally include a segment that is connected between the watercourse and first road drainage facility or structure located up-grade from the watercourse crossing (Refer to **Figure 2**). The likelihood of connectivity generally decreases rapidly as the distance between the road and the watercourse increases. Low delivery potential roads also include road segments on flat terrain that do not intersect watercourse channels. For all existing road segments where hydrologic connection may be present, 14 CCR § 923.1(e) [943.1(e), 963.1(e)] requires that an evaluation be conducted to identify which segments need to be disconnected and how the disconnection will occur.

#### A. Key Areas to Evaluate for Hydrologic Connectivity

When evaluating the hydrologic connectivity of logging roads, particular attention should be devoted to identifying road segments with a high number of watercourse crossings and those located close to watercourses (e.g., <200 feet). Key areas to consider in this context include, but are not limited to:

- Road segments with road drainage structure or facility outlets near watercourses.
- Insloped or crowned road segments with inside ditches.
- Crowned or outsloped road segments with outside berms.
- Steep road or ditch grades (e.g., > 7 percent).
- Roads on steep hillslope gradients (e.g., > 40 percent).
- Roads located on lower hillslope positions (as opposed to mid-slope and upper hillslope positions).

- Throughcut and incised road segments that are difficult to adequately drain.
- Areas with relatively high hillslope instability (e.g., Franciscan mélange terrain).
- Areas with high precipitation amounts and intensity, and/or high levels of snowmelt runoff (e.g., transient and seasonal rain-on-snow zone).
- Road segments with surfaces prone to erosion (e.g., non-cohesive soils such as decomposed granitic soils) and/or significant rutting from intensive use.
- Road segments with wet weather use.
- Areas with little surface roughness or vegetative cover (e.g., areas recently burned), or compacted soils with low infiltration capacities.
- Unsurfaced roads that are graded on a regular basis.
- Inside ditches that are graded on a regular basis.
- Roads with high traffic volumes (e.g., primary roads in a road network, as opposed to secondary, low-use roads).
- Roads with maintenance issues (e.g., road segments with damaged or plugged drainage structures) and/or limitations regarding ownership or control (e.g., public roads, private non-appurtenant roads, roads with unauthorized use).
- Evidence of direct sediment entry into a watercourse or a flood prone area from road surfaces or drainage structures and facilities (e.g., ponded sediment, sediment deposits, delivery of turbid runoff from drainage structures during rainfall events).
- Ditch scour or downcutting resulting from excessively long undrained ditches with infrequent ditch drain (relief) culverts or other outlet structures or facilities. This condition can also result from design inadequacies (e.g., spacing not altered for steep ditch gradient), inadequate erosion prevention practices (e.g., lack of armoring), or ditches located in areas of erodible soils.
- Gullies or other evidence of erosion on road surfaces or below the outlets of road drainage facilities or structures, including ditch drain (relief) culverts, with transport or a high likelihood of transport to a watercourse.

Additionally, if a road and/or ditch runoff is hydrologically connected to a watercourse, the following factors elevate the risk of sediment delivery to a watercourse:

- Existing or high potential for cutbank sloughing or erosion into inside ditches.
- Native surfaced road exhibiting erosion.
- Native-surfaced road composed of erodible soil types (e.g., granitic soils).
- Rilled, gullied, or rutted road approaches to crossings.
- Existing ditch drain (relief) culverts or other road drainage structures with significant plugging from sediment and/or small woody debris.

- Existing ditch drain (relief) culverts or other road drainage structures with

## B. Indicators of Significant Existing or Potential Problems

Indicators of significant existing or potential problems with the existing road drainage conditions include, but are not limited to:

decreased capacity due to damage or impairment (e.g., crushed or bent inlets, flattened dips due to road grading).

- Decreased structural integrity of ditch drain (relief) culverts, waterbreaks, or other road drainage structures (e.g., excessive pipe corrosion, breached waterbreaks, or rutted road segments).

### C. Design and Treatment Measures to Achieve Hydrologic Disconnection

Treatment measures for existing logging roads are necessary where site-specific field observations indicate that key areas and problem indicators combine to result in significant existing or potential erosion sites. Proposed and reconstructed roads should be designed to achieve hydrologic disconnection to the extent feasible. Additional restrictions and requirements specified under 14 CCR § 923.4(a) [943.4(a), 963.4(a)] apply for new or reconstructed roads, while 14 CCR § 923.5(a) [943.5(a), 963.5(a)], and 923.6(g) and (h)(3) [943.6(g) and (h)(3), 963.6(g) and (h)(3)] apply to existing roads.

Measures to hydrologically disconnect logging road segments include, but are not limited to:

- Installation of a road drainage facility or structure as close as possible to the watercourse crossing. Typically, this distance is 30 to 100 feet above the crossing (Refer to [Figure 2](#)), but may be up to 200 feet or more based on road drainage design and site-specific conditions. For example, the distance from the watercourse crossing to the road drainage facility or structure might be based on the location of where the buffering capacity of the filter strip is the greatest (i.e., densest vegetation and ground cover). Note that this spacing may be closer than the maximum distance specified under 14 CCR § 923.5(f) [943.5(f), 963.5(f)], or as needed for conformance with 14 CCR § 923.5(g) [943.5(g),

963.5(g)]. Depending on the road drainage design, the road drainage facility or structure can be a ditch drain (relief) culvert, rolling dip, waterbreak, or other effective facility or structure. Surface drainage designs or facilities that concentrate runoff (e.g., crowned or insloped road surfaces) require more buffering distance between the drainage outlet and the watercourse than those that disperse runoff (e.g., outsloped road surfaces).

- Installation of additional road drainage facilities or structures above (upgrade of) the closest road drainage facility or structure to the watercourse crossing that are appropriately sized and located in conformance with 14 CCR § 923.5(b) and (c) [943.5(b) and (c), 963.5(b) and (c)]. Maximum waterbreak spacing for roads is specified under 14 CCR § 923.5(f) [943.5(f), 963.5(f)]. Appropriate spacing for rolling dips is considered in Section II.C. of this Technical Rule Addendum.
- Installation of ditch drains that are sufficiently spaced to minimize: ditch scour, prevent exceedance of ditch drain hydraulic capacity, and erosion at drain outlets. Local experience, knowledge and site specific conditions (e.g., hydrology, soil and geologic material present) should be considered by the RPF in the location and spacing of ditch drains. Spacing of ditch drains should be adjusted in response to: (1) poor filtering capacity or potentially unstable areas at the outlet (additional factors are listed in the following section), and (2) proximity to a watercourse. Near a watercourse, the ditch drain spacing should be closer so that smaller amounts of flow are routed down the ditch line, thus providing an added factor of safety for high flow conditions and potential failure of drainage facilities. An example of ditch drain (relief) spacing guidelines is displayed in [Table 1](#) (see Section IV of this addendum). In the preparation of THPs, NTMPs, and PTHPs, RPFs may develop and use other spacing

guidelines that better match the field conditions where their plans are proposed. For example, the RPF can observe the length of road necessary to initiate significant rill erosion and use these observations to adjust spacing guidelines to local conditions.

- In general, if ditch drain (relief) culverts are used, they are recommended to be at least 18 inches in diameter to lower the potential for plugging from soil and small woody debris.
- Elevation of the crossing slightly above the road grade to insure that the crossing (e.g., bridges or relatively flat road approaches) does not serve as the low point for road surface runoff (Refer to **Figures 2 and 7**). Where applicable, this does not alleviate the necessity for installation of a critical dip to mitigate diversion potential.
- Installation of outside berms to decrease hydrologic connectivity where they direct flow to a more suitable discharge area.

Many road segments will have a small portion of their length still connected, even following implementation of 14 CCR §§ 923.2(a)(5) [943.2(a)(5), 963.2(a)(5)], 923.5(a) [943.5(a), 963.5(a)], and 923.6(g) and (h)(3) [943.6(g) and (h)(3), 963.6(g) and (h)(3)]. Additionally, treatment of road approaches for connected road segments next to watercourses may be necessary pursuant to 14 CCR § 923.5(i) [943.5(i), 963.5(i)].

## II. Road Drainage, Energy Dissipation, Outsloping and Rolling Dips

### A. Location of Drainage Facilities and Structures

In addition to drainage structures and facilities being located: (1) to disconnect road drainage upslope of watercourses, and (2) at a sufficient

interval (spacing) to avoid volume concentrations and associated erosion, as discussed above, there are additional factors that should be considered prior to placing drainage structures and facilities in the field. To assist in identifying sites best suited for a drainage structure or facility, the following criteria should be considered. These criteria should be evaluated and appropriately weighted based on site-specific conditions, so that the effectiveness of the drainage structure or facility is maximized and potential problems are avoided or minimized. RPFs should maintain or restore natural drainage patterns as much as possible, while considering the factors listed below. Drainage structures and facilities should be placed:

- To avoid the concentration of flow onto unstable or potentially unstable areas, such as known active landslides, hummocky ground, concave headwalls, or steep fill slopes.
- To discharge onto divergent (convex) to planar slopes where possible, to allow for better dispersion and infiltration (Refer to **Figure 3**).
- Before hydrologic divides to prevent water from one hydrologic basin mixing with, and potentially impacting, another hydrologic basin not conditioned to receiving the additional flows.
- Above breaks in the road grade that transition from low-gradient to high-gradient to remove the water off of the road before it gains velocity and erosive power on the downslope steep road segment.
- To drain localized or emergent groundwater, springs, and wet areas present in the road prism.

### B. Installation of Energy Dissipators for Drainage Structures and Facilities

Where the natural topography, soil surface texture, and vegetation is inadequate to dissipate the energy of flowing water, energy dissipators (e.g., slash, rock armor, flow diverters, downspouts, etc.) should be placed at outfalls of drainage structures and facilities to disperse flows and promote infiltration, consistent with the requirements stated in 14 CCR § 923.5(h) [943.5(h), 963.5(h)]. The use and selection of an appropriate energy dissipator should be based on field conditions and is a function of flow, erosion characteristics of the soils, slope gradient, slope roughness and cover, and distance to a receiving watercourse. Effective energy dissipators commonly used in the forest setting, include, but are not limited to:

- Dense vegetative ground cover.
- Wood slash that is “packed” into place with heavy equipment (ideally) or by hand.
- Pit-run rock. Generally composed of competent local rock that has a range of rock sizes and is of sufficient size to resist movement from road runoff.
- Properly located, sized, and maintained stilling basins.

### C. Logging Road Outsloping and Installation of Rolling Dips

Outsloped roads are built with a slight angle of the road surface towards the outside edge (Refer to [Figure 4](#)). This configuration allows road surface runoff to drain in a dispersed manner over the fill slope onto undisturbed forest soils. As defined in 14 CCR § 895.1, outsloping means shaping the road surface to drain toward the outside edge of the logging road or landing.

Rolling dips are typically constructed on outsloped roads to ensure adequate drainage of the road surface. As defined in 14 CCR § 895.1, a rolling dip means a drainage facility that is constructed to remain effective while allowing passage of motor vehicles at reduced road speeds.

An outsloped road’s running surface is considered hydrologically disconnected as long as runoff is effectively transported across rather than down the road surface, outside berms do not restrict runoff, and the road prism does not encroach upon the watercourse. Rolling dips should be installed on outsloped roads to ensure that surface flow is routed off the road surface in situations where outsloping alone may not be effective to prevent concentrating flow or eroding the fill (Refer to [Figure 5](#)). Outsloped roads with rolling dips are typically not appropriate for roads with a gradient in excess of ten percent (10%) because of the steepness of the dip approach grades that would be required and the added difficulty to effectively drain the road surface. The maximum amount of outsloping achievable depends on the type of traffic that will use the road (e.g., lowboys, log trucks, pickup trucks), and the road surfacing. Outsloped roads are not appropriate in all situations due to safety concerns, timing of use, or expected traffic (e.g., winter use in snow zones).

The spacing of rolling dips must be in conformance with 14 CCR § 923.5(g) [943.5(g), 963.5(g)]. As with ditch drain (relief) culvert location, the location of rolling dips is to be modified based on the site buffering capacity at proposed installation locations and avoidance of concentrated flow onto unstable areas. Spacing of rolling dips is a function of: (1) road grade, soil erodibility, and road surface area draining to the dip, and (2) proximity to a watercourse. Near a watercourse, the rolling dip spacing should be closer so that smaller amounts of flow are routed towards each dip, thus providing an added factor of safety for high flow

conditions and potential failure of drainage facilities. Local experience and knowledge of soil and geologic material present should be considered by the RPF in the location and spacing of rolling dips. An example of general rolling dip spacing guidelines is displayed in **Table 1**. In the preparation of THPs, NTMPs, and PTHPs, RPFs may develop and use other spacing guidelines that better match the field conditions where their plans are proposed.

### III. Diversion Potential at Watercourse Crossings and Critical Dip Installation

Diversion potential at watercourse crossings is typically associated with large storm events, and can be a significant source of erosion and sediment. Watercourse crossings have diversion potential if overflow at a plugged culvert inlet diverts the watercourse down the road rather than over the crossing and back into the natural watercourse channel. Diverted flows can create excessive erosion where the flows erode non-channeled surfaces and where they exceed the channel capacity of non-original channels. Diversion potential exists on roads that have a continuous climbing grade across the crossing or where the road slopes downward away from the crossing in at least one direction (Refer to **Figure 6**). Forest Practice Rules 14 CCR § 923.10(k) [943.10(k), 963.10(k)] requires diversion potential on constructed (new) and existing logging roads to be addressed; similar requirements have existed since 1990. As specified in 14 CCR § 923.10(j) [943.10(j), 963.10(j)], critical dips are incorporated into the construction or reconstruction of logging road watercourse crossings utilizing culverts, except where diversion of overflow is addressed by other methods stated in the plan. The critical dip should be constructed at the point where the potential for erosion and the loss of fill is minimized (Refer to **Figure 7**).

### IV. Crossings with Higher Risk of Failure and Higher Risk to the Environment

Some watercourse crossings have a higher relative risk of failure due to the landscape in which they are installed (e.g., areas prone to debris flows or landsliding); or due to seasonal lack of access or remoteness, both of which limit effective emergency maintenance. Additionally, crossings that employ larger than typical fills to achieve running surface elevations often present a higher risk to the environment if they fail due to the large volumes of fill that could be introduced to downstream watercourses. In these cases, it is recommended and/or required (Forest Practice Rule 14 CCR § 923.11(i) [943.11(i), 953.11 (i)] that such crossings be oversized, designed for low maintenance, reinforced, or removed before the completion of timber operations. As discussed in *Designing Watercourse Crossings for 100-year Flood Flows, Wood and Sediment* (Cafferata et al., 2004), where temporary crossings are not used, rock ford or rock armored fill crossings are often a better alternative to culverts on small to medium sized watercourses in areas where winter maintenance is difficult or debris flows are more likely; the same holds true in areas prone to earthflows or other types of landsliding. Overall, fords (including native surface, rock, armored fill, and vented) are more apt to effectively transport flows, sediment, and debris in unstable landscapes and areas with poor access for emergency monitoring and repairs than culvert crossings. Where culverts are used, and fills are large, Cafferata et al. (2004) recommend that the diameter of the culvert be increased by 6 inches for every 5 feet of fill above the culvert on the discharge side of the crossing. The additional culvert diameter reduces the risk of failure by allowing more room for transport of flow, sediment and debris, and is relatively inexpensive compared to the cost of replacement of a failed crossing. Crossings may also be reinforced by utilizing large rock designed to resist movement during high

flows to line fill faces and by incorporating large critical dips to allow flow passage if the culvert becomes plugged. Temporary crossings typically provide the least environmental risk since flow is unimpeded after the crossings are removed.

## V. Table and Figures

The following table and figures are provided as examples to illustrate design concepts. These are not intended to serve as default performance standards.

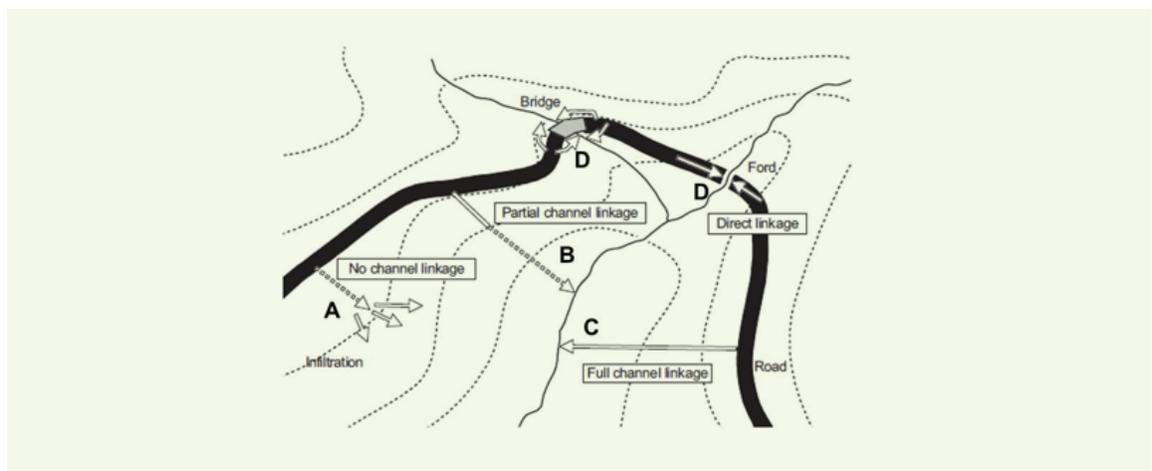
**TABLE 1.**

An example of ditch-relief culvert and rolling dip spacing guidelines is found in the University of California's Publication 8262, *Rural Roads: A Construction and Maintenance Guide for California Landowners* (Kocher et al. 2006, adopted from Keller and Sherar 2003). Note that spacing of rolling dips and ditch relief culverts should be a function of proximity to a watercourse, with closer spacing near the channel.

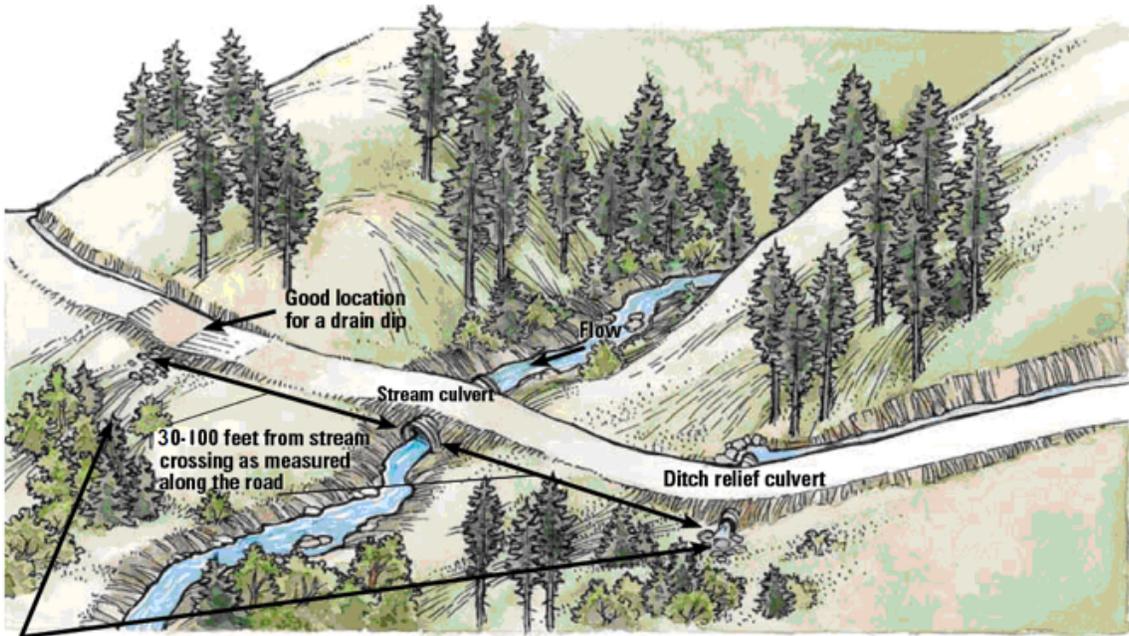
Road Grade (percent)	Soil Erodibility	
	Low to Nonerosive soils	Erosive soils
0–3%	400'	250'
4–6%	300'	160'
7–9%	250'	130'
10–12%	200'	115'
12+	160'	100'

**Note:** (1) **Low Erosion Soils** = Coarse Rocky Soils, Gravel, and Some Clay

(2) **High Erosion Soils** = Fine, Friable Soils, Silt, Fine Sands



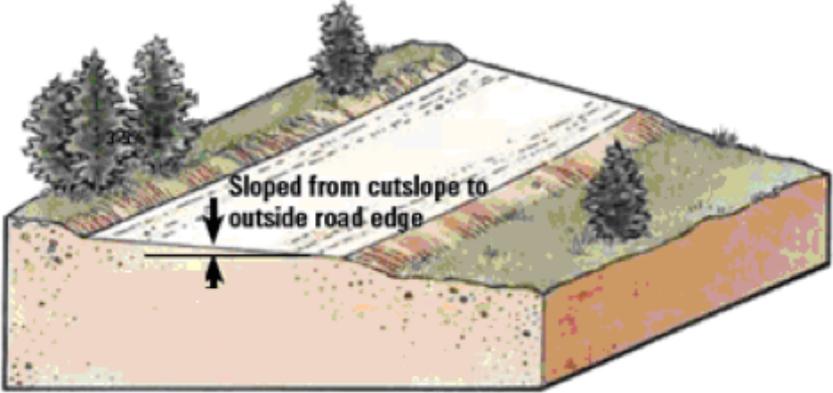
**FIGURE 1.** The range of hydrologic connectivity (i.e., linkage) for a road. Ideally, road runoff is drained to an effective filter strip where runoff and sediment is dispersed onto the forest floor (A). Roads can be partially connected when a portion of runoff and sediment reaches the watercourse (B). Full hydrologic connectivity can occur when road runoff initiates channels or gullies (C), or is drained directly into watercourses at road crossings (D). Figure adapted from Croke and Hairsine, 2006.



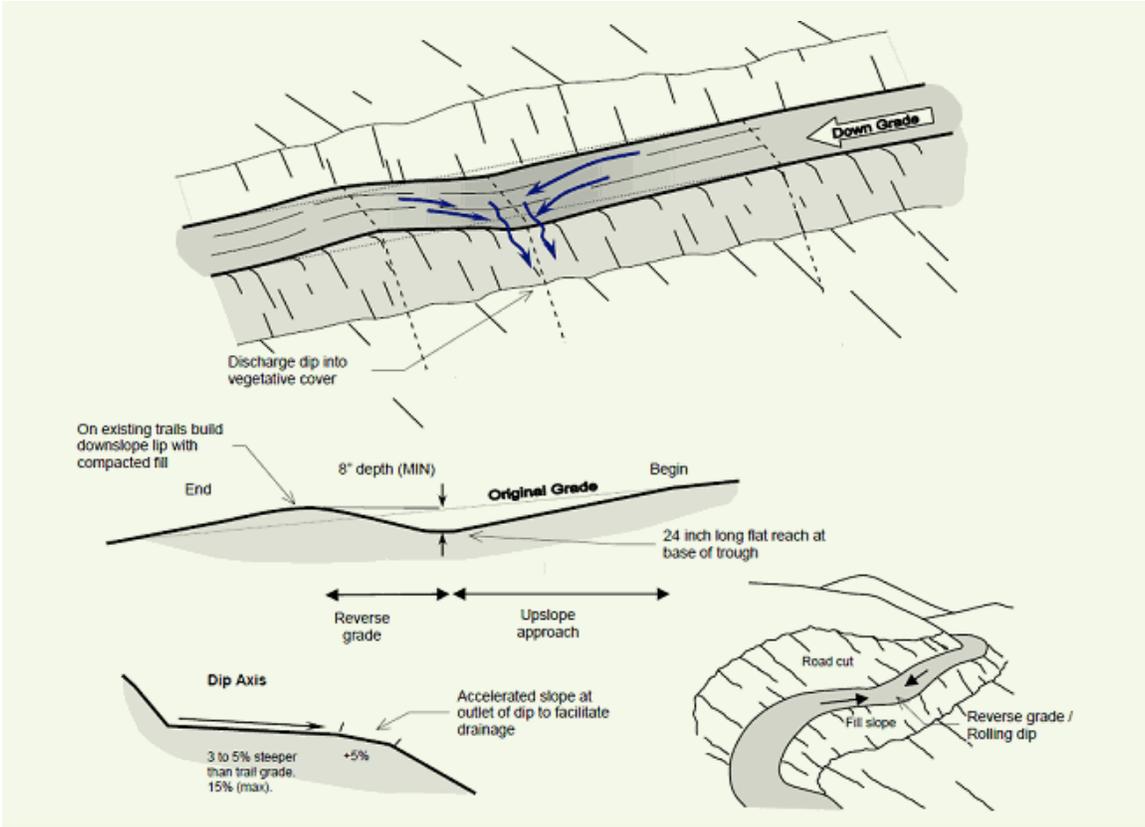
Ditch drainage should be directed into vegetation and undisturbed soil filter, and not allowed to continue flowing down the ditch and into the stream.

**FIGURE 2.** Diagram showing implementation of road drainage disconnection facilities/structures to limit sediment delivery into a watercourse. Note the absence of an apparent critical dip at the crossing. (modified from Oregon Forest Resources Institute 2011, 2nd Ed., used with permission).

**FIGURE 3.** Three major slope forms; water should be discharged onto divergent (convex) to planar slopes where possible (from WFPB 2004).



**FIGURE 4.** Diagram displaying a typical outsloped road (Modified from Oregon Forest Resources Institute 2011, 2nd Ed., used with permission).



**FIGURE 5.** Example of rolling dip specifications (Modified diagram provided by Tim Best, CEG).



**FIGURE 6.** Diagram illustrating diversion potential at a watercourse crossing (from DFG 2006).



**FIGURE 7.** Illustration of a critical dip installed at a watercourse crossing to remove diversion potential (from DFG 2006). The critical dip should be constructed at the point where the potential for erosion and the loss of fill is minimized.

