STATE OF CALIFORNIA—OFFICE OF ADMINISTRATIVE LAW

NONSUBSTANTIVE

NOTICE PUBLICATION/REGULATIONS SUBMISSION

(See instructions on reverse)

STD. 400 (REV. 01-2013)

For use by Secretary of State only

ENDORSED FILED IN THE OFFICE OF 2014 NOV 26 PM 1:42 DEBRA BOWEN SECRETARY OF STATE

OAL FILE NUMBERS	NOTICE FILE NUMBER	REGULATORY ACTION NUMBER	EMERGENCY NUMBER
	Z-	2014-1027-03N	

For use by Office of Administrative Law (OAL) only

2014 OCT 27 PM 1:45 OFFICE OF ADMINISTRATIVE LAW

NOTICE | REGULATIONS

AGENCY WITH RULEMAKING AUTHORITY: Board of Forestry and Fire Protection

AGENCY FILE NUMBER (If any):

A. PUBLICATION OF NOTICE (Complete for publication in Notice Register)

1. SUBJECT OF NOTICE	TITLE(S)	FIRST SECTION AFFECTED	2. REQUESTED PUBLICATION DATE

3. NOTICE TYPE	4. AGENCY CONTACT PERSON	TELEPHONE NUMBER	FAX NUMBER (Optional)
☐ Notice re Proposed Regulatory Action ☐ Other			

OAL USE ONLY	ACTION ON PROPOSED NOTICE	NOTICE REGISTER NUMBER	PUBLICATION DATE
	☐ Approved as Submitted ☐ Approved as Modified ☐ Disapproved/ Withdrawn		

B. SUBMISSION OF REGULATIONS (Complete when submitting regulations)

1a. SUBJECT OF REGULATION(S): Changes to TRA5 and, in Road Rules, TRA5 Revision Date, 2014 (§ 100)

1b. ALL PREVIOUS RELATED OAL REGULATORY ACTION NUMBER(S):

2. SPECIFY CALIFORNIA CODE OF REGULATIONS TITLE(S) AND SECTION(S) (Including title 26, if toxics related)

SECTION(S) AFFECTED (List all section number(s) individually. Attach additional sheet if needed.)

ADOPT:

AMEND: See additional sheet.

REPEAL:

TITLE(S): 14

3. TYPE OF FILING

- ☐ Regular Rulemaking (Gov. Code §11346)
- ☐ Resubmittal of disapproved or withdrawn nonemergency filing (Gov. Code §§11349.3, 11349.4)
- ☐ Emergency (Gov. Code, §11346.1(b))
- ☐ Certificate of Compliance: The agency officer named below certifies that this agency complied with the provisions of Gov. Code §§11346.2-11347.3 either before the emergency regulation was adopted or within the time period required by statute.
- ☐ Resubmittal of disapproved or withdrawn emergency filing (Gov. Code, §11346.1)
- ☐ Emergency Readopt (Gov. Code, §11346.1(h))
- ☐ File & Print
- ☐ Other (Specify) _____
- ☒ Changes Without Regulatory Effect (Cal. Code Regs., title 1, §100)
- ☐ Print Only

4. ALL BEGINNING AND ENDING DATES OF AVAILABILITY OF MODIFIED REGULATIONS AND/OR MATERIAL ADDED TO THE RULEMAKING FILE (Cal. Code Regs. title 1, §44 and Gov. Code §11347.1)

5. EFFECTIVE DATE OF CHANGES (Gov. Code, §§ 11343.4, 11346.1(d); Cal. Code Regs., title 1, §100)

- ☐ Effective January 1, April 1, July 1, or October 1 (Gov. Code §11343.4(a))
- ☐ Effective on filing with Secretary of State
- ☒ §100 Changes Without Regulatory Effect
- ☐ Effective other (Specify)

6. CHECK IF THESE REGULATIONS REQUIRE NOTICE TO, OR REVIEW, CONSULTATION, APPROVAL OR CONCURRENCE BY, ANOTHER AGENCY OR ENTITY

- ☐ Department of Finance (Form STD. 399) (SAM §6660)
- ☐ Fair Political Practices Commission
- ☐ State Fire Marshal
- ☐ Other (Specify) _____

7. CONTACT PERSON	TELEPHONE NUMBER	FAX NUMBER (Optional)	E-MAIL ADDRESS (Optional)
Thembi Borras	916-653-9633	916-653-0989	thembi.borras@bof.ca.gov

8. **I certify that the attached copy of the regulation(s) is a true and correct copy of the regulation(s) identified on this form, that the information specified on this form is true and correct, and that I am the head of the agency taking this action, or a designee of the head of the agency, and am authorized to make this certification.**

SIGNATURE OF AGENCY HEAD OR DESIGNEE: Thembi Borras

DATE: October 27, 2014

TYPED NAME AND TITLE OF SIGNATORY: Thembi Borras, Regulations Coordinator for the Board of Forestry and Fire Protection

For use by Office of Administrative Law (OAL) only

ENDORSED APPROVED

NOV 26 2014

Office of Administrative Law

INSTRUCTIONS FOR PUBLICATION OF NOTICE AND SUBMISSION OF REGULATIONS

Use the form STD. 400 for submitting notices for publication and regulations for Office of Administrative Law (OAL) review.

ALL FILINGS

Enter the name of the agency with the rulemaking authority and agency's file number, if any.

NOTICES

Complete Part A when submitting a notice to OAL for publication in the California Regulatory Notice Register. Submit two (2) copies of the STD. 400 with four (4) copies of the notice and, if a notice of proposed regulatory action, one copy each of the complete text of the regulations and the statement of reasons. Upon receipt of the notice, OAL will place a number in the box marked "Notice File Number." If the notice is approved, OAL will return the STD. 400 with a copy of the notice and will check "Approved as Submitted" or "Approved as Modified." If the notice is disapproved or withdrawn, that will also be indicated in the space marked "Action on Proposed Notice." Please submit a new form STD. 400 when resubmitting the notice.

REGULATIONS

When submitting regulations to OAL for review, fill out STD. 400, Part B. Use the form that was previously submitted with the notice of proposed regulatory action which contains the "Notice File Number" assigned, or, if a new STD. 400 is used, please include the previously assigned number in the box marked "Notice File Number." In filling out Part B, be sure to complete the certification including the date signed, the title and typed name of the signatory. The following must be submitted when filing regulations: seven (7) copies of the regulations with a copy of the STD. 400 attached to the front of each (one copy must bear an original signature on the certification) and the complete rulemaking file with index and sworn statement. (See Gov. Code § 11347.3 for rulemaking file contents.)

RESUBMITTAL OF DISAPPROVED OR WITHDRAWN REGULATIONS

When resubmitting previously disapproved or withdrawn regulations to OAL for review, use a new STD. 400 and fill out Part B, including the signed certification. Enter the OAL file number(s) of all previously disapproved or withdrawn filings in the box marked "All Previous Related OAL Regulatory Action Number(s)" (box lb. of Part B). Submit seven (7) copies of the regulation to OAL with a copy of the STD. 400 attached to the front of each (one copy must bear an original signature on the certification). Be sure to include an index, sworn statement, and (if returned to the agency) the complete rulemaking file. (See Gov. Code §§ 11349.4 and 11347.3 for more specific requirements.)

EMERGENCY REGULATIONS

Fill out only Part B, including the signed certification, and submit seven (7) copies of the regulations with a copy of the STD. 400 attached to the front of each (one copy must bear an original signature on the certification). (See Gov. Code §11346.1 for other requirements.)

NOTICE FOLLOWING EMERGENCY ACTION

When submitting a notice of proposed regulatory action after an emergency filing, use a new STD. 400 and complete Part A and insert the OAL file number(s) for the original emergency filing(s) in the box marked "All Previous Related OAL Regulatory Action Number(s)" (box 1b. of Part B). OAL will return the STD. 400 with the notice upon approval or disapproval. If the notice is disapproved, please fill out a new form when resubmitting for publication.

CERTIFICATE OF COMPLIANCE

When filing the certificate of compliance for emergency regulations, fill out Part B, including the signed certification, on the form that was previously submitted with the notice. If a new STD. 400 is used, fill in Part B including the signed certification, and enter the previously assigned notice file number in the box marked "Notice File Number" at the top of the form. The materials indicated in these instructions for "REGULATIONS" must also be submitted.

EMERGENCY REGULATIONS - READOPTION

When submitting previously approved emergency regulations for readoption, use a new STD. 400 and fill out Part B, including the signed certification, and insert the OAL file number(s) related to the original emergency filing in the box marked "All Previous Related OAL Regulatory Action Number (s)" (box 1b. of Part B).

CHANGES WITHOUT REGULATORY EFFECT

When submitting changes without regulatory effect pursuant to California Code of Regulations, Title 1, section 100, complete Part B, including marking the appropriate box in both B.3. and B.5.

ABBREVIATIONS

Cal. Code Regs. - California Code of Regulations
Gov. Code - Government Code
SAM - State Administrative Manual

For questions regarding this form or the procedure for filing notices or submitting regulations to OAL for review, please contact the Office of Administrative Law Reference Attorney at (916) 323-6815.

"Changes to TRA5 and, in Road Rules, TRA5 Revision Date, 2014 (§ 100)"

ADDITIONAL SHEET

Section(s) affected (List all section(s) numbers individually. Attach additional sheet if needed.):

§ 923.2 [943.2, 963.2]

§ 923.4 [943.4, 963.4]

§ 923.5 [943.5, 963.5]

§ 923.9 [943.9, 963.9]

"Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14).

State of California
Office of Administrative Law

In re:

Board of Forestry and Fire Protection

Regulatory Action:

Title 14, California Code of Regulations

Adopt sections:
Amend sections: **923.2 [943.2, 963.2], 923.4 [943.4, 963.4], 923.5 [943.5, 963.5], 923.9 [943.9, 963.9]**
Repeal sections:

NOTICE OF APPROVAL OF CHANGES WITHOUT REGULATORY EFFECT

California Code of Regulations, Title 1, Section 100

OAL File No. 2014-1027-03 N

The Board of Forestry and Fire Protection submitted this Section 100 action to update incorrect or obsolete cross-references in an incorporated by reference document, "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition), and to add a version date to the document and to all title 14 regulations where the incorporation by reference of the document appears.

OAL approves this change without regulatory effect as meeting the requirements of California Code of Regulations, Title 1, section 100.

Date: 11/26/2014

Richard L. Smith
Richard L. Smith
Senior Attorney

For: DEBRA M. CORNEZ
Director

Original: George Gentry
Copy: Thembi Borras

Board of Forestry and Fire Protection

"Changes to TRA5 Revision Date in Road Rules, 2014 (§ 100)"

Title 14 of the California Code of Regulations (14 CCR), Division 1.5, Chapter 4, Subchapter 4, Article 12, Subchapter 5, Article 11 and Subchapter 6, Article 12

Amend § 923.2 [943.2, 963.2] (a)(5)-(6). Design and Location of Logging Roads and Landings.

*******(a)*******

*******(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 "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference.

(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 "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference.*****

Note: Authority cited: Sections 4551, 4551.5 and 4553, Public Resources Code. Reference: Sections 4512, 4513, 4551, 4551.5, 4562.5 and 4562.7, Public Resources Code; 33 USC 1288(b); and *Natural Resources Defense Council, Inc. v. Arcata Natl. Corp.* (1976) 59 Cal.App.3d 959, 131 Cal. Rptr. 172.

Amend § 923.4 [943.4, 963.4]. Construction and Reconstruction of 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 "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference. *****

Note: Authority cited: Sections 4551, 4551.5 and 4553, Public Resources Code. Reference: Sections 4512, 4513, 4551, 4551.5, 4562.5 and 4562.7, Public Resources Code; 33 USC 1288(b); and *Natural Resources Defense Council, Inc. v. Arcata Natl. Corp.* (1976) 59 Cal.App.3d 959, 131 Cal. Rptr. 172.

Amend § 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 "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference.*****

*****(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 "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference.

(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 for drainage structures may be found in "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference. *****

Note: Authority cited: Sections 4551, 4551.5, 4553, 4561.7, and 4562.9, Public Resources Code. Reference: Sections 4512, 4513, 4551, 4551.5, 4562.5 and 4562.7, Public Resources Code; 33 USC 1288(b); and *Natural Resources Defense Council, Inc. v. Arcata Natl. Corp.* (1976) 59 Cal.App.3d 959, 131 Cal. Rptr. 172.

Amend § 923.9 [943.9, 963.9] (m)(2) and (o). Watercourse Crossings.

*****(m)*****

***** **(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 "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference. *****

***** **(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 "Board of Forestry Technical Rule Addendum Number 5: Guidance on Hydrologic Disconnection, Road Drainage, Minimization of Diversion Potential, and High Risk Crossings" (1st Edition, revised 10/27/14), hereby incorporated by reference.

Note: Authority cited: Sections 4551, 4551.5 and 21004, Public Resources Code. Reference: Sections 4512, 4513, 4551, 4551.5, 4562.5 and 4562.7, Public Resources Code; 40 CFR 130.2(q); and *Natural Resources Defense Council, Inc. v. Arcata Natl. Corp.* (1972) 59 Cal. App. 3d 959, 131 Cal. Rptr. 172.

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BOARD OF FORESTRY TECHNICAL RULE ADDENDUM NO. 5: GUIDANCE ON HYDROLOGIC DISCONNECTION, ROAD DRAINAGE, MINIMIZATION OF DIVERSION POTENTIAL, AND HIGH RISK CROSSINGS (1st EDITION, revised 10/27/14)

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 dissipaters, 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).

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:

- 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 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 culvert 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 minimize 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 ditchline, 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~~ V 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 fill 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 ensure 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 fillslopes.
- 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 Dissipaters for Drainage Structures and Facilities

Where the natural topography, soil surface texture, and vegetation is inadequate to dissipate the energy of flowing water, energy dissipaters (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 dissipater 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 dissipaters 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 fillslope 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~~9(k) [943.~~10~~9 (k), 963.~~10~~9(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~~9(j) [943.~~10~~9(j), 963.~~10~~9(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)~~9(o) [943.~~11(i)~~9(o), 953.~~11(i)~~9(o)]) 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 recommends 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 Non-erosive 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

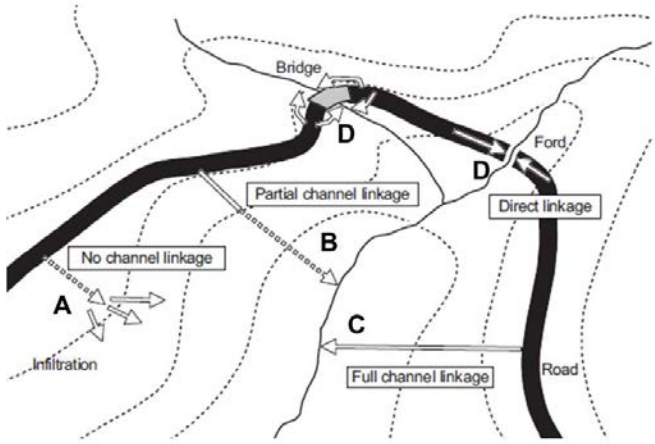

Figure 1. The range of hydrologic connectivity (i.e., linkage) for a road. Ideally, road runoff is drained to an effective filter strip where runoff and sediment is dispersed onto the forest floor (A). Roads can be partially connected when a portion of runoff and sediment reaches the watercourse (B). 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.

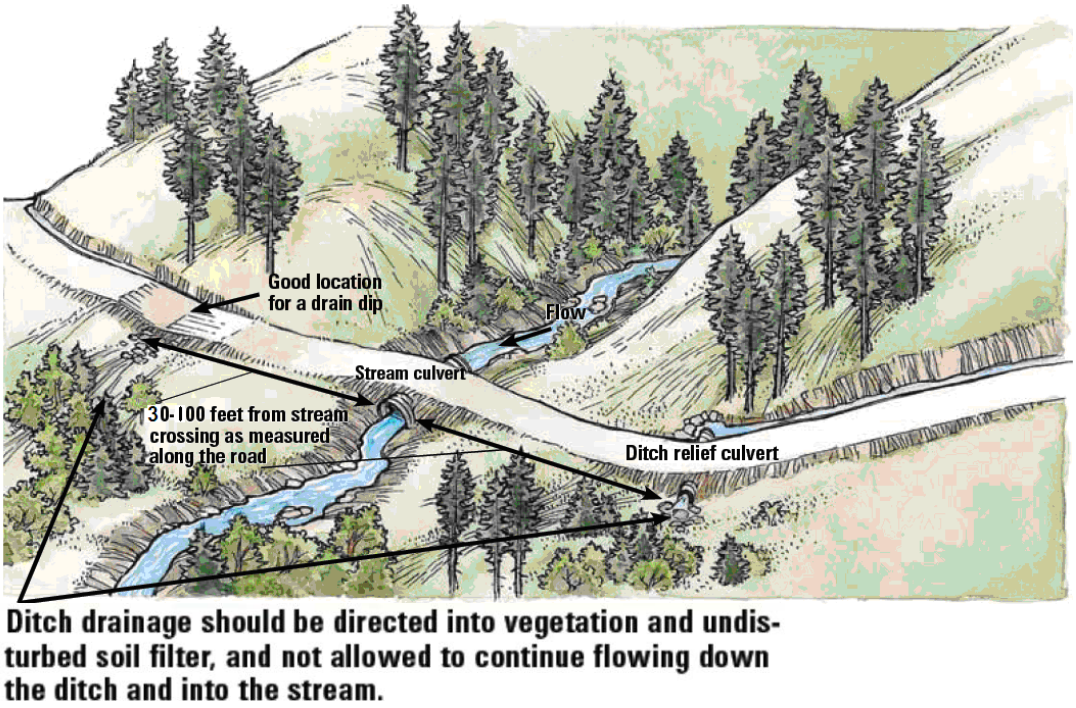

Figure 2. Diagram showing implementation of road drainage disconnection facilities/structures to limit sediment delivery into a watercourse. Note the absence of an apparent critical dip at the

crossing. (modified from Oregon Forest Resources Institute 2011, 2nd Ed., used with permission).

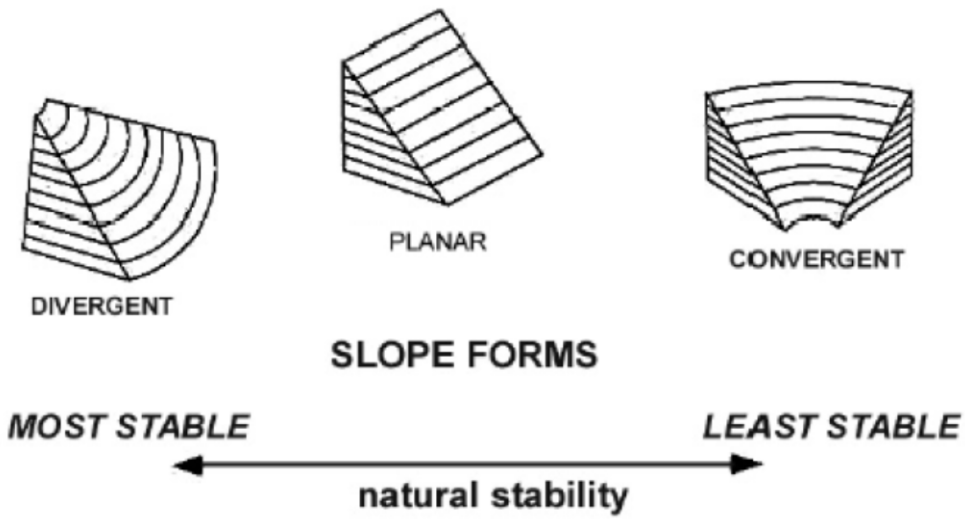

Figure 3. Three major slope forms; water should be discharged onto divergent (convex) to planar slopes where possible (from WFPB 2004).

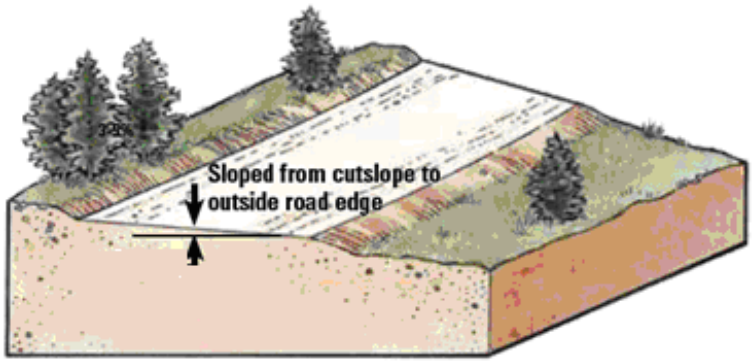

Figure 4. Diagram displaying a typical outsloped road (modified from Oregon Forest Resources Institute 2011, 2nd Ed., used with permission.

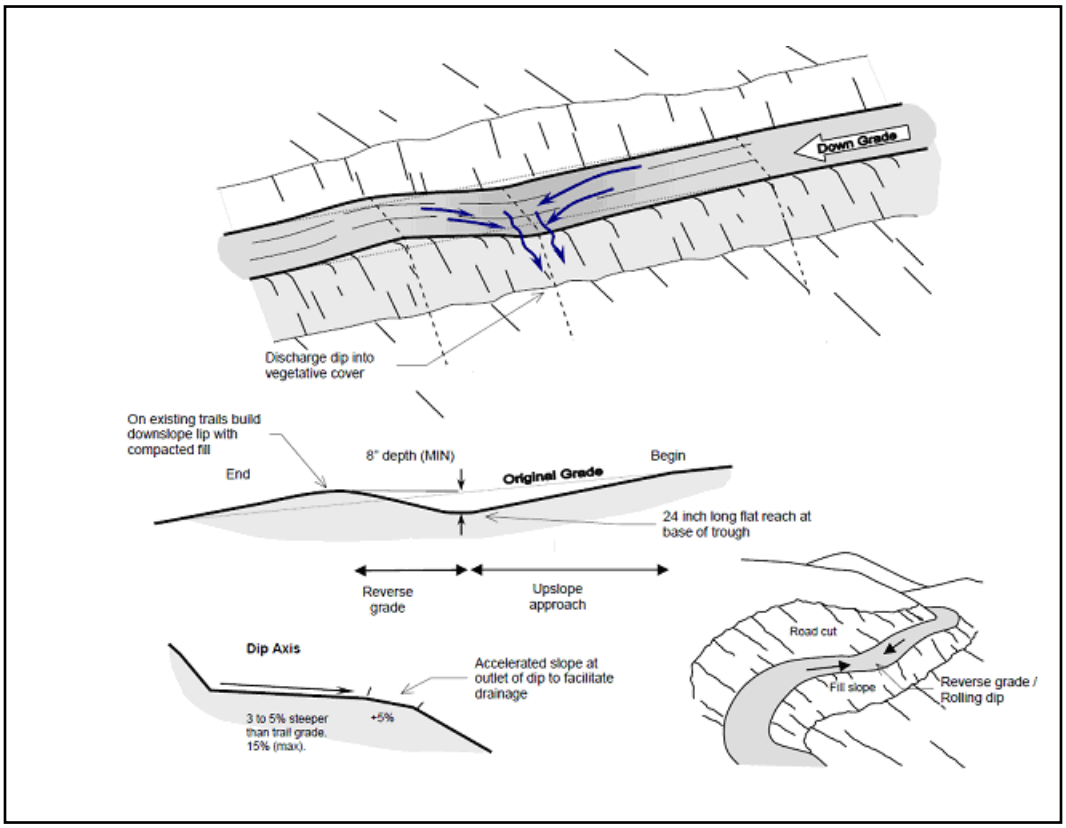

Figure 5. Example of rolling dip specifications (modified diagram provided by Tim Best, CEG).

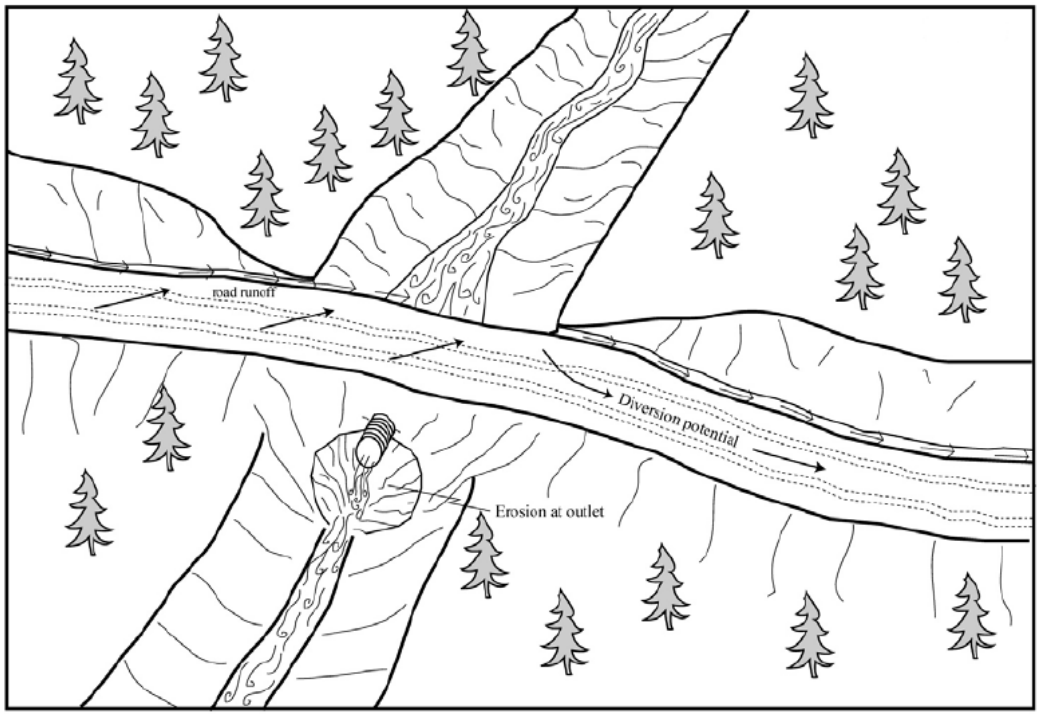

Figure 6. Diagram illustrating diversion potential at a watercourse crossing (from DFG 2006).

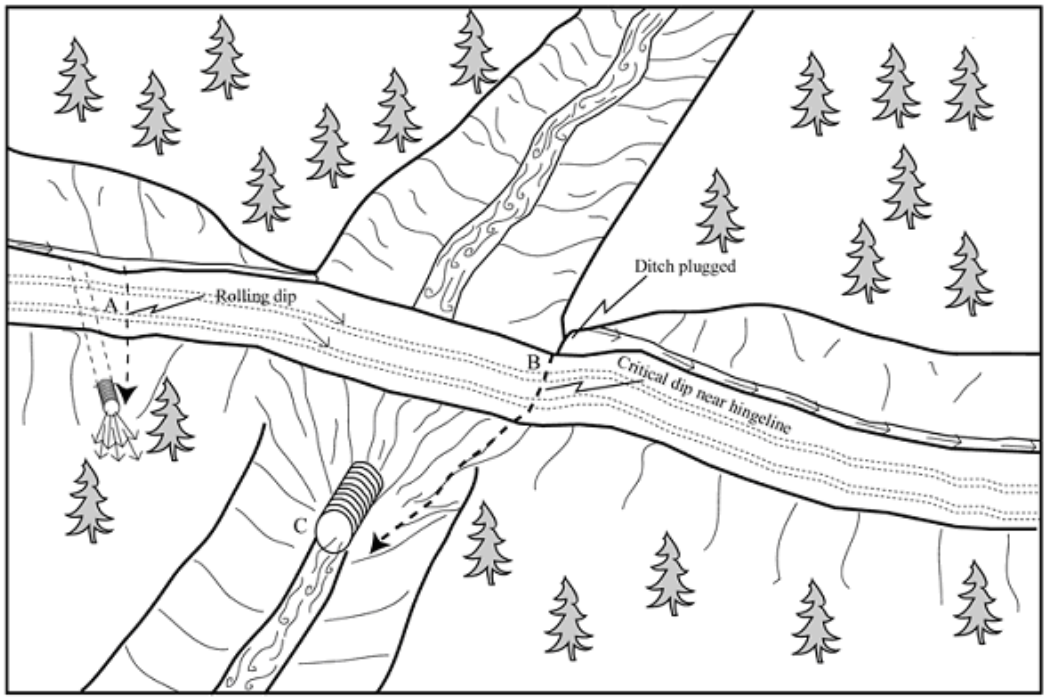

Figure 7. Illustration of a critical dip installed at a watercourse crossing to remove diversion potential (from DFG 2006). The critical dip should be constructed at the point where the potential for erosion and the loss of fill is minimized.