Water Resource Protection Plan

WDID: 1B16858CHUM

APN(s): 223-124-003 (Humboldt)

Prepared by:

Timberland Resource Consultants

165 South Fortuna Blvd

Fortuna, California 95540

6/21/2017

Revised: 4/9/2018

Purpose

This Water Resource Protection Plan (WRPP) has been prepared on behalf of the property owner for the Humboldt county property identified as parcel numbers 223-124-003 by agreement and in response to the California Water Code Section 13260(a), which requires that any person discharging waste or proposing to discharge waste within any region that could affect the quality of the waters of the state, other than into a community sewer system, shall file with the appropriate regional water board a Report of Waste Discharge (ROWD) containing such information and data as may be required by the Regional Water Board. The Regional Water Board may waive the requirements of Water Code section 13260 for specific types of discharges if the waiver is consistent with the Basin Plan and in the public interest. Any waiver is conditional and may be terminated at any time. A waiver should include monitoring requirements to verify the adequacy and effectiveness of the waiver's conditions. Order R1-2015-0023 conditionally waives the requirement to file a ROWD for discharges and associated activities described in finding 4.

Scope of Report

Order No. R1-2015-0023 states that "Tier 2 Dischargers and Tier 3 Dischargers who intend to cultivate cannabis before, during, or following site cleanup activities shall develop and implement a water resource protection plan that contains the elements listed and addressed below. Dischargers must keep this plan on site, and produce it upon request by Regional Water Board staff. Management practices shall be properly designed and installed, and assessed periodically for effectiveness. If a management measure is found to be ineffective, the plan must be adapted and implemented to incorporate new or additional management practices to meet standard conditions. Dischargers shall certify annually to the Regional Water Board individually or through an approved third-party program that the plan is being implemented and is effectively protecting water quality, and report on progress in implementing site improvements intended to bring the site into compliance with all conditions of this Order.

Methods

The methods used to develop this WRPP include both field and office components. The office component consisted of aerial photography review and interpretation, existing USGS quad map review, GIS mapping of field data, review of on-site photography points, streamflow calculations, and general planning. The field component included identifying and accurately mapping all watercourses, wet areas, and wetlands located downstream of the cultivation areas, associated facilities, and all appurtenant roads accessing such areas. An accurate location of the Waters of the State is necessary to make an assessment of whether potential and existing erosion sites/pollution sites have the potential to discharge waste to an area that could affect waters of the State (including groundwater). Next, all cultivation areas, associated facilities, and all appurtenant roads accessing such areas were assessed for discharges and related controllable water quality factors from the activities listed in Order R1-2015-0023, Finding 4a-j. The field assessment also included an evaluation and determination of compliance with the Standard Conditions per Provision I.B of Order No. R1-2015-0023. The water resource protection plans required under Tier 2 are meant to describe the specific measures a discharger implements to achieve compliance with standard conditions. Therefore, all required components of the water resource protection plan per Provision I.B of Order No. R1-2015-0023 were physically inspected and evaluated. A comprehensive summary of each Standard Condition as it relates to the subject property is appended.

Property Description

The property assessed is approximately 29 acres, located in Section 16, T4S, R4E, HB&M, Humboldt County from the Harris 7.5' USGS Quad Map. The property is located approximately 1 ¼ miles northeast of Garberville, California, and is accessed by Alderpoint Road. The property has a primarily facing aspect with an elevation range of approximately 2,460' to 2,752' above sea level. The project area contains a tributary to Buck Mountain Creek and the East Branch South Eel River.

Project Description

There are currently two cultivation areas located on the property. Cultivation on the property consists of raised beds on graded flats within greenhouses totaling approximately 8,200 ft^2. All water used for irrigation is derived from a deeded surface water diversion (POD) located off the property.

Monitoring Plan

Tier 2 Dischargers shall include a monitoring element in the water resource protection plan that at a minimum provides for periodic inspection of the site, checklist to confirm placement and efficacy of management measures, and document progress on any plan elements subject to a time schedule. Tier 2 Dischargers shall submit an annual report (Appendix C) by March 31 of each year that documents implementation and effectiveness of management measures during the previous year. Tier 2 annual reporting is a function that may be provided through an approved third-party program.

Monitoring of the site includes visual inspection and photographic documentation of each feature of interest listed on the site map, with new photographic documentation recorded with any notable changes to the feature of interest. At a minimum, all site features must be monitored annually, to provide the basis for completion of the annual re-certification process. Additionally, sites shall be monitored at the following times to ensure timely identification of changed site conditions and to determine whether implementation of additional management measures is necessary to iteratively prevent, minimize, and mitigate discharges of waste to surface water: 1) just prior to October 15 to evaluate site preparedness for storm events and storm water runoff, 2) following the accumulation of 3" total precipitation or by November 15, whichever is sooner, and 3) following any rainfall event with an intensity of 3" precipitation in 24 hours. Precipitation data can be obtained from the National Weather Service Forecast Office (e.g. by entering the zip code of the parcel location at http://www.srh.noaa.gov/forecast).

Monitoring Plan Reporting Requirements

Order No. R1-2015-0023, Appendix C must be submitted to the Regional Water Board or approved third party program upon initial enrollment in the Order (NOI) and annually thereafter by March 31. Forms submitted to the Regional Water Board shall be submitted electronically to northcoast@waterboards.ca.gov. If electronic submission is infeasible, hard copies can be submitted to: North Coast Regional Water Quality Control Board, 5550 Skylane Boulevard, Suite A, Santa Rosa, CA 95403.

Assessment of the Standard Conditions

Assessment of Standard Conditions consisted of field examinations in the winter of 2017/2018. The examination evaluated areas near, and areas with the potential to directly impact, watercourses 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, changeable channels, overflow channels, flood prone areas, and riparian zones. Field examinations also evaluated all roads and trails on the property, developed areas, cultivation sites, and any structures and facilities appurtenant to cultivation on the property. Anywhere the Standard Conditions are not met on the property, descriptions of the assessments and the prescribed treatments are outlined following each associated section below.

Summary of Standard Conditions Compliance

1. Site Maintenance, Erosion Control, and Drainage Features Y☒/N☐
2. Stream Crossing Maintenance Y☒/N☐
3. Riparian and Wetland Protection and Management Y☒/N☐
4. Spoils Management Y☒/N☐
5. Water Storage and Use Y☐/N☒
6. Irrigation Runoff Y☒/N☐
7. Fertilizers and Soil Amendments Y☒/N☐
8. Pesticides and Herbicides Y☒/N☐
9. Petroleum Products and other Chemicals Y☒/N☐
10. Cultivation-Related Wastes Y☒/N☐
11. Refuse and Human Waste Y☒/N☐

1. Site Maintenance, Erosion Control, and Drainage Features

Roads are being classified as "permanent" (being used year-round), "seasonal" (being used primarily during summer months), and "trail" (being rarely used for occasional access to features on the property).

Permanent roads consist of a main access road to the residence, both cultivation areas, adjacent properties, and the point of diversion. The main access road is adequately surfaced with imported rock and is in acceptable condition with minor signs of erosion or concentrated surface runoff. Seasonal roads consist of access roads to structures and Cultivation Area A. Seasonal roads show no sign of erosion and are adequately surfaced. Trails exist leading a decommissioned cultivation area, water infrastructure, and the point of diversion. The trails are infrequently used and show no sign of erosion.

No unstable areas, nor evidence of the potential of road/surface related runoff to create unstable areas, was noted during the assessment of the property. No stockpiled construction materials are stored in locations that cannot be transported to receiving waters.

During inspection of the roads, cultivation areas, and watercourses, no sites were identified where road surface runoff was not being adequately dispersed, drained, and/or erosion of the road surface was occurring.

Summary of Standard Conditions Compliance (Cont.)

Cultivation Area A is located on a previously graded pad adjacent to the residence and a greenhouse downslope of the house with slopes of less than approximately 5% and adjoining natural hillslopes of less than approximately 30%. Surrounding the cultivation area is the residence and grassy hillsides with the nearest riparian area being a Class III watercourse to the southwest approximately 220' away. No drainage or erosion issues were observed within the cultivation area or the graded pad it is on.

Cultivation Area B is located on a naturally flat area on a ridge-top with slopes of less than approximately 5%. There is also a terrace to the southwest with slopes of less than approximately 5% with adjoining natural hillslopes of less than approximately 15%. Surrounding the cultivation area is timberland and grassland with no nearby watercourses. No drainage or erosion issues were observed within the cultivation area or the landing it is on.

The decommissioned cultivation area is located on a terraced hillside with slopes of approximately 40%. The potted plants have been removed and cultivation soils contoured into the terraces to promote vegetative growth. No apparent potential of delivery of runoff to surface waters is possible with this decommissioned cultivation area.

2. Stream Crossing Maintenance

There are no stream crossings located on the property.

3. Riparian and Wetland Protection and Management

Assessment of the property concluded that cultivation areas and associated facilities are not located or occurring within 100' of any Class I or II watercourse or within 50' of any Class III watercourse or wetland, buffers maintain natural slopes with native vegetation, and buffers are of sufficient width to filter wastes from runoff discharging from production lands and associated facilities to all wetlands, streams, drainage ditches, or other conveyances. No cultivation is occurring within the preferred minimum distance of 200 feet from any watercourse or waterbody.

4. Spoils Management

Currently, no spoils are stored or placed in or where they can enter any surface water. Any/all spoils shall be adequately contained or stabilized to prevent sediment delivery to surface waters. Any/all spoils generated through development or maintenance of roads, driveways, earthen fill pads, or other cleared or filled areas have not been sidecast in any location where they can enter or be transported to surface waters.

If any further spoiling material is required, such as from stream crossing installation or other grading, the discharger shall follow the BMPs in Appendix B of the Order, under Spoil Management. Spoil sites shall be located outside any standard width riparian area (50' for Class III and 100' for Class III) and shall be stabilized and contained as per the BMPs.

5. Water Storage and Use

All water on the property is derived from a surface water diversion located off of the property. The surface water diversion meets and exceed the required water demands for agricultural use and domestic use.

Summary of Standard Conditions Compliance (Cont.)

Diversion intake infrastructure at the Point of Diversion consists of a 24-inch diameter concrete cistern of unknown depth which functions as a seep well. From the cistern, water is conveyed via a 6-inch PVC pipe to a distribution cistern where diverted water is divided between approximately 16 ownerships. Water is then conveyed from the distribution cistern to a transfer tank located approximately 350-feet downslope. Water is then pumped uphill to the residence and water storage tanks.

At this time, the discharger has 46,450 gallons of water tank storage installed. This volume of storage is insufficient to allow for full forbearance during the Forbearance Period. The discharger shall obtain adequate water storage so that stored water provides adequate water resources for the Forbearance Period.

It is estimated that the discharger uses approximately 60,500 gallons of water during the forbearance period for agricultural use. The discharger shall obtain approximately another 14,000 gallons of water storage installed and filled in accordance to the Forbearance Period determined by the required Lake and Streambed Alteration Agreement with the California Department of Fish and Wildlife.

Water metering device(s) shall be installed in 2018 to meter water used for the irrigation of cannabis. Recorded water use data shall be used to determine any remaining storage needs to meet full forbearance, if needed. If any additional storage is needed to meet water needs during the Forbearance Period, it shall be installed and filled prior to the next Forbearance Periods. A separate water meter shall be installed to record domestic water use from the diversions. The discharger shall also implement water conservation measures such as drip line irrigation, morning or evening watering, and mulch or cover cropping of cultivated top soils. Monthly water use estimates with the season total are as follows below.

	Jan	Feb	March	April (40%)	May (65%)	Jun (85%)	Jul (100%)	Aug (100%)	Sep (75%	Oct (25%)	Nov	Dec
Agriculture				5084	7995	10455	12300	12300	9225	3075		
Sq. ft. = 8,200	% = percent of peak usage											
									Total AG Water Use =	60434		

A Lake and Streambed Alteration Agreement with the California Department of Fish and Wildlife, as well as an Initial Statement of Water Diversion and Use with the California State Water Resource Control Board Division of Water Rights, will be required for the continued use of the surface water diversions. Any additional guidelines, treatments, or restrictions set forth under the finalized Lake and Stream Alteration Agreement shall be followed.

6. Irrigation Runoff

During multiple visits to the property, no irrigation runoff, or evidence of such runoff, was observed at any of the cultivation sites.

7. Fertilizers and Soil Amendments

Fertilizers and soil amendments are stored in a shop building next to the residence and in the shop buildings adjacent to the residence. The discharger shall ensure that fertilizers, potting soils, compost, and other soils and soil amendments are stored in structures on the property in a manner in which they will not enter or be transported into surface waters and so that nutrients or other pollutants will not be leached into groundwater. Soil and amendment piles shall be either used or contained with staked wattles or earthen berms, yearly,

Summary of Standard Conditions Compliance (Cont.)

prior to the wet season. Fertilizers and soil amendments shall be applied and used per the manufacturers guidelines.

8. Pesticides and Herbicides

Pesticides and fungicides are stored alongside fertilizers and soil amendments in the shop buildings adjacent to the residence. The discharger shall ensure that all pesticide and herbicide products on the property are currently used, and stored in closed structures, to ensure that they do not enter or are released into surface or ground waters and that the use of pesticide products is consistent with product labeling.

9. Petroleum Products and Other Chemicals

Currently, there is no bulk fuel storage is present on the property. Small quantities of fuel in canisters is stored in the shop buildings adjacent to the residence.

All bulk fuel storage or petroleum products, any/all future petroleum products and other liquid chemicals, including but not limited to diesel, biodiesel, gasoline, and oils shall be stored so as to prevent their spillage, discharge, or seepage into receiving waters. Storage tanks and containers shall be of suitable material and construction to be compatible with the substance(s) stored and conditions of storage such as pressure and temperature. Above ground storage tanks and containers shall be provided with a secondary means of containment for the entire capacity of the largest single container and sufficient cover shall be provided to prevent any/all precipitation from entering said secondary containment vessel. Dischargers shall ensure that diked areas are sufficiently impervious to contain discharged chemicals. Discharger(s) shall implement spill prevention, control, and countermeasures (SPCC) and have appropriate cleanup materials available onsite if the volume of a fuel container is greater than 1,300 gallons. Underground storage tanks 110 gallons and larger shall be registered with the appropriate County Health Department and comply with State and local requirements for leak detection, spill overflow, corrosion protection, and insurance coverage.

10. Cultivation-Related Wastes

Organic cultivation-related wastes are collected from the cultivation areas and composted or burned in the winter. No organic cultivation-related wastes are stored or discarded in a location where these wastes can enter surface waters.

Non-organic cultivation-related wastes are stored in lidded trashcans next to or in the residence, shop buildings, and cultivation areas and are disposed of regularly. No non-organic cultivation related wastes are stored or discarded in a location where these wastes can enter surface waters.

11. Refuse and Human Waste

Garbage and refuse is stored on the property within lidded trash cans and hauled away to a landfill transfer station periodically. No refuse is stored or discarded in a location where these wastes can enter surface waters.

Human waste is managed by a septic system on site, attached to the residence. At the time of the assessment the septic system showed no signs of failure and posed no threat to water quality. It is the discharger's

Summary of Standard Conditions Compliance (Cont.)

responsibility to ensure compliance of such action with the Humboldt County Department of Environmental Health and Human Services.

12. Remediation/Clean-up/Restoration

Currently, one of the Standard Conditions are not being met; Water Storage and Use. Sites will be treated in accordance with regulations, following approval of any and/or all necessary permits, and done in accordance with the BMP's listed in Appendix B of the Order and those included in this WRPP. Additionally, several other general recommendations have been made as follows:

General Recommendations

- ☐ Fertilizer, soil amendments, and pesticide use it to be recorded in such a manner that cumulative annual totals are recorded for annual reporting.
- ☐ Water use shall be designed and metered such that water used for the irrigation of cannabis will be recorded separately from domestic use. Water use for the irrigation of cannabis is to be recorded monthly for annual reporting.
- ☐ Frequent use of un-surfaced roads should be avoided, particularly when road surfaces are soft/saturated.
- ☐ Existing or newly installed road surface drainage structures such as water bars, rolling dips, ditch relief culverts, and intentionally in/out-sloped segments of road shall be maintained to ensure continued function of capturing and draining surface runoff.

STATEMENT OF CONTINGENT AND LIMITING CONDITIONS CONCERNING THE PREPARATION AND USE OF WATER RESOURCE PROTECTION PLAN

Prepared by Timberland Resource Consultants

1. This Water Resource Protection Plan has been prepared for the property within APN 223-124-003 in Humboldt County, at the request of the Client.

2. Timberland Resource Consultants does not assume any liability for the use or misuse of the information in this Water Resource Protection Plan.

3. The information is based upon conditions apparent to Timberland Resource Consultants at the time the inspection was conducted. Changes due to land use activities or environmental factors occurring after this inspection have not been considered in this Water Resource Protection Plan.

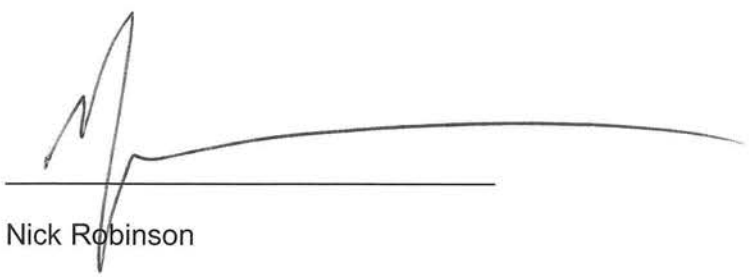
4. Maps, photos, and any other graphical information presented in this report are for illustrative purposes. Their scales are approximate, and they are not to be used for locating and establishing boundary lines.

5. The conditions presented in this Water Resource Protection Plan may differ from those made by others or from changes on the property occurring after the inspection was conducted. Timberland Resource Consultants does not guarantee this work against such differences.

6. Timberland Resource Consultants did not conduct an investigation on a legal survey of the property.

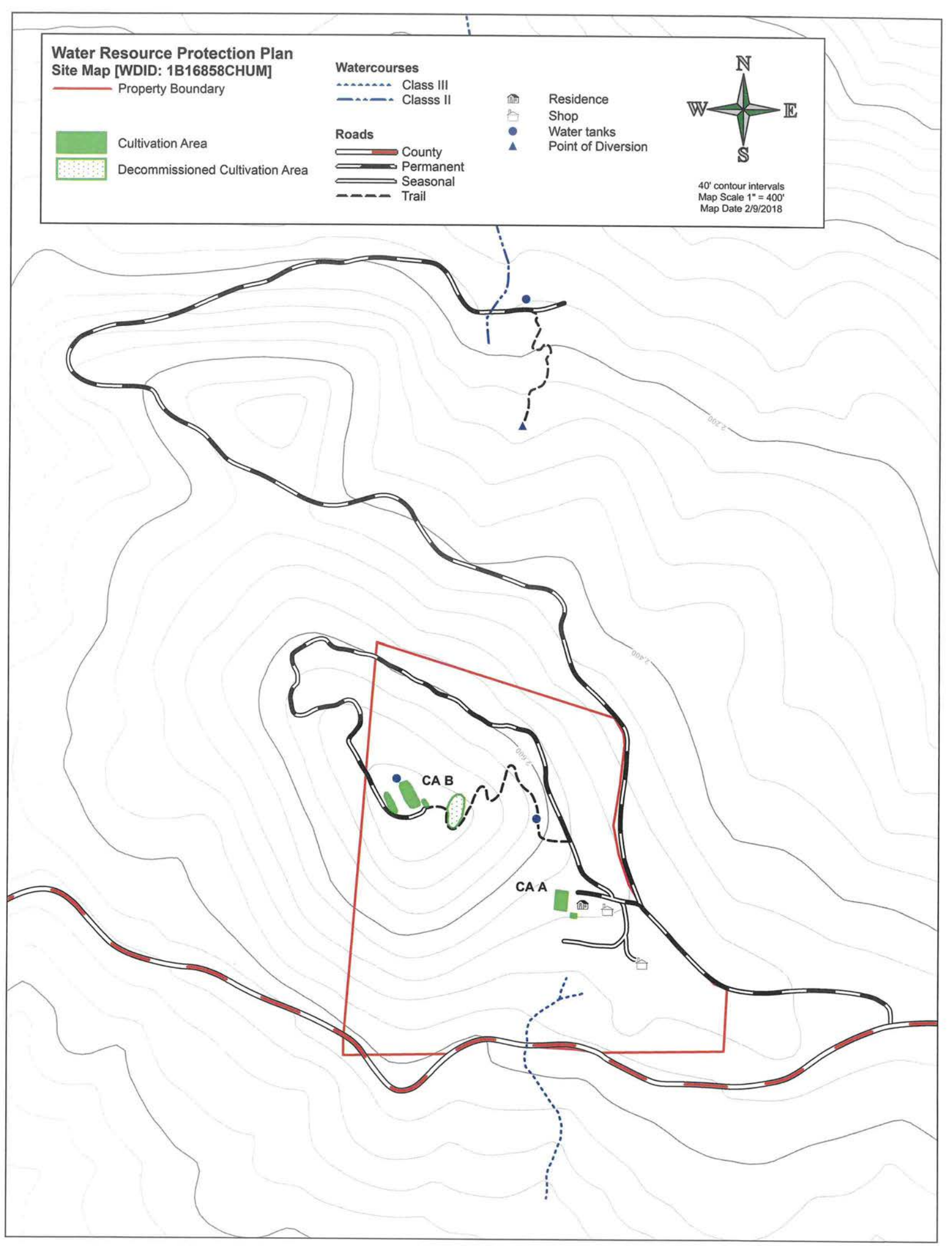
7. Persons using this Water Resource Protection Plan are advised to contact Timberland Resource Consultants prior to such use.

8. Timberland Resource Consultants will not discuss this report or reproduce it for anyone other than the Client named in this report without authorization from the Client.



Nick Robinson

Timberland Resource Consultants


Water Resource Protection Plan
Site Map [WDID: 1B16858CHUM]
Property Boundary
Cultivation Area
Decommissioned Cultivation Area
Watercourses
Class III
Classs II
Roads
County
Permanent
Seasonal
Trail
Residence
Shop
Water tanks
Point of Diversion
N
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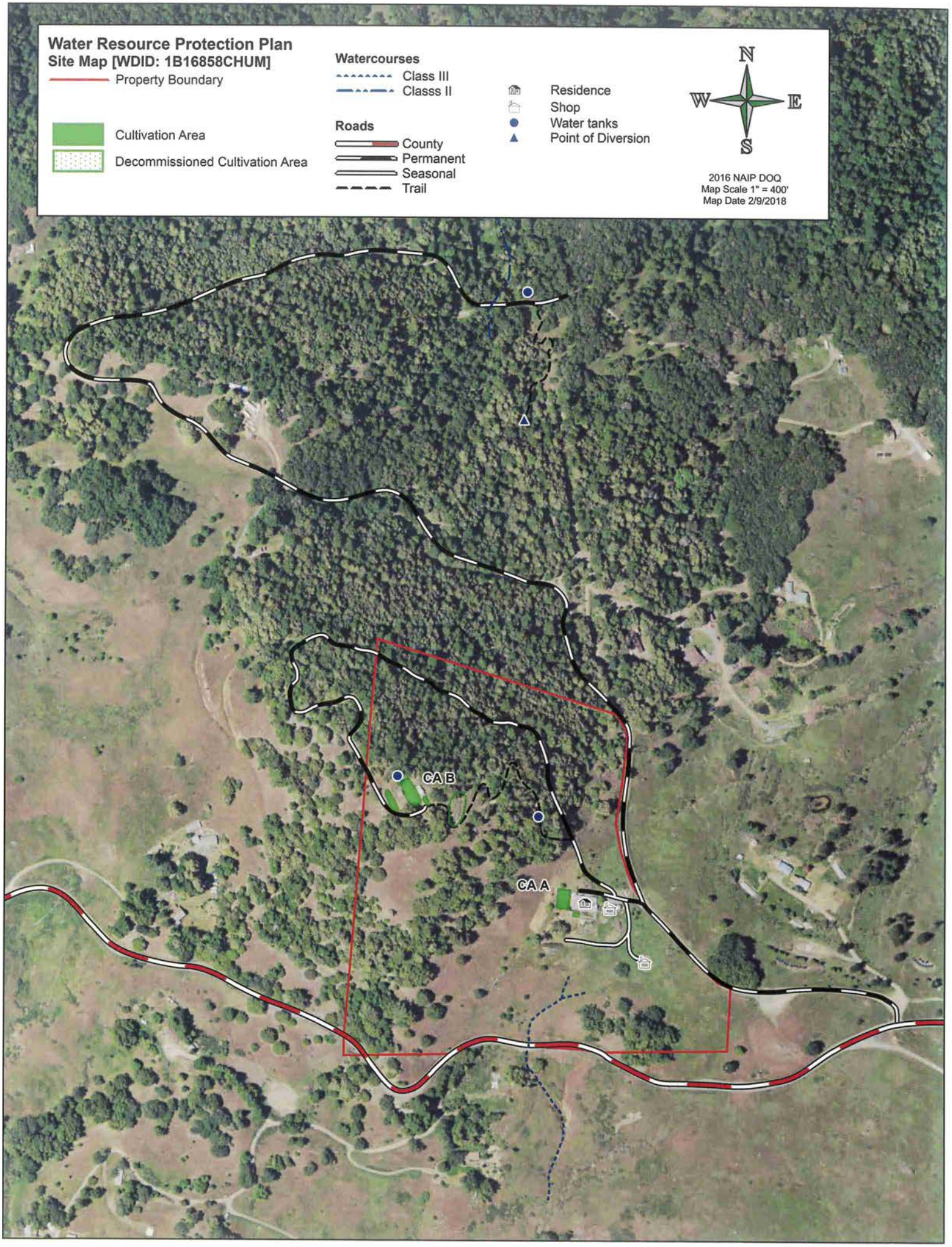
40' contour intervals
Map Scale 1" = 400'
Map Date 2/9/2018
CA B
CA A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Map Scale 1" = 400'
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CA A

BMP: General BMPs

- If operations require moving of equipment across a flowing stream, such operations shall be conducted without causing a prolonged visible increase in stream turbidity. For repeated crossings, the operator shall install a bridge, culvert, or rock-lined crossing.

- During construction in flowing water, which can transport sediment downstream, the flow shall be diverted around the work area by pipe, pumping, temporary diversion channel or other suitable means. When any dam or artificial obstruction is being constructed, maintained, or placed in operation, sufficient water shall at all times be allowed to pass downstream to maintain fish life below the dam. Equipment may be operated in the channel of flowing live streams only as necessary to construct the described construction.

- Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations. The disturbed portion of any stream channel shall be restored to as near their original condition as possible. Restoration shall include the mulching of stripped or exposed dirt areas at crossing sites prior to the end of the work period.

- Structures and associated materials not designed to withstand high seasonal flow shall be removed to areas above the high-water mark before such flows occur.

- No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete washing, oil or petroleum products, or other organic or earthen material from any logging, construction, or associated activity of whatever nature shall be allowed to enter into or be placed where it may be washed by rainfall or runoff into waters of the State. When operations are completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high-water mark of any stream.

BMP: General Erosion Control

- Timing for soil stabilization measures within the 100 feet of a watercourse or lake: For areas disturbed from May 1 through October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface. For areas disturbed from October 16 through April 30, 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, whichever is earlier.

- Within 100 feet of a watercourse or lake, the traveled surface of logging roads shall be treated to prevent waterborne transport of sediment and concentration of runoff that results from operations. Treatment may consist of, but not limited to, rocking, out sloping, rolling dips, cross drains, water bars, slope stabilization measures, or other practices appropriate to site-specific conditions.

- The treatment for other disturbed areas within 100 feet of a watercourse or lake, including: (A) areas exceeding 100 contiguous square feet where operations have exposed bare soil, (B) approaches to road watercourse crossings out to 100 feet or the nearest drainage facility, whichever is farthest, (C) road cut banks and fills, and (D) any other area of disturbed soil that threatens to discharge sediment into waters in amounts deleterious to the quality and beneficial uses of water, shall be grass seeded and mulched with straw or fine slash. Grass seed shall be applied at a rate exceeding 100 pounds per acre. Straw mulch shall be applied in amounts sufficient to provide at least 2- 4-inch depth of straw with minimum 90% coverage. Slash may be substituted for straw mulch provided the depth, texture, and ground contact are equivalent to at least 2 – 4 inches of straw mulch. Any treated area that has been subject to reuse or has less than 90% surface cover shall be treated again prior to the end of operations.

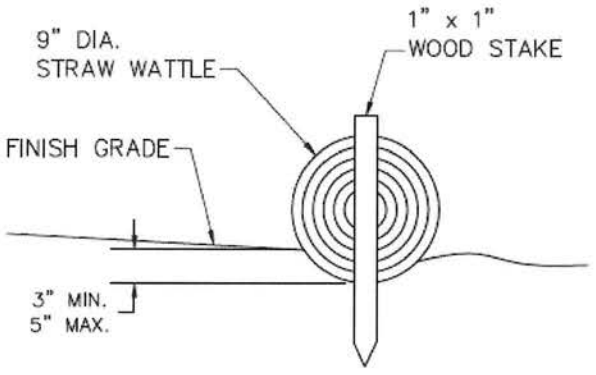
- Within 100 feet of a watercourse or lake, where the undisturbed natural ground cover cannot effectively protect beneficial uses of water from operations, the ground shall be treated with slope stabilization measures described in #3 above per timing described in #1 above.

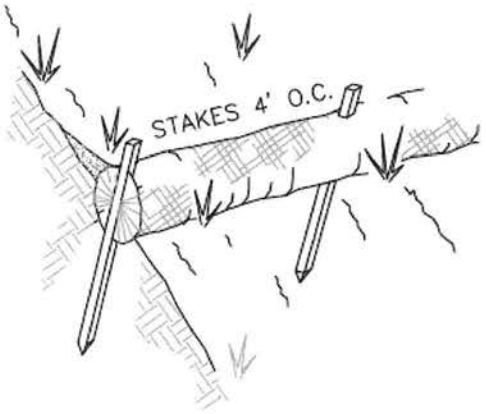
- Side cast or fill material extending more than 20 feet in slope distance from the outside edge of a landing which has access to a watercourse or lake shall be treated with slope stabilization measures described in #3 above. Timing shall occur per #1 above unless outside 100 feet of a watercourse or lake, in which completion date is October 15.

- All roads shall have drainage and/or drainage collection and storage facilities installed as soon as practical following operations and prior to either (1) the start of any rain which causes overland flow across or along the disturbed surface within 100 feet of a watercourse or lake protection, or (2) any day with a National Weather Service forecast of a chance of rain of 30 percent or more, a flash flood warning, or a flash flood watch.

BMP: General Erosion Control (Cont.)

- Erosion control and sediment detention devices and materials shall be incorporated into the cleanup/restoration work design and installed prior to the end of project work and before the beginning of the rainy season. Any continuing, approved project work conducted after October 15 shall have erosion control works completed up-to-date and daily.
- Erosion control materials shall be, at minimum, stored on-site at all times during approved project work between May 1 and October 15.
- Approved project work within the 5-year flood plain shall not begin until all temporary erosion controls (straw bales or silt fences that are effectively keyed-in) are installed downslope of cleanup/restoration activities.
- Non-invasive, non-persistent grass species (e.g., barley grass) may be used for their temporary erosion control benefits to stabilize disturbed slopes and prevent exposure of disturbed soils to rainfall.
- Upon work completion, all exposed soil present in and around the cleanup/restoration sites shall be stabilized within 7 days.
- Soils exposed by cleanup/restoration operations shall be seeded and mulched to prevent sediment runoff and transport.
- Straw Wattles (if used) shall be installed with 18 or 24-inch wood stakes at four feet on center. The ends of adjacent straw wattles shall be abutted to each other snugly or overlapped by six inches. Wattles shall be installed so that the wattle is in firm contact with the ground surface.





BMP: General Erosion Control Techniques

TABLE 34. Guidelines for erosion and sediment control application

Timing of application	Technique	Portion of road and construction area treated
Erosion control during construction	Hydromulching, hydroseeding	Road fill slopes, cut slopes, bare soil areas
	Dry seeding	Road fill slopes, cut slopes, bare soil areas
	Wood chip, straw, Excelsior or tackified mulch	Road fill slopes, cut slopes, bare soil areas
	Straw wattles	Road fill slopes and cut slopes
	Gravel surfacing	Road, landing and turnout surfaces
	Dust palliative	Road surfaces
	Minimize disturbance (soil and vegetation)	All areas peripheral to construction
Sediment control during construction	Sediment basin	Roadside ditches, turnouts and small stream crossings
	Sediment traps (e.g., silt fences, straw bales barriers, woody debris barriers)	Road fill slopes, cutbanks, bare soil areas and ditches
	Straw bale dams	Ditches and small streams
	Sumps and water pumps	Stream channels and stream crossings
	Streamflow diversions (e.g., temporary culverts, flex pipe, etc.)	Stream channels and stream crossings
	Surface diversion and dispersion devices (pipes, ditches, etc.)	All disturbed bare soil areas
Permanent erosion control	Road shaping	Road and landing surfaces
	Gravel surfacing	Road, landing and turnout surfaces
	Bituminous or asphalt surfacing	Road surface
	Rolling dips	Road surface
	Ditch relief culverts	Roadbed and road fill
	Downspouts and berm drains	Road fill slopes
	Waterbars	Road and landing surfaces
	Berms	Road surface and roadside areas
	Ditches	Road and landing surfaces
	Riprap	Road fill slopes, stream crossing fills, cutbanks, stream and lake banks
	Soil bioengineering	Road fill slopes, cut slopes, stream crossings, streambanks
	Tree planting	Road fill slopes, cutbanks, bare soil areas, stream crossings, streambanks

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

BMP: Permanent Culvert Crossing

- New culvert installations shall be sized to accommodate flows associated with a 100-year storm event.
- If the new culvert is replacing a poorly installed old culvert, the crossing may need to be abandoned to the following standard:
  - When fills are removed they shall be excavated to form a channel that is as close as feasible to natural watercourse grade and orientation, and that is wider than the natural channel.
  - Excavated banks shall be laid back to a 2:1 (50%) or natural slope.
- New culverts shall be placed at stream gradient, or have downspouts, or have energy dissipaters at outfall.
  - Align culverts with the natural stream channel orientation to ensure proper function, prevent bank erosion, and minimize debris plugging. See Figure 97 below.
  - Place culverts at the base of the fill and at the grade of the original streambed or install a downspout past the base of the fill. Downspouts should only be installed if there are no other options.
  - Culverts should be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
  - Culvert beds should be composed of rock-free soil or gravel, evenly distributed under the length of the pipe.
  - Compact the base and sidewall material before placing the pipe in its bed.
  - Lay the pipe on a well-compacted base. Poor basal compaction will cause settling or deflection in the pipe and can result in separation at a coupling or rupture in the pipe wall.
  - Backfill material should be free of rocks, limbs, or other debris that could dent or puncture the pipe or allow water to seep around the pipe.
  - Cover one end of the culvert pipe, then the other end. Once the ends are secure, cover the center.
  - Tamp and compact backfill material throughout the entire process, using water as necessary for compaction.
  - Backfill compacting will be done in 0.5 – 1.0 foot lifts until 1/3 of the diameter of the culvert has been covered.
  - Push layers of fill over the crossing to achieve the final design road grade, road fill above the culvert should be no less than one-third to one-half the culvert diameter at any point on the drivable surface.
- Critical dips shall be installed on culvert crossings to eliminate diversion potential. Refer to Figure 84 below.
- Road approaches to crossings shall be treated out to the first drainage structure (i.e. waterbar, rolling dip, or hydrologic divide) to prevent transport of sediment.
- Road surfaces and ditches shall be disconnected from streams and stream crossings to the greatest extent feasible. Ditches and road surfaces that cannot be feasible disconnected from streams or stream crossings shall be treated to reduce sediment transport to streams.
- If downspouts are used, they shall be secured to the culvert outlet and shall be secure on fill slopes.
- Culverts shall be long enough so that road fill does not extend or slough past the culvert ends.
- Inlet of culverts, and associate fill, shall be protected with appropriate measures that extend at least as high as the top of the culvert.
- Outlet of culverts shall be armored with rock if road fill sloughing into channel can occur.
- Armor inlets and outlets with rock, or mulch and seed with grass as needed (not all stream crossings need to be armored).
- Where debris loads could endanger the crossing, a debris catchment structure shall be constructed upstream of the culvert inlet.
- Bank and channel armoring may occur, when appropriate, to provide channel and bank stabilization.

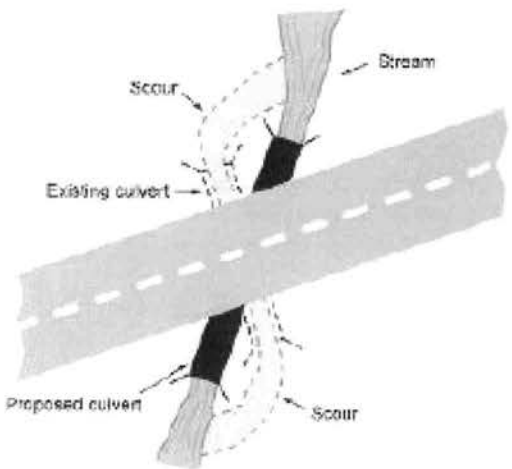


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FIGURE 97. *Culvert alignment should be in relation to the stream and not the road. It is important that the stream enters and leaves the culvert in a relatively straight horizontal alignment so streamflow does not have to turn to enter the inlet or discharge into a bank as it exits. This figure shows a redesigned culvert installation that replaces the bending alignment that previously existed. Channel turns at the inlet increase plugging potential because wood going through the turn will not align with the inlet. Similarly, channel turns at the inlet and outlet are often accompanied by scour against the channel banks (Wisconsin Transportation Information Center, 2004).*

BMP: Permanent Culvert Crossing (Cont.)

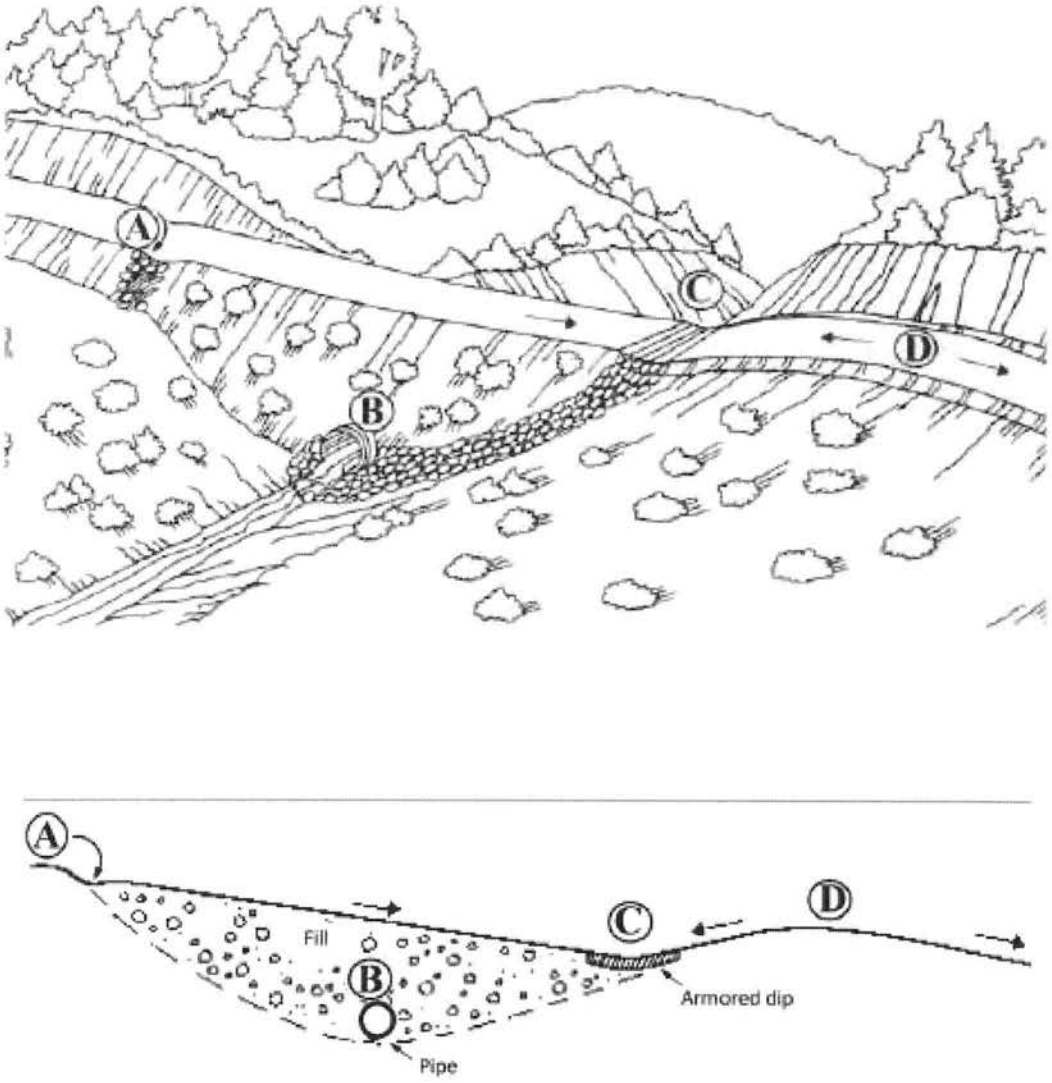

FIGURE 84. *Critical dips or dipped crossing fills should be centered near a stream crossing's down-road hingeline, not over the centerline of the crossing where overtopping could cause washout or severe erosion of the fill. If the stream crossing culvert (B) plugs, water will pond behind the fill until reaching the critical dip or low point in the crossing (C) and flowing back down into the natural stream channel. The down-road ditch must be plugged to prevent streamflow from diverting down the ditch line. For extra protection in this sketch, riprap armor has been placed at the critical dip outfall and extending downslope to the stream channel. This is only required or suggested on stream crossings where the culvert is* **highly likely** *to plug and the crossing fill overtopped. The dip at the hinge line is usually sufficient to limit erosional damage during an overtopping event. Road surface and ditch runoff is disconnected from the stream crossing by installing a rolling dip and ditch relief culvert just up-road from the crossing (A) (Keller and Sherar, 2003).*

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BMP: Permanent Culvert Crossing (Cont.)

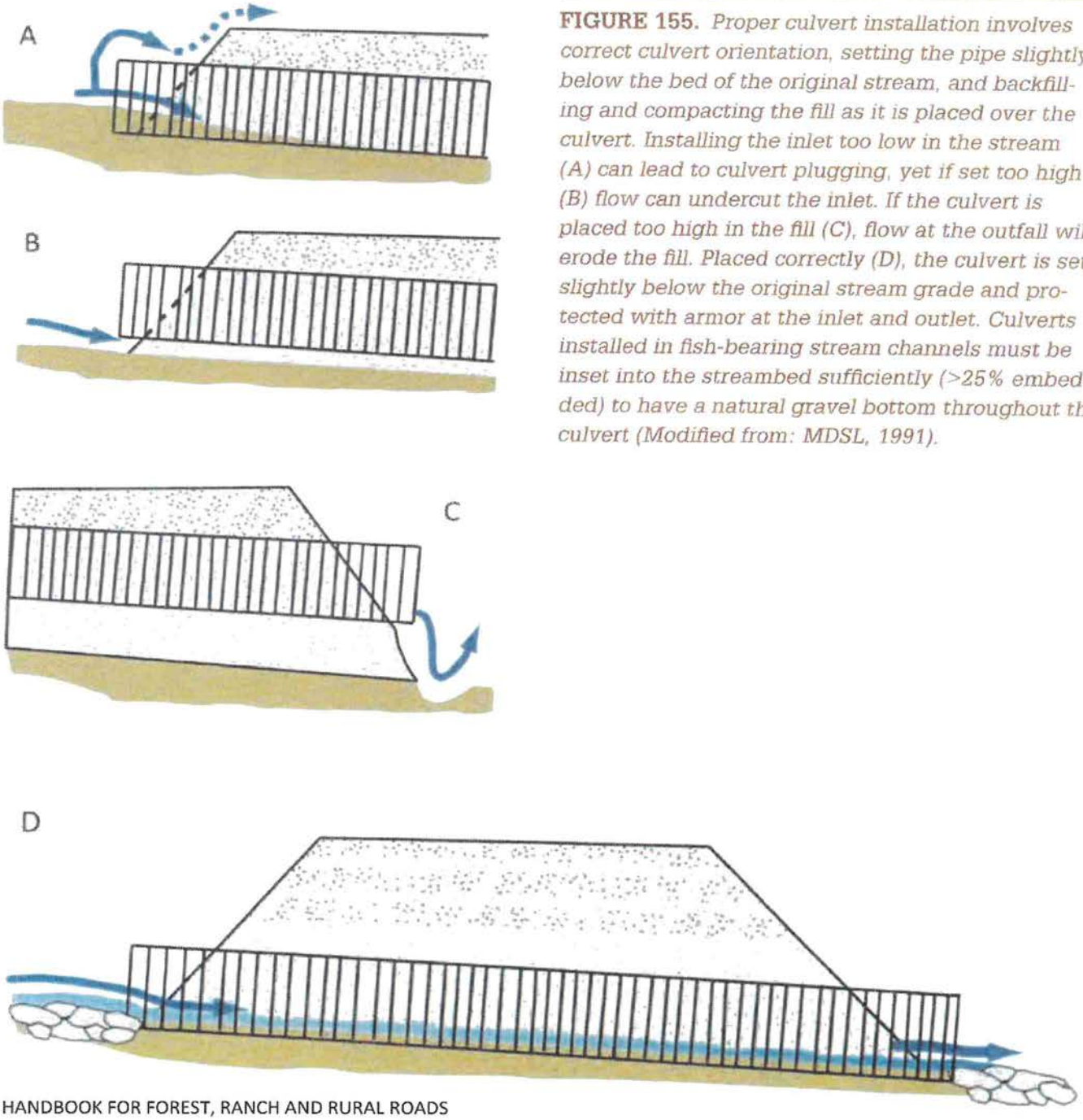

FIGURE 155. *Proper culvert installation involves correct culvert orientation, setting the pipe slightly below the bed of the original stream, and backfilling and compacting the fill as it is placed over the culvert. Installing the inlet too low in the stream (A) can lead to culvert plugging, yet if set too high (B) flow can undercut the inlet. If the culvert is placed too high in the fill (C), flow at the outfall will erode the fill. Placed correctly (D), the culvert is set slightly below the original stream grade and protected with armor at the inlet and outlet. Culverts installed in fish-bearing stream channels must be inset into the streambed sufficiently (>25% embedded) to have a natural gravel bottom throughout the culvert (Modified from: MDSL, 1991).*

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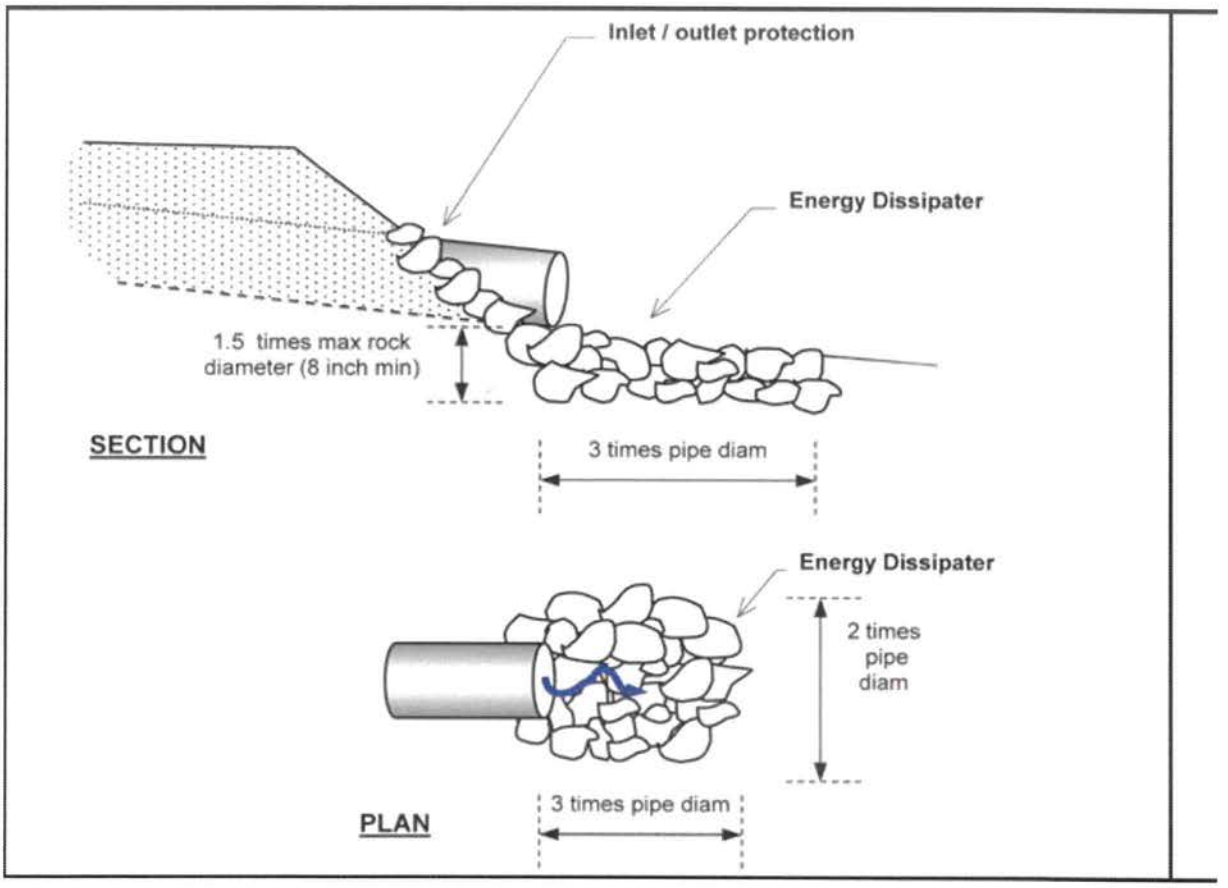
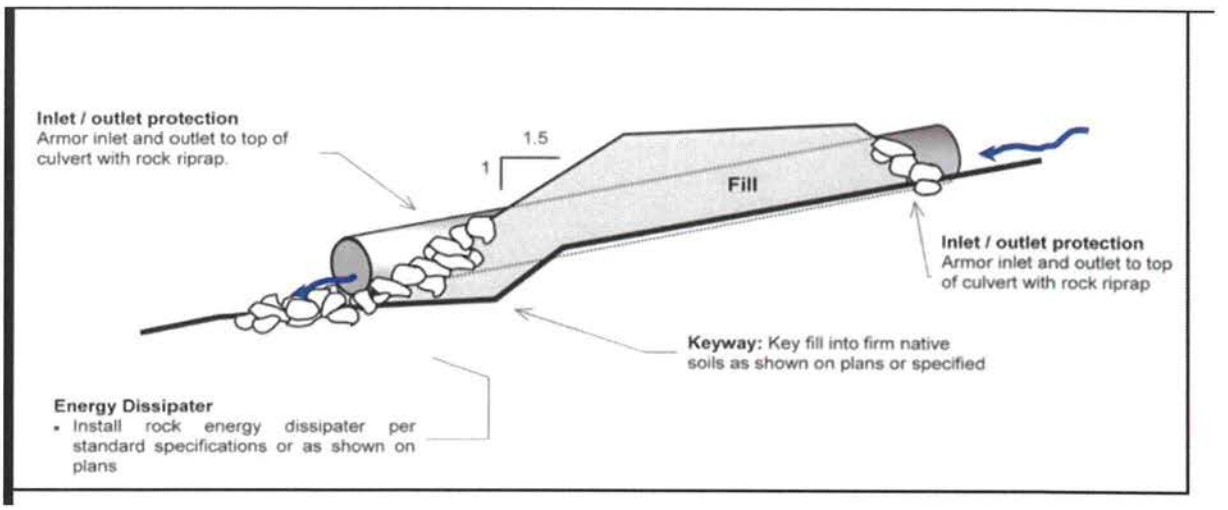
BMP: Culvert Rock Armoring Specifications





Riprap installed to protect the inlet and outlet of a stream crossing culvert from erosion or for energy dissipation should be keyed i the natural channel bed and banks to an approximate depth of about 1.5x the maximum rock thickness. Riprap should be placed at le up to the top of the culvert at both the inlet and outlet to protect them from splash erosion and to trap any sediment eroded from t newly constructed fill slope above.

BMP: Inlet and Outlet Armoring

- Inlets of culverts and associate fills shall be protected with rock armoring that extends at least as high as the top of the culvert.
- Outlets of culverts shall be provided a rocked energy dissipater at the outfall of the culvert.
- Outlets of culverts and associate fills shall be protected with rock armoring that extends at least as high as the top of the culvert if road fill sloughing into channel can occur.
- Prior to inlet and outlet rocking, the inlet and outlets shall be prepared. Preparation will include removal of vegetation and stored materials from the inlet and outlet.
- Inlets may require construction of an inlet basin.
- Slopes at the outlet should be shaped to a 2:1 or natural slope prior to placing rock armor.
- Rock used at culvert inlets and outlets should be a matrix of various sized rocks and rip-rap that range from a 3" dia. to a 2' dia.
- The largest rocks should be places at the base of the culvert or fill. Incrementally smaller rocks shall be placed over the larger rocks at the armoring extend up the slope. Voids and spaces shall be back filed with smaller gravels and rocks.

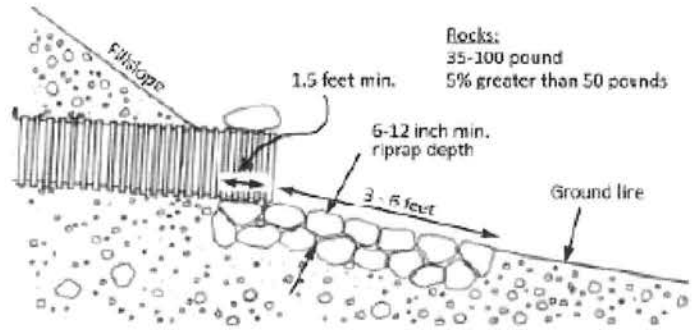


FIGURE 107A. *Riprap armor at culvert outlet (Modified from: Keller et al., 2011).*

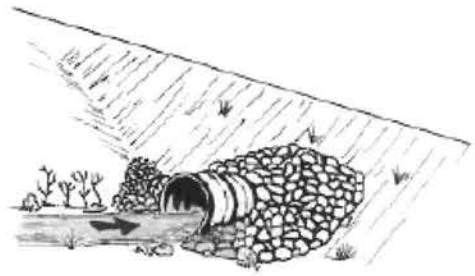


FIGURE 107B. *Riprap armor at culvert inlet (Keller and Sherar, 2003).*

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BMP: Stream Bank Armoring (Riprap)

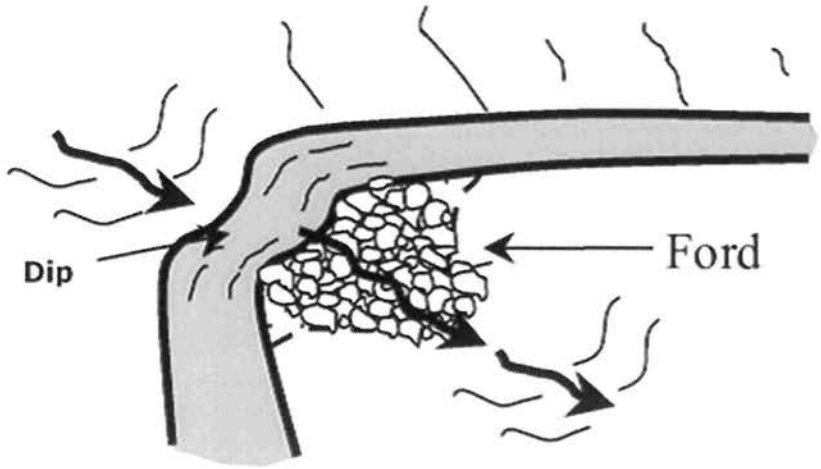
- Riprap should be installed on top of geotextile fabric or a clean mixture of coarse gravel and sand.
- The riprap should be keyed into the streambed and extend below the maximum expected scour depth with an adequately sized key base width at a thickness of a minimum of 2x the median (D50) rock diameter with the largest stone sizes placed at the base of the riprap structure.
- The armor should be set into the streambank so it does not significantly protrude into, or constrict, the natural channel, or otherwise reduce channel capacity.
- The riprap should extend along the length of unstable or over steepened bank and up the bank sufficiently to encompass the existing bank instability and/or design flood elevations.

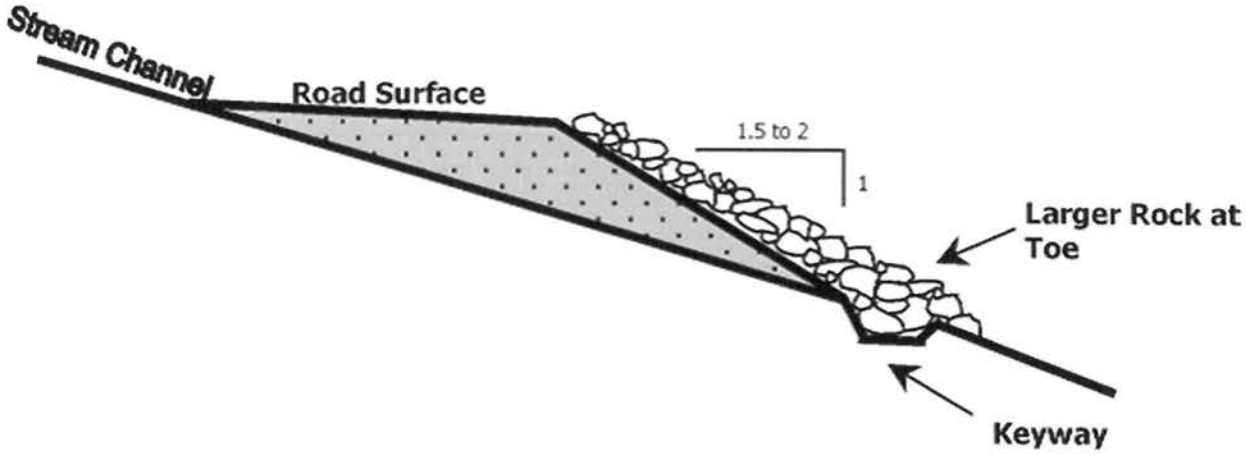
BMP: Rocked Ford

- Rocked fords are drainage structures designed to carry watercourses across roads with little to no erosion of the road surface or fill.
- Fords constructed in-channel shall be of appropriately sized material that shall withstand erosion or displacement by expected velocities and placed in a broad, U-shaped channel to create a drivable crossing.
  - The road shall dip into and out of the rocked ford to minimize diversion potential. Construct a broad rolling dip across the roadbed, centered at the crossing, which is large enough to contain the expected 100-yr flood discharge while preventing flood flow from diverting down the road or around the rock armor.
- The road surface at the ford shall be constructed with clean rock. The rock shall be applied to a minimum depth of 6 inches.
  - A range of interlocking rock armor sizes should be selected and sized so that peak flows will not pluck or transport the armor off the roadbed or the sloping fill face of the armored fill.
- The ford's outlet shall be rock armored to resist downcutting and erosion.
  - *Excavate the keyway and armored area* - Excavate a two to three-foot-deep "bed" into the dipped road surface and adjacent fillslope (to place the rock in) that extends from approximately the middle of the road, across the outer half of the road, and down the outboard road fill to where the base of the fill meets the natural channel. At the base of the fill, excavate a keyway trench extending across the channel bed.
  - *Armor the basal keyway* - Put aside the largest rock armoring to create the buttresses. Use the largest rock armor to fill the basal trench and create a buttress at the base of the fill. This should have a "U" shape to it and it will define the outlet where flow leaves the armored fill and enters the natural channel.
  - *Armor the fill* - Backfill the fill face with the remaining rock armor making sure the final armor is unsorted and well placed, the armor is two coarse-rock layers in thickness, and the armored area on the fill face also has a "U" shape that will accommodate the largest expected flow.
  - *Armor the top of the fill* - Install a second trenched buttress for large rock at the break-in-slope between the outboard road edge and the top of the fill face.
- Road approaches to rocked fords shall be rock surfaced out to the first drainage structure (i.e. waterbar, rolling dip, or hydrologic divide) to prevent transport of sediment using rock.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.
- Road approach rock and rock ford armoring shall be reapplied following use as needed to maintain a permanent crossing.

BMP: Rocked Ford (Cont.)

FORD: A large dip is graded into the road at the axis of the stream channel. The outside fill face is dished out to form a spillway with large rock. On large watercourses, rock is keyed several feet into firm native soils. The road surface is rocked with 6" of minus rock .





BMP: Armored Ford/Fill

- Armored fords are watercourse crossing fills comprised primarily of rock and designed to carry watercourses across roads without erosion or displacement of installed fill material.
- Armored fords shall have a U-shaped channel to create a drivable crossing.
  - The road shall dip into and out of the armored ford to minimize diversion potential. Construct a broad rolling dip across the roadbed, centered at the crossing, which is large enough to contain the expected 100-yr flood discharge while preventing flood flow from diverting down the road or around the rock armor.
- The road surface at the armored ford shall consist of rock small enough to be easily passable by vehicle, but large enough to not be transported during high flow storm events.
- The ford's inlet shall be rocked if a threat of head cutting exists.
  - *Excavate the keyway* - Excavate a one to three-foot-deep "bed" into the inboard edge of the road
  - *Armor the basal keyway* – place various sized rock in the constructed keyway to prevent head cutting. Use the largest rock armor to fill the keyway trench and create a buttress along the inboard edge of the road. This should have a "U" shape to it and it will define the inlet where flow leaves the natural channel and enters the road.
- The ford's outlet shall be rock armored to resist downcutting and erosion.
  - *Excavate the keyway and armored area* - Excavate a two to three-foot-deep "bed" into the dipped road surface and adjacent fillslope (to place the rock in) that extends from approximately the middle of the road, across the outer half of the road, and down the outboard road fill to where the base of the fill meets the natural channel. At the base of the fill, excavate a keyway trench extending across the channel bed.
  - *Armor the basal keyway* - Put aside the largest rock armoring to create the buttresses. Use the largest rock armor to fill the basal trench and create a buttress at the base of the fill. This should have a "U" shape to it and it will define the outlet where flow leaves the armored fill and enters the natural channel.
  - *Armor the fill* - Backfill the fill face with the remaining rock armor making sure the final armor is unsorted and well placed, the armor is two coarse-rock layers in thickness, and the armored area on the fill face also has a "U" shape that will accommodate the largest expected flow.
  - *Armor the top of the fill* - Install a second trenched buttress for large rock at the break-in-slope between the outboard road edge and the top of the fill face.
- Road approaches to armored fords shall be surface rocked out to the first drainage structure (i.e. waterbar, rolling dip, or hydrologic divide) to prevent transport of sediment using rock.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.
- Armored ford armoring shall be reapplied following use as needed to maintain a permanent crossing.

FIGURE 120. *This armored fill crossing of a steep, ephemeral stream was constructed to provide a low maintenance crossing. The crossing has been deeply dipped to reduce the volume of road fill and to eliminate the potential for stream diversion. The fill slope has been heavily armored through the axis of the crossing to contain flood flows and prevent down-cutting. Armored fills cannot be used on fish bearing streams.*

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BMPs and Diagrams

BMP: Armored Ford [Fill] (Cont.)

FIGURE 121D. *Well graded rock armor is then backfilled into the structure and spread across the breadth of the U-shaped stream crossing, and about one-third the way up the roadbed, so that streamflow will only flow over or come in contact with resistant armor material. The armor must be spread and compacted across the design width of the expected flood flow channel width so peak flows will not flank the armored structure.*

FIGURE 121E. *Two weeks after this armored fill was constructed, a storm flow event occurred and the structure maintained its function and integrity. The road approaches had not yet been compacted or surfaced with road rock.*

FIGURE 121F. *The same armored fill as it appeared after the first winter flood flows. No maintenance was required to reopen the road. It is also clear that no stream diversion is possible at this stream crossing site, and the volume of fill within the crossing has been reduced to the minimum amount needed to maintain a relatively smooth driving surface on this low volume road.*

BMP: Permanent Crossing Decommissioning Specifications

- When fills are removed they shall be excavated to form a channel that is as close as feasible to natural watercourse grade and orientation, and that is wider than the natural channel.
- Excavated banks shall be laid back to a 2:1 (50%) or natural slope.
- Temporary crossings shall be removed by November 15.
  - Any temporary culvert crossing left in after October 15 or installed between October 15 and May 1, shall be sized to accommodate the estimated 100-year flow.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.

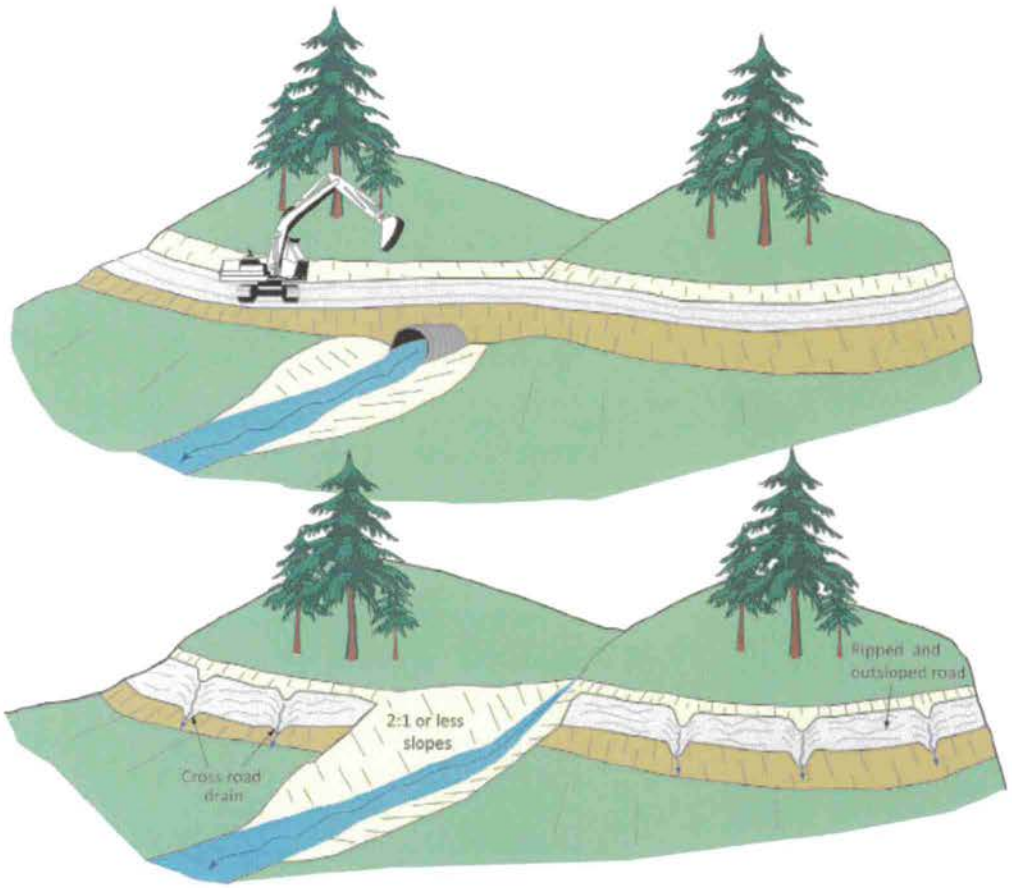

FIGURE 263. *On roads that are to be closed (decommissioned), all stream crossing culverts and fills should be removed. Stream crossing excavations are best performed using an excavator. The original channel should be excavated and exhumed down to the former streambed, with a channel width equal or greater than the natural channel above and below the crossing. Sideslopes should be laid back to a stable angle, typically a 2:1 (50%) gradient, or less. Spoil can be endhauled off-site or stored on the road bench adjacent the crossing, provided it is placed and stabilized where it will not erode or fail and enter the stream.*

BMP: Permanent Crossing Decommissioning Specifications (Cont.)

- Excavating and removing all fill materials placed in the stream channel when the crossing was originally built.
- Fill material should be excavated to recreate the original channel grade (slope) and orientation.
- The excavated channel bed should be as wide, or slightly wider than, the original watercourse channel.
    - This can be better determined by observing the channel width of the watercourse up slope of crossing to be removed at a point in which the crossing or any other disturbance has not affected the natural channel slope and width.
- If the channel sideslopes were disturbed, they should be graded (excavated) back to a stable angle (generally less than 50% (2:1)) to prevent slumping and soil movement.
- The bare soils should then be mulched, seeded, and planted to minimize erosion until vegetation can protect the surface.
- The approaching, hydrologically connected road segments should be cross-road drained to prevent road runoff from discharging across the freshly excavated channel sideslopes.

BMP: Waterbar Construction

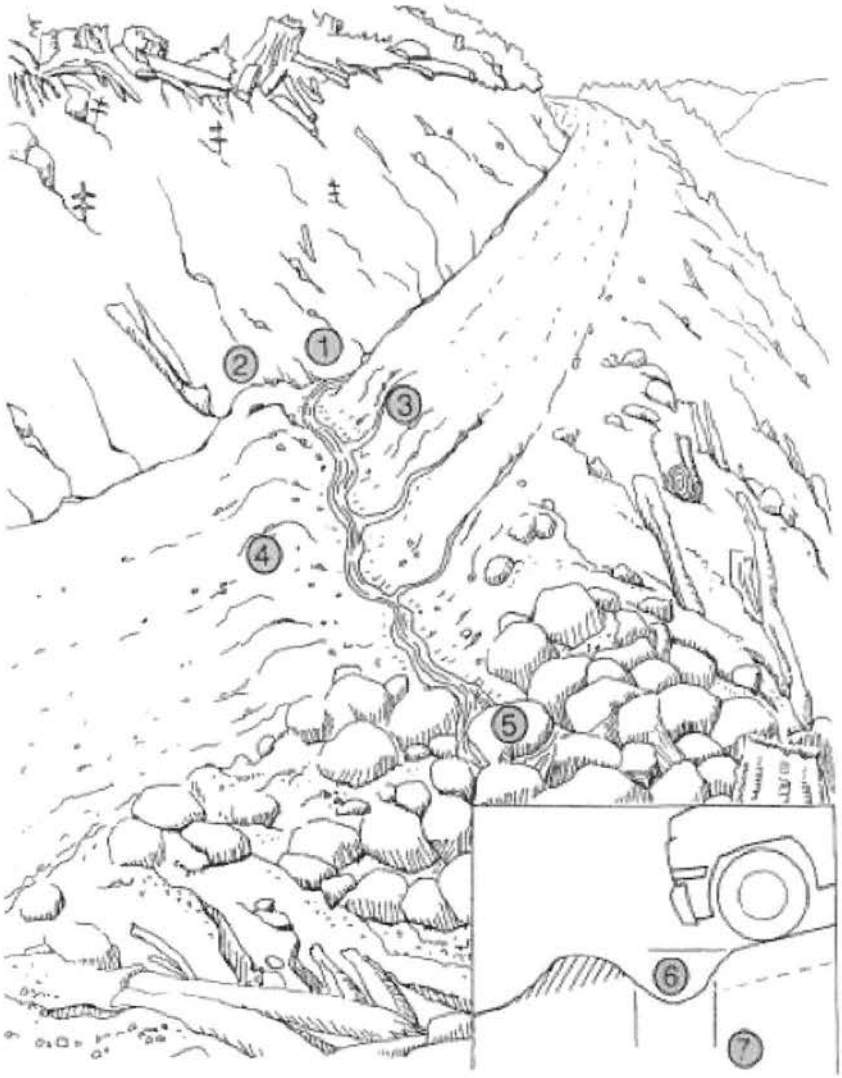

FIGURE 40. *Waterbars are constructed on unsurfaced forest and ranch roads that will have little or no traffic during the wet season. The waterbar should be extended to the cutbank to intercept all ditch flow (1) and extend beyond the shoulder of the road. A berm (2) must block and prevent ditch flow from continuing down the road during flood flows. The excavated waterbar (3) should be constructed to be self-cleaning, typically with a 30° skew to the road alignment with the excavated material bermed on the downhill grade of the road (4). Water should always be discharged onto the downhill side on a stable slope protected by vegetation. Rock (shown in the figure) should not be necessary if waterbars are spaced close enough to prevent serious erosion. (5) The cross ditch depth (6) and width (7) must allow vehicle cross-over without destroying the function of the drain. Several alternate types of waterbars are possible, including one that drains only the road surface (not the ditch), and one that drains the road surface into the inside ditch (BCMF, 1991).*

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BMP: Rolling Dip

- Rolling dips are drainage structures designed to capture and discharge surface water collected on road surfaces and in inside ditches at a specific location.
- The road shall dip into and out of the rolling dip to eliminate the possibility of water flowing along the road surface or in an inside ditch to bypass the dip structure.
- The rolling dip shall be constructed with clean native materials.
- The rolling dips outlet may be armored to resist downcutting and erosion.
- Do not discharge rolling dips into swales that show signs of instability or active landsliding.
- If the rolling dip is designed to divert both road surface and ditch runoff, block the down-road ditch with compacted fill.

BMP: Rocked Rolling Dip

- Rocked Rolling dips are drainage structures designed to capture and discharge surface water collected on road surfaces and in inside ditches at a specific location.
- The road shall dip into and out of the rolling dip to eliminate the possibility of water flowing along the road surface or in an inside ditch to bypass the dip structure.
- The rocked rolling dips inlet and outlet shall be armored to resist downcutting and erosion.
- The entire length of the rocked rolling dip shall be rock armored to a minimum of 5-feet from the centerline of the dip.
- If a keyway is necessary, the rocked rolling dip keyway shall be constructed at the base of the dip and shall be of sufficient size, depth, and length to support materials used in the rocked rolling dip construction back up to the road crossing interface.
- Do not discharge rolling dips into swales that show signs of instability or active landsliding.
- If the rolling dip is designed to divert both road surface and ditch runoff, block the down-road ditch with compacted fill.
- The rolling dip must be drivable and not significantly inhibit traffic and road use.

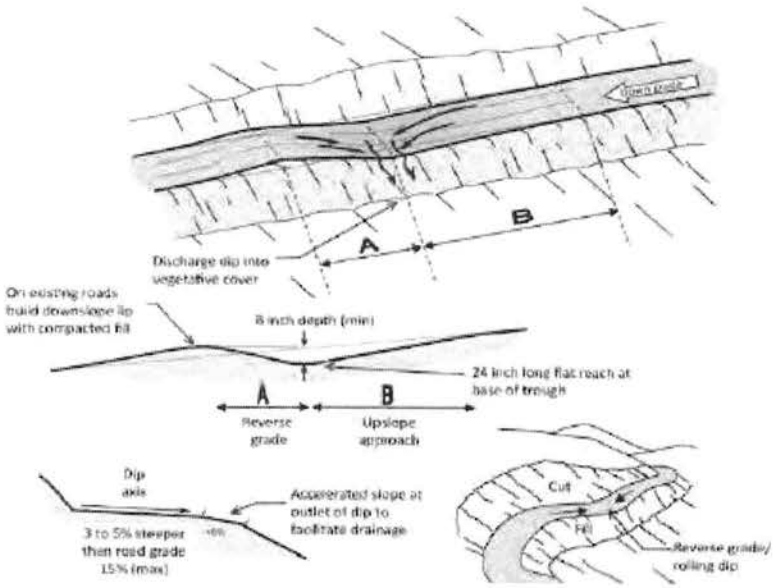

FIGURE 34. *A classic Type I rolling dip, where the excavated up-road approach (B) to the rolling dip is several percent steeper than the approaching road and extends for 60 to 80 feet to the dip axis. The lower side of the structure reverses grade (A) over approximately 15 feet or more, and then falls down to rejoin the original road grade. The dip must be deep enough that it is not obliterated by normal grading, but not so deep that it is difficult to negotiate or a hazard to normal traffic. The outward cross-slope of the dip axis should be 3% to 5% greater than the up-road grade (B) so it will drain properly. The dip axis should be out-sloped sufficiently to be self-cleaning, without triggering excessive downcutting or sediment deposition in the dip axis (Modified from: Best, 2013).*

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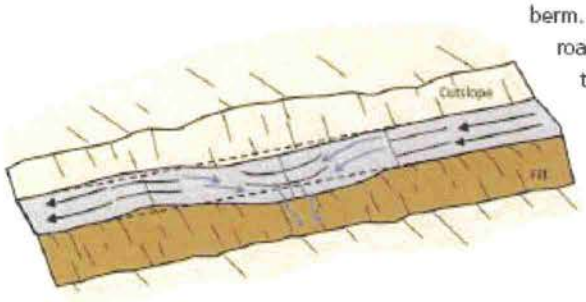
BMP: Rolling Dip and Rocked Rolling Dip (Cont.)

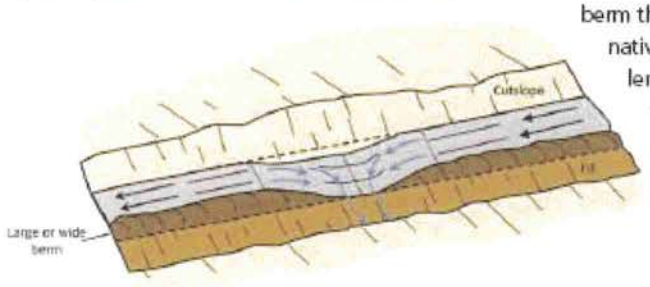
Type 1 Rolling Dip
(Standard)

Type 1 rolling dips are used where road grades are less than about 12-14% and road runoff is not confined by a large through cut or berm. The axis of the dip should be perpendicular to the road alignment and sloped at 3-4% across the road tread. Steep roads will have longer and more abrupt dip dimensions to develop reverse grade through the dip axis. The road tread and/or the dip outlet can be rocked to protect against erosion, if needed.



Type 2 Rolling Dip
(Through-cut or thick berm road reaches)

Type 2 rolling dips are constructed on roads up to 12-14% grade where there is a through cut up to 3 feet tall, or a wide or tall berm that otherwise blocks road drainage. The berm or native through cut material should be removed for the length of the dip, or at least through the axis of the dip, to the extent needed to provide for uninterrupted drainage onto the adjacent slope. The berm and slope material can be excavated and endhauled, or the material can be sidecast onto native slopes up to 45%, provided it will not enter a stream.



Type 3 Rolling Dip
(Steep road grade)

Type 3 rolling dips are utilized where road grades are steeper than about 12% and it is not feasible to develop a reverse grade that will also allow passage of the design vehicle (steep road grades require more abrupt grade reversals that some vehicles may not be able to traverse without bottoming out).

Instead of relying on the dip's grade reversal to turn runoff off the roadbed, the road is built with an exaggerated outslope of 6-8% across the dip axis. Road runoff is deflected obliquely across the dip axis and is shed off the outsloped section rather than continuing down the steep road grade.

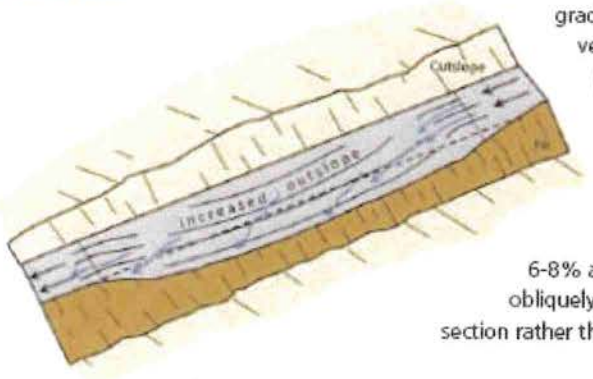


FIGURE 36. *Rolling dip types*

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BMP: Rolling Dip with Leadout ditch (Cont.)

FIGURE 55. *Steep roads that go straight up or down a hillside are very difficult to drain. This steep, fall line road developed a through cut cross section that was drained using lead out ditches to direct runoff off the road and onto the adjacent, vegetated hillside. The road was "outsloped" to drain runoff to the right side, and the lead out ditch was built slightly steeper than the road grade, to be self-cleaning. Four lead out ditches have been constructed at 100-foot intervals to the bottom of the hillside.*

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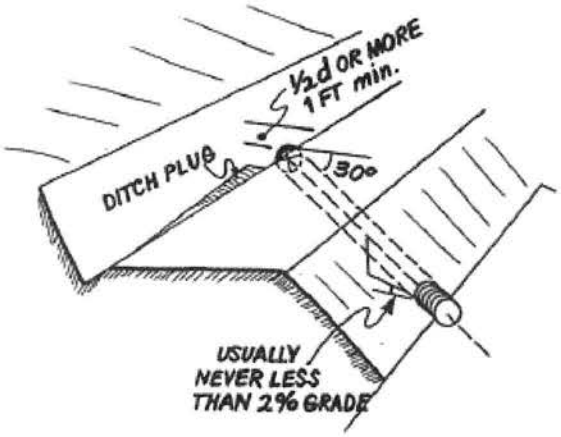
BMP: Ditch Relief Culvert

- Install ditch relief culverts at an oblique (typically 30 degree) angle to the road so that ditch flow dis not forced to make a sharp angle turn to enter the pipe. On low gradient roads (<5%), where ditch flow is slow, ditch relief culverts can be installed at right angles to the road.
- Install ditch relief culverts (DRC) to outlet at, and drain to, the base of the fill.
- If it cannot be installed at the base of the fill, install the DRC with a grade steeper than the inboard ditch draining to the culvert inlet, and install a downspout on the outlet to carry the culverted flow to the base of the fillslope.
- Downspouts longer than 20 feet should be secured to the hillslope for stability.
- Ditch relief culverts should not carry excessive flow such that downcutting of the ditchline or gullying below the outlet occur.
- Do not discharge flows from ditch relief culverts onto unstable fill or active landslides.
- If the ditch is on an insloped or crowned road, consider using outsloping to drain the road surface. The ditch and the ditch relief culvert would then convey only spring flow from the cutbanks and hillslope runoff, and not turbid runoff from the road surface.



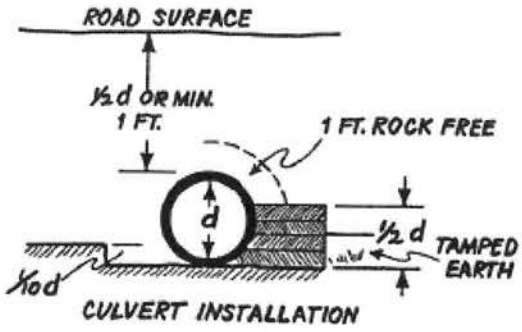


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FIGURE 48. *The elements of a properly installed ditch relief culvert. The culvert is angled at about 30 degrees to the road alignment to help capture flow and prevent culvert plugging or erosion of the inlet area. It is set at the base of the fill (ideally) or with a grade slightly steeper than the grade of the contributing ditch (but never with a grade less than 2 percent) (USDA-SCS, 1983). At a minimum, the grade of the ditch relief culvert should be sufficient to prevent sediment accumulation at the inlet or deposition within the culvert itself (it should be self-cleaning) (USDA-SCS, 1983).*

BMP: Ditch Relief Culvert (Cont.)

FIGURE 39.
Waterbars are often used to drain surface runoff from seasonal, unsurfaced roads. Because they are easily broken down by vehicles, waterbars are only used on unsurfaced roads where there is little or no wet weather traffic. In this photo, a waterbar and ditch relief culvert are used to drain all road surface and ditch runoff from the insloped road prism.

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FIGURE 238. *Traffic and surface runoff from graveled roads often produces surface erosion, turbid runoff and fine sediment transport that can be delivered to streams. Where ditches can't be eliminated, sediment traps and roadside settling basins can be installed to capture and remove most of the eroded sediment. This settling basin has been constructed along the inside ditch just before a stream crossing culvert inlet (see arrow). Eroded sediment from the road and ditch are deposited in the basin before flow is released to the stream. Fine sediments have filled about 1/3 of this basin and vegetation is now growing. Sediment basins require periodic maintenance to maintain their storage capacity.*

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BMP: Storage Bladders

- Location for storage bladder must be sited and planned as to minimize the potential for impacts due to rolling and/or failure. Storage bladders should be stored on flat slopes where stability will not be affected.
- If bladders are stored on slopes the potential for rolling must be assessed and if necessary containment or anchors installed. Options to mitigate the potential for rolling may include a fence, dirt berm, or a tethered anchor.
- Secondary containment is recommended in the form of a dirt berm, containment pit or impermeable material with skeletal support. Dirt berms shall be sculpted to a maximum 1:2 slope ratio. The containment should be capable of holding the contents of the bladder. At the least, secondary containment should be designed to slow the initial force of a failure.
- Bladders should be monitored consistently throughout their use to prevent failure. Inspections for structural weaknesses and other risks that may cause failure should occur a minimum of once per month.

This is an example of a containment pit which will assist in mitigating the impacts if this storage bladder failed.

BMP: Cultivation Site Restoration

- Remove all cultivation and associated materials from designated cultivation site.
  - This includes plant mass, root balls, potting containers, cultivation medium and any materials associated with the preparation, cultivation, and harvest of commercial cannabis.
  - Cultivation medium removed from the site shall be stored/disposed of in compliance with Order conditions related to spoils management.
- All disturbed and/or unstable slopes shall be stabilized and returned to pre-project conditions.
  - Slopes shall be contoured as close as feasible to natural grade and aspect.
  - Temporary erosion control shall be applied to prevent sediment run-off.
- Soil exposed as a result of project work, soil above rock riprap, and interstitial spaces between rocks shall be revegetated with native species by live planting, seed casting, or hydroseeding prior to the rainy season of the year work is completed.
  - Native plants characteristic of the local habitat shall be used for revegetation when implementing and maintaining cleanup/restoration work in riparian and other sensitive areas.
  - Native forbes and gramminoids shall be planted to replace sediment stabilization, sediment filtration and nutrient filtration
  - Native trees and shrubs shall be planted to replace bank stabilization, inputs of large woody debris and temperature control within riparian areas.
  - Restoration of the quality/health of the riparian stand shall promote: 1) shade and microclimate controls; 2) delivery of wood to channels, 3) slope stability and erosion control, 4) ground cover, and 5) removal of excess nutrients.