

## ROAD DRAINAGE BMPs

### BMP- ROLLING DIPS (Unpaved roads)

#### DESCRIPTION

Rolling dips along unpaved road surfaces are probably the most effective way to disperse runoff. While an insloped, outsloped, or crowned road surface can disperse runoff, their function can be reduced by wheel rutting. Frequently installed rolling dips ensure the most reliable form of road drainage with the least amount of maintenance in the future. Also, rolling dips can be constructed to drain the cutbank and inboard ditch as well as the road surface. See *BMP-Ditch Relief Culvert* which may be used in conjunction with rolling dips.

Rolling Dips are smooth, angled depressions constructed in the roadbed where the road grade reverses for a short distance and surface runoff is directed in the dip to the outside or inside of the road. The dip causes storm water runoff to exit the road surface while allowing for passage of motor vehicles at reduced road speeds. On average, no more than 150' of road surface or ditch should be connected to a rolling dip. See Typical drawings 11, 19a, 19b, 19c.

#### APPLICATIONS

Appropriate for road surface drainage on any low-speed ranch or forest road. Rolling dips may be traveled on in winter if the road surface has sufficient rock and otherwise good drainage.

#### LIMITATIONS

- Never outlet rolling dips onto unstable fillslopes.
- Take into consideration the rate of speed the user is permitted to travel.
- Must be deep enough that it is not obliterated by normal grading or driving, but not so deep that it is difficult to negotiate or a hazard to normal traffic.
- Along sections of 'thru-cut' road where the outboard berm is significant construct a Type 2 rolling dip. See Typical drawing 19b.
- As road grades exceed 12% gradient it can be difficult to construct the reverse grade of the rolling dip. In these instances consider constructing a Type 3 rolling dip. See typical drawing 19c

#### CONSTRUCTION GUIDELINES

- 1) Begin the cut portion of the rolling dip about 50 to 80 feet up the road from where you would like the trough of the dip to outlet. This cut portion should increase in its outslope as it approaches the trough. The trough portion of the rolling dip should be oriented at a 30 degree skew to the road. At the trough the reverse grade or fill portion of the dip should begin, running for about 15 to 20 feet in length. The fill portion should then gradually return to the original road grade. See Typical drawings 11, 19a, 19b, 19c.
- 2) Angle the axis of the dip no less than 30 degrees and up to 60 degrees to the road alignment. A steeper angle is required for steeper road grades.
- 3) The lowest portion of the dip should be 11 to 18 inches deep into the roadbed with the cross-slope of the dip axis at least 1% greater than that of the original roadbed cross-slope.
- 4) If rolling dips are constructed along rock roads then rolling dip needs to be rock.
- 5) The outlet must be on stable ground or armored or otherwise stabilized.

- 6) On average, no more than 150’ of road surface or ditch should be connected to a rolling dip. See Table 1 for road grade specific spacing guidelines.

**BMP MAINTENANCE**

- Instruct road maintenance personnel as to the function and design of rolling dips.
- Check outlet for erosion and repair as needed.
- Periodically inspect before and during rainy season. Remove sediment buildup, repair ruts.

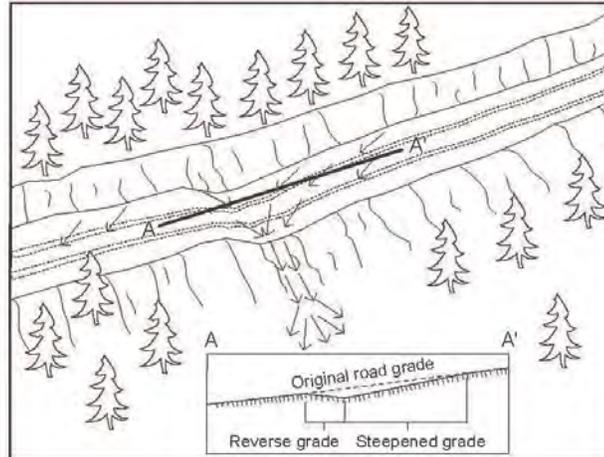
**BMP REMOVAL**

- N/A

<b>Table 1. Maximum distance between waterbreaks on roads and trails (feet)<sup>1</sup></b>				
<b>Erosion Hazard Rating (for surface erosion)</b>	<b>Road or Trail Gradient (%)</b>			
	<b>10% or less</b>	<b>11-25%</b>	<b>26-50%</b>	<b>over 50%</b>
Extremely high	100'	75'	50'	50'
High	150'	100'	75'	50'
Moderate	200'	150'	100'	75'
Low	300'	200'	150'	100'

<sup>1</sup> From California Forest Practice Rules. This is the maximum distance between waterbreaks: when in doubt, reduce the spacing. Soils are non- renewable and waterbreaks are inexpensive.

## Typical Road Surface Drainage by Rolling Dips



### Rolling dip installation:

1. Rolling dips will be installed in the roadbed as needed to drain the road surface.
2. Rolling dips will be sloped either into the ditch or to the outside of the road edge as required to properly drain the road.
3. Rolling dips are usually built at 30 to 45 degree angles to the road alignment with cross road grade of at least 1% greater than the grade of the road.
4. Excavation for the dips will be done with a medium-size bulldozer or similar equipment.
5. Excavation of the dips will begin 50 to 100 feet up road from where the axis of the dip is planned as per guidelines established in the rolling dip dimensions table.
6. Material will be progressively excavated from the roadbed, steepening the grade until the axis is reached.
7. The depth of the dip will be determined by the grade of the road (see table below).
8. On the down road side of the rolling dip axis, a grade change will be installed to prevent the runoff from continuing down the road (see figure above).
9. The rise in the reverse grade will be carried for about 10 to 20 feet and then return to the original slope.
10. The transition from axis to bottom, through rising grade to falling grade, will be in a road distance of at least 15 to 30 feet.

**Table of rolling dip dimensions by road grade**

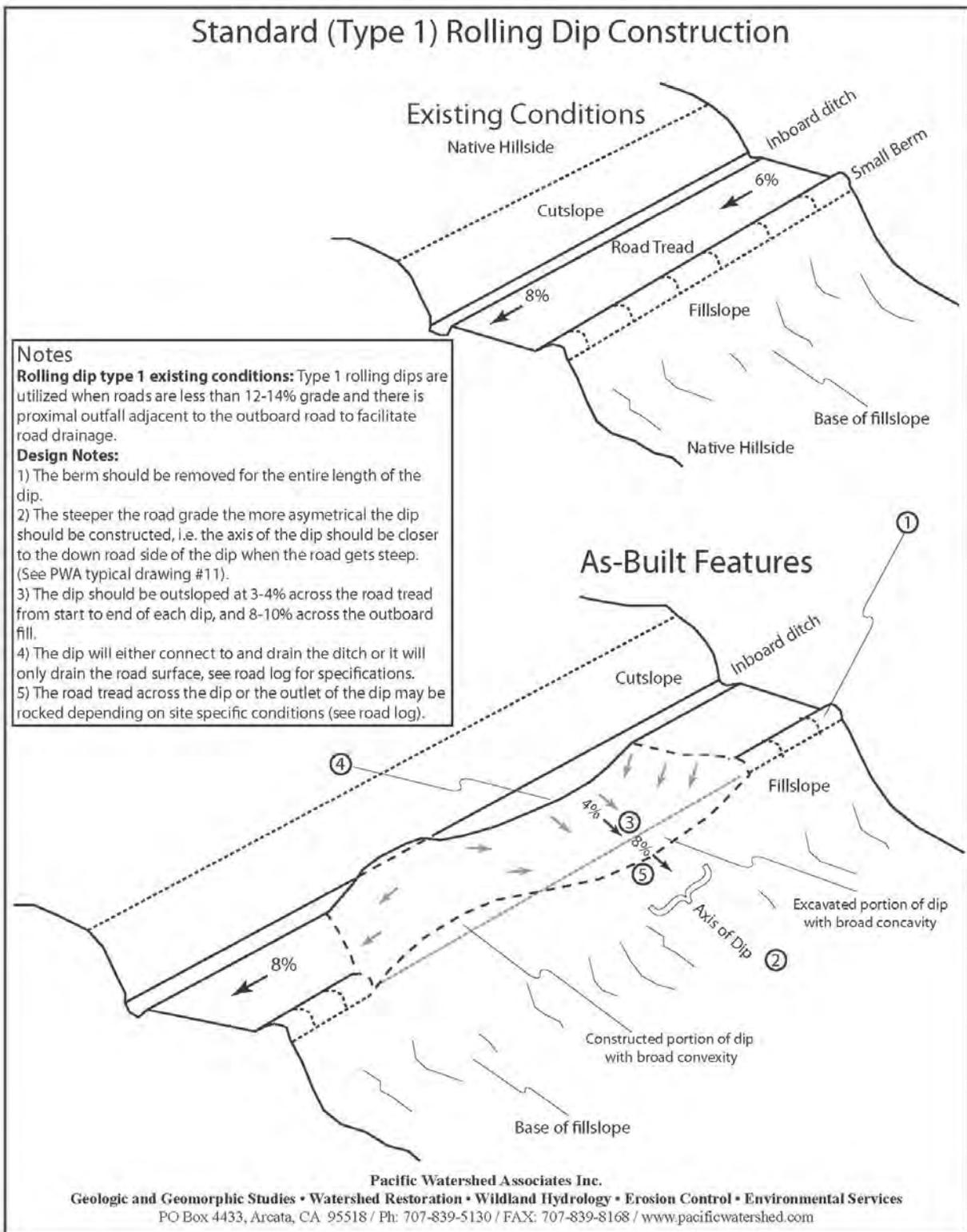
Road grade %	Upslope approach distance (from up road start to trough) ft	Reverse grade distance (from trough to crest) ft	Depth at trough outlet (below average road grade) ft	Depth at trough inlet (below average road grade) ft
<6	55	15 - 20	0.9	0.3
8	65	15 - 20	1.0	0.2
10	75	15 - 20	1.1	0.01
12	85	20 - 25	1.2	0.01
>12	100	20 - 25	1.3	0.01

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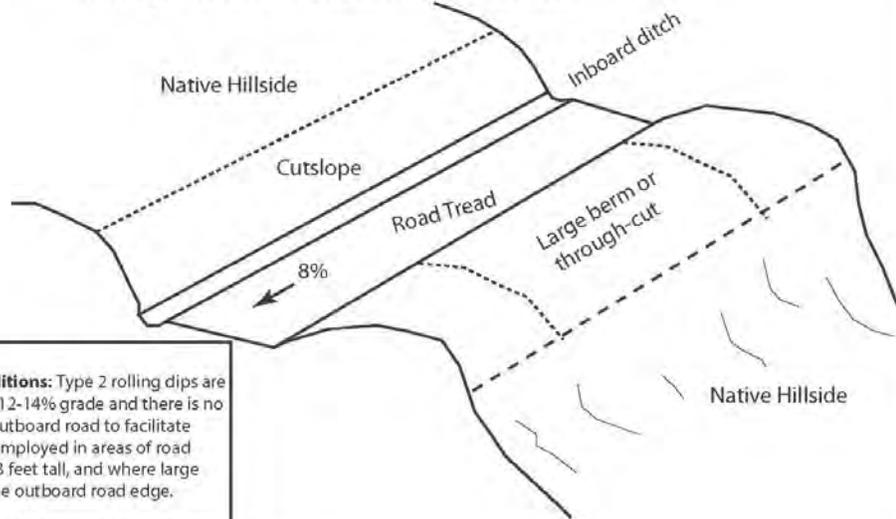
**Typical Drawing #11**

## Standard (Type 1) Rolling Dip Construction



PWA Typical Drawing #19a

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



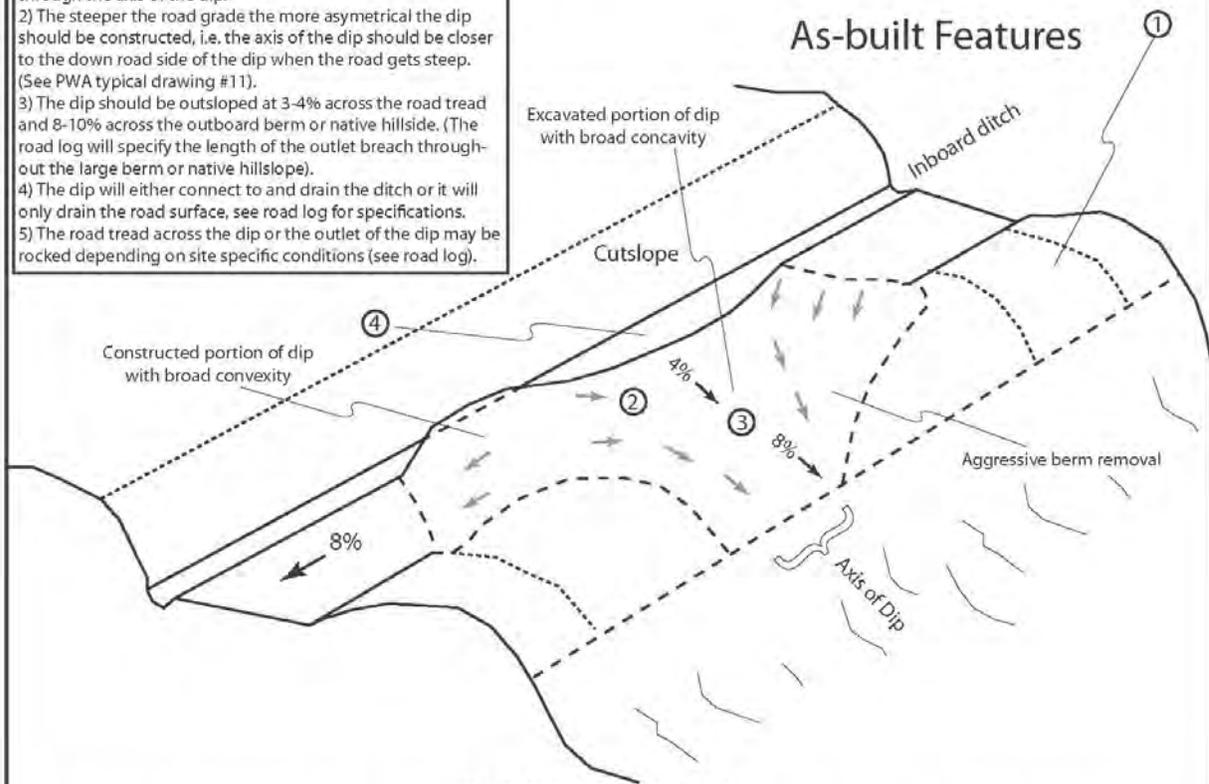
### Notes

**Rolling dip type 2 existing conditions:** Type 2 rolling dips are utilized when roads are less than 12-14% grade and there is no proximal outfall adjacent to the outboard road to facilitate road drainage. These should be employed in areas of road through-cuts generally less than 3 feet tall, and where large wide and/or tall berms exist on the outboard road edge.

### Design Notes:

- 1) The berm or native hillside should be removed for the entire length of the excavated portion of the dip, or, at a minimum through the axis of the dip.
- 2) The steeper the road grade the more asymmetrical the dip should be constructed, i.e. the axis of the dip should be closer to the down road side of the dip when the road gets steep. (See PWA typical drawing #11).
- 3) The dip should be outsloped at 3-4% across the road tread and 8-10% across the outboard berm or native hillside. (The road log will specify the length of the outlet breach through-out the large berm or native hillside).
- 4) The dip will either connect to and drain the ditch or it will only drain the road surface, see road log for specifications.
- 5) The road tread across the dip or the outlet of the dip may be rocked depending on site specific conditions (see road log).

### As-built Features

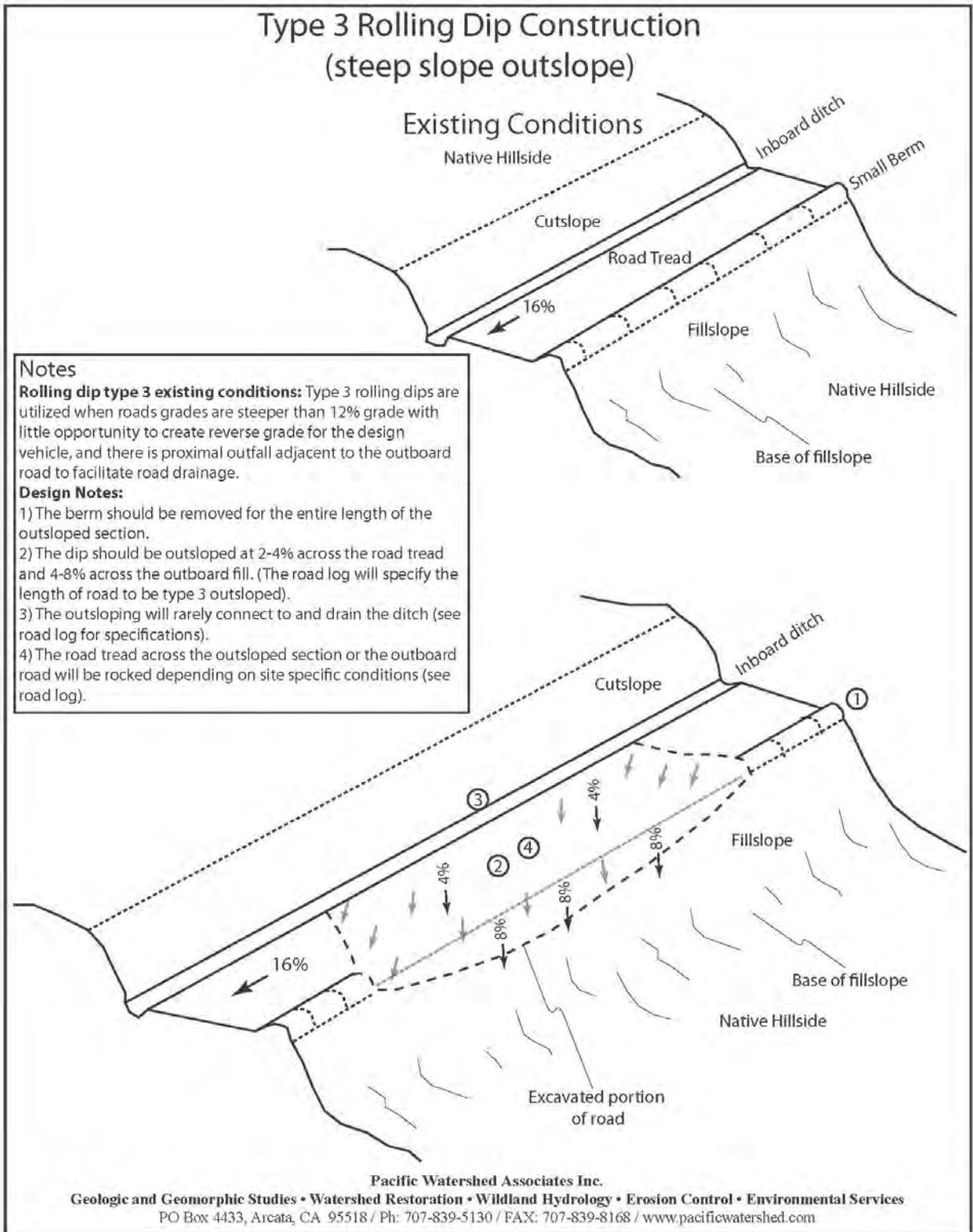


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PWA Typical Drawing #19b

## Type 3 Rolling Dip Construction (steep slope outslope)



**PWA Typical Drawing #19c**