

TECHNICAL MEMORANDUM:  
Recommended Procedures for Road Closures in the Outfall 008 and Outfall 009  
Watersheds

Prepared by:

Surface Water Expert Panel  
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## **Introduction**

The Expert Panel has been participating in the review of the progress being made by Boeing on erosion control practices within the watersheds of Outfalls 008 and 009. Because soil erosion is an important factor in transport of pollutants off the property, the Panel has taken particular interest in measures to control soil loss from existing unpaved roads. Unpaved roads can also concentrate surface water runoff and increase water flow in areas that contribute to additional downslope erosion. Therefore, the Panel recommends that Boeing consider abandoning and restoring unpaved roads where use is no longer required.

This memo sets forth the recommendations on specifications for the closure of unpaved roads. Site specific designs are not provided as the work often requires case-by-case evaluation. Instead, a set of guidelines and techniques for decommissioning, stabilizing, and re-vegetating the roads is provided below based on standards and experience developed by the US Forest Service and other open space agencies that have published standards on road decommissioning. Boeing is advised to assure that all actions undertaken in reliance on these recommendations is consistent with their federal and state water quality permits and the land development requirements for the County of Ventura and furthermore, is reviewed and approved by all associated land owners. Lastly, these guidelines do not provide an adequate level of detail for the closure of all roads. Boeing is advised to seek a geotechnical assessment where steep roads, embankments, or unstable soils are present.

## **Goal**

The goal of road closure is to perform decompaction, temporary erosion control, and revegetate for long-term soil stability so that little or no maintenance is required so that little or no maintenance for erosion control is required in the future.

## **Timing**

All road closure work should be performed during the dry season of any year or if not during this time, work should be phased such that erosion control measures are in place as closure work proceeds and that weather conditions are monitored such that any bare ground is properly managed to avoid erosion problems. When rain is predicted within the next five days, erosion control protections should be put in place.

Hydroseed should be applied soon after ground disturbing work is completed. The ideal time to apply seed is 1 to 14 days before a light rain. Between October 30 and May 1,

weather should be monitored closely to ensure there is adequate time to apply hydroseed and other BMPs prior to rainfall.

## **Equipment**

Heavy equipment used for road decommissioning typically includes a bulldozer with hydraulic rippers for de-compacting rock roads and a hydroseeding truck to apply seed and mulch. A hydraulic excavator and dump truck may also be necessary to move soils from unstable areas to stable storage sites.

## **Treatment of Unstable Areas**

Any unstable or potentially unstable road or landing fills should be excavated and stabilized so material does not fail and enter a watercourse or destroy down-slope vegetation. These sites are most likely to occur where roads have been cut into steep slopes or fill 'dips' on the hillside. One such area is shown in Figure 1.

## **Management of Road Surface Runoff and other Drainage**

Roads that are to be closed and unmaintained should have adequate, self-maintaining surface drainage so that the road surface is stable and will not erode and deliver sediment to creeks. The following recommendations build upon road erosion control recommendations that were provided in the following documents: "Boeing SSFL Conceptual BMP Designs for Outfalls 008 and 009" (Geosyntec 2007), "Technical Memorandum: Cellular Confinement System Products for the Santa Susana Field Laboratory" (Geosyntec 2007), and "Stormwater Maintenance Activities" (Geosyntec 2008).

- Berms: Any berms at the outer edges of a road should be removed to encourage drainage off the road surface. Out-slope closed roads whenever possible.
- Existing Ditches: Inside road ditches should be eliminated when closing roads so that water is not diverted and gullies do not form. Any ditched segments of roads to be closed should be re-graded to be out-sloped. If out-sloping is not feasible, cross road ditches should be added. Drains should be made deeper than standard water bars and extend all the way from the cut bank to the outside edge of the road in order to intercept all ditch flow. Cross road ditches should be installed at regular intervals according to the frequency indicated in Table 1 below.
- Out-sloping: Ideally, closed roads should be re-graded to match pre-developed slopes. Where this is not feasible, closed roads should be out-sloped at least 4% more than the road grade. Special attention should be given to protecting disturbed slopes that remain after out-sloping occurs (e.g. With hydroseeding, fiber rolls, erosion control blankets, rock armoring, or other substantial measures.
- Cross road drains: On out-sloped roads that do not require cross-slope ditches, install water bars or rolling dips at regular intervals according to Table 1a and 1b below. On roads that have less than 10% slope, align cross-drains at a 30 degrees to 45 degrees to the centerline of the road. Cross road drains should be extended below the former road edge onto the steeper side slope to ensure water flow will not bypass the drain. The uphill end of the cross-drain should tie into the cutbank of the road.
- Outfall Protection: Wherever cross road drains discharge concentrated flows onto

slopes, erosion control measures should be in place at the outfall to prevent rill erosion from forming.

- Rolling Dips: Rolling dips are preferable over water bars because they are less likely to fill with sediment or erode over time. Rolling dips can not be used on steep slopes of over 15%. Spillway openings should be at least 2 feet wide at the base of the dip. See Figure 1 for details.
- Water Bars: The outflow end of the water bar should be fully open and extend far enough beyond the edge of the road or trail to safely disperse runoff water to the undisturbed hillside. The outlet should fall no more than 2%. See Figure 2 for details.
- Steep roads: On steep sections of road (slope: >10%), cross drains should be skewed at an angle of 45 degrees to 60 degrees to the road alignment to reduce the threat of erosion at the inlet.
- Rock drain outlets: All cross-road drains should be armored with rock at their outlet and should be discharged into vegetated areas to filter water and sediment before it reaches a drainage.
- Concentrated flows: Any locations where concentrated water flows across the abandoned road, such as from springs, natural gullies or wet areas, shall be evaluated on a case-by-case basis by a civil engineer to provide adequate guidance on placing appropriately sized gravel. Alternatively, these areas can be lined with a heavy duty permanent reinforcement mat from the list below:
  - Pyramat (Propex Inc. [www.geotextile.com](http://www.geotextile.com))
  - VMAX3 P550 Mat (North American Green [www.nagreen.com](http://www.nagreen.com))
- Unstable slopes: Cross-road drains should not be constructed to discharge into areas of active or potential landslides.
- Low Points: In addition to the spacing shown below, cross-road drains should also be placed at low points to avoid ponding.

Table 1a Spacing of Water Bars and cross road ditches):

Closed Road Slope	Maximum On-Center Spacing (ft)
2%	250
5%	135
10%	80
15%	60
20%*	45
20-23%*	40
23-25*	30
30	Consult Engineer

Table 1b Spacing of Rolling Dips:

Closed Road Slope	Maximum On-Center Spacing (ft)
2%-5%	100
5-10%	80
10-15%	60

\*Note: Rolling dips are only appropriate on roads that have slopes of 15% or less.

### **Decompaction of Closed Roads**

Planting closed roads can reduce runoff and erosion long-term. However, compaction is a huge barrier to plant growth. The abandoned road surface should be ripped to a depth of 6–18 inches to promote revegetation.

Ripping is most effective in breaking compaction when it is conducted with a winged subsoiler that lifts and shatters the soil. Ripping can also be performed with hydraulically operated chisel teeth mounted on the back of a large tractor, although several passes may be required to disaggregate the entire roadbed.

### **Revegetation of Closed Roads**

Hydromulching and seeding is recommended for all areas of disturbed soils resulting from the work to close roads. Boeing has recently adopted the use of Flexterra High Performance – Flexible Growth Medium and the seed mix in Table 2. Recommended methods for hydroseed and hydromulch application are set forth in the Technical Memorandum: “Expert Panel Recommendations for Erosion Control Hydroseeding Methods and Culvert Modification Areas for ISRA Excavation Areas in Outfall 009 Watersheds” dated July 21, 2010. These methods should be applied for road closures as well.

Table 2: Recommended Hydroseed Mix

Species	Application Rate (lbs/Acre)
Chamise ( <i>Adenostoma fasciculatum</i> )	1.0
Black sage ( <i>Salvia mellifera</i> )	1.0
Bush mallow ( <i>Malacothamnus fasciculatus</i> )	0.5
Purple sage ( <i>Salvia leucophylla</i> )	1.5
California brome ( <i>Bromus carinatus</i> )	3.0
Cucamonga brome ( <i>Bromus arizonicus</i> )	4.0
California bush sunflower ( <i>Encelia californica</i> )	3.0
Buckbrush ( <i>Ceanthous cuneatus</i> )	5.0
Purple needlegrass ( <i>Nassella pulchra</i> )	2.0
Deer weed ( <i>Lotus scoparius</i> )	3.0
Laurel Sumac ( <i>Malosma laurina</i> )	2.5
Small fescue ( <i>Vulpia microstachys</i> )	10.0

Flexterra and hydroseed may not be appropriate for all sites. In areas with steep slopes of greater than 20%, a geotechnical engineer should be consulted. In steep, unstable areas where vegetation establishment is slow, more substantial erosion protection than spray –applied products may be warranted. Fully biodegradable erosion control blankets, specified by a qualified engineer, are recommended for these areas.

**Monitoring of Revegetation**

All roads that undergo decompaction or are otherwise disturbed and/or revegetated, should be monitored on a regular basis until adequate revegetation has been re-established. Boeing is advised to monitor revegetated sites on a monthly basis during the wet season (December 1 – April 30), once during the dry season, (May 1 – September 30) and once in October, prior to early rains. The Frequency of monitoring can be reduced to every other month during the wet season as vegetation becomes established and discontinued when vegetation is deemed to be adequately established to prevent erosion. Problem areas and recommendations for remedial erosion control should be reported and acted upon to prevent further erosion.

## **Treatment of Bedrock Areas**

Where abandoned roads travel along exposed bedrock, no stabilization, decompaction, or revegetation work is required. However, special attention should be given to concentration of flows runoff from these areas. Long stretches of exposed bedrock have the potential to create high velocity flows with erosive power. Water bars down slope of bedrock road sections may require added protection in the form of erosion control mats or gravel as described in the previous section on concentrated flows.

## **Design Build Contractor**

Boeing is advised to select a contractor that has previous experience with designing and building road abandonment projects where providing proper drainage and erosion control was a focus of the project. Boeing is advised to require the contractor to submit a statement of qualification that documents the contractor's experience with the methods contained in this technical memorandum with the bid for design construction. This statement of qualifications may detail the contractor's history of business and past record of performing road closure activities including: 1) project name, 2) area or linear feet of road closure performed, 3) description of procedures used, and 4) client references.

## **Roads to Remain Open**

Some roads are not available for closure because of on-going but infrequent use. In these cases, Boeing may wish to consider paving select areas that are otherwise difficult to adequately stabilize. In some cases, soils entrained from a dirt or gravel road may be less harmful than the increases in runoff and the hydrocarbons and heavy metals associated with road runoff. If paving is deemed necessary, runoff from paved areas should be captured and treated in a roadside BMP. Wherever it is possible to stabilize road surfaces with gravel or gravel-filled cellular confinement systems, paving should be avoided, as gravel promotes greater infiltration compared to pavement.

Current road maintenance practices include grading and gravelling in specific locations. Recommendations contained in this memo, especially out-sloping and the installation of water bars, are preferred road maintenance. Further discussion of recommended road building and maintenance BMPs is provided in the Technical Memorandum, "Boeing SSFL Conceptual BMP Designs for Outfalls 008 and 009."

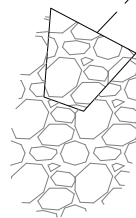
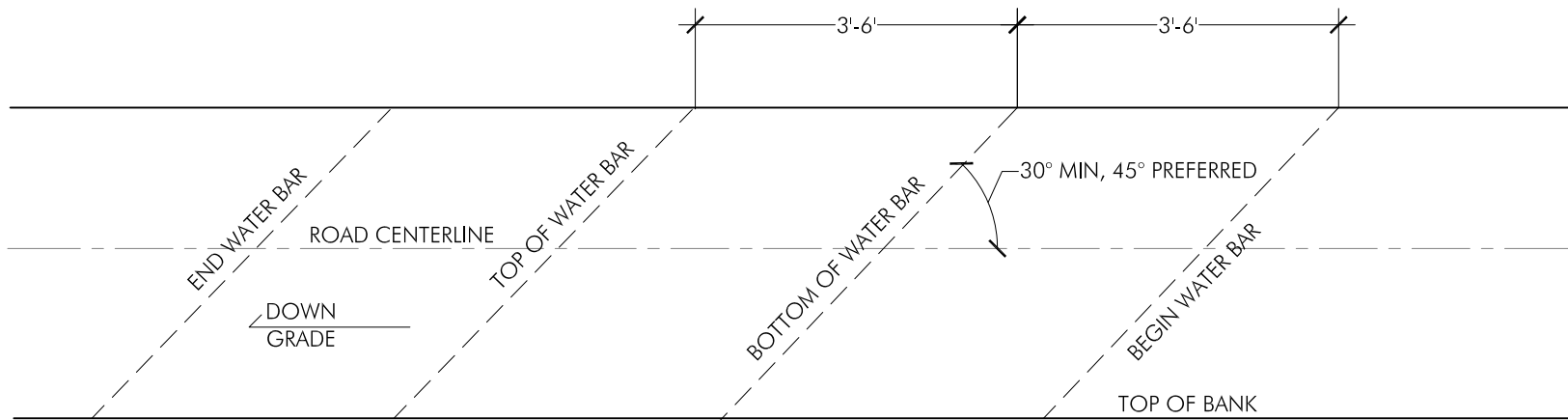
## **Expected Outcome**

Road closures will eliminate sources of sediment by re-establishing natural drainage patterns, revegetating road surfaces and stabilizing soil.

## FIGURES & DETAILS

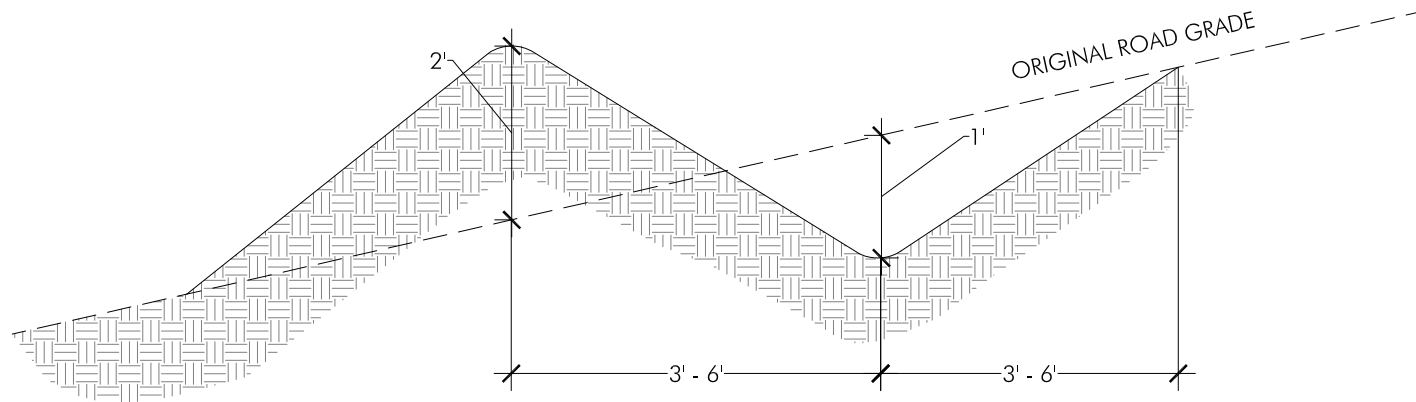






CENTER ROCKED OUTFALL ON HYDRAULIC BOTTOM.  
 EXTEND WATER BAR BEYOND TOP OF ROAD BANK  
 ROCKED OUTLET SHALL BE CLEAR TO DRAIN

PLAN



PROFILE

## Figure 2. Water Bar Typical Detail

Boeing Santa Susana Field Station

Technical Memorandum: Recommended Procedures for Road Closures

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