

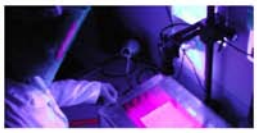

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# Guidelines for mitigating the impacts on erosion and water quality from post-fire salvage harvesting

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## Introduction

This bulletin outlines best management practice (BMP) guidelines for mitigating impacts on erosion and water quality from post-wildfire salvage harvesting of plantation forests.

Salvage harvesting operations have increased in response to wildfires in 2003, 2006–07 and 2009 across south-eastern Australia. Salvage operations are only viable within a limited timeframe, and are conducted when forest landscapes are vulnerable to increased runoff and erosion. It is therefore important to develop sound management practices to ensure that the impacts of fire on erosion and water quality are not exacerbated by the impact of harvesting.

The BMP guidelines presented in this bulletin are based on findings from the Cropper Creek research project, and supplemented by information from previous research on impacts of salvage harvesting and the effectiveness of mitigation strategies.

## The Cropper Creek project

The Cropper Creek research project was established in 1975 in north-east Victoria to investigate the hydrology of three small native eucalypt forest catchments. One catchment was subsequently converted to radiata pine.

Following a wildfire in 2006 that burnt all three catchments, the pine catchment was salvage harvested (Fig. 1a). Neither of the native forest catchments were harvested. The CRC for Forestry began a research project to quantify post-fire salvage harvesting impacts on runoff, erosion and water quality.

This research found that the combination of fire and salvage harvesting substantially increased runoff in the pine catchment compared with the adjacent native forest catchments.

Post-fire and harvesting water quality impacts were greatest during storm events (Fig. 1b). Sediment and nutrient yields from the burnt and harvested pine catchment greatly exceeded those from the burnt native forest catchments. The largest increases in yields were for sediment (33 and 180 times the yields from the two burnt native forest catchments) and particulate phosphorous (20 and 78 times). However, figures for increases in sediment yield from the pine catchment are conservative because large quantities of bedload material exported from the catchment could not be measured. The increase in sediment yield from the pine catchment was probably closer to 71 and 320 times yields from the two burnt native forest catchments. These estimates are based on a survey of eroded channels in the pine catchment combined with measurement of the post-survey sediment output.

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

**Figure 1** (a) Post-fire salvage harvesting operation underway (left)
and (b) discharge from the burnt and harvested pine catchment during a storm in July 2008 (right)

The large impact on erosion and catchment sediment/nutrient yields following fire and salvage harvesting occurred mainly in response to substantial increases in runoff and peak flows during intense summer storms. These hydrological changes in the burnt pine catchment resulted from:

1. the effect of log drag-lines formed by cable harvesting. These acted as an extension to the drainage network and routed overland flow more rapidly to the catchment outlet
2. increased runoff due to more highly water-repellent soils. This effect may have occurred in response to a combination of higher burn severity than in the native forest catchments and drier soils due to less shading in the harvested pine plantation, which enhanced the water repellency of soils under the pines compared with the adjacent eucalypt forest.

Previous research into post-fire salvage harvesting has shown that impacts on erosion and water quality vary, with studies generally reporting only minor impacts (increases in erosion and decreases in water quality) in addition to the effect of burning alone. However, findings from Cropper Creek show that the combined effect of fire and salvage harvesting of the pine plantation caused substantial increases in runoff, erosion and catchment sediment/nutrient yields compared with the adjacent burnt eucalypt forest catchments, and compared with pre-fire conditions. This underscores the importance of identifying BMPs for implementation during and after post-fire salvage operations to reduce the likelihood that harvesting operations will exacerbate burn effects.

## Guidelines for best practice

The following BMP guidelines provide a set of practical measures that may be readily adopted for use during and after post-fire salvage harvesting operations to mitigate impacts on runoff, erosion and water quality:

- Remove logs up-slope when cable harvesting if permitted by the road network.
- Do not disturb riparian buffers.
- Place logs and harvest slash in the runoff convergence zones (areas where runoff accumulates from multiple up-slope directions) of harvested sub-catchments.
- Retain and distribute harvest slash across hillslopes.
- Apply additional erosion control measures (e.g. mulch) to harvested hillslopes.

The optimal management approach would involve adopting as many of the recommended mitigation measures as possible to increase the resilience of burnt and harvested catchments to the effects of intense storms.

Once harvesting is complete, time should be allocated for site rehabilitation. Priority actions should involve placement of logs along contours in convergent sub-catchments and distribution of harvest slash across steep hillslopes with a focus on areas with north and north-west aspects. This maximises surface cover and roughness on steep slopes and increases resistance to erosion, promotes infiltration and decreases overland flow velocities. The use of hillslope erosion control measures such as mulch is recommended for steep sites burnt at high severities. This could be applied immediately after harvesting or during the replanting phase, assuming replanting occurs soon after harvest.

Erosion control measures should be applied in a targeted fashion to achieve maximum return on investment.

## Take-home messages

- The Cropper Creek study showed that large increases in runoff and sediment/nutrient yields occurred following post-fire salvage harvesting of a radiata pine catchment compared with the adjacent burnt native forest catchments.
- Impacts in the pine catchment were greater than in the eucalypt catchments for two reasons:
    1. Log drag-lines formed by cable harvesting contributed to increased peak flows at the catchment outlet.
    2. Soil water repellency was greater in the burnt and harvested pine catchment than in the native forest catchment and contributed to increased catchment runoff. The enhanced soil water repellency may be due to a combination of higher burn severity and drier soils resulting from less shading after harvesting.
- Key BMP recommendations for mitigating impacts from post-fire salvage harvesting of plantation forests are:
    1. remove logs up-slope when cable harvesting
    2. avoid riparian buffer disturbance
    3. retain and distribute harvest slash
    4. apply erosion control measures (e.g. mulch).

## References

Smith HG, Sheridan GJ, Lane PNJ, Bren L (2010) ‘Best management practice guidelines for mitigating impacts on erosion and water quality from post-fire salvage harvesting of plantation forests’. CRC for Forestry Technical Report 207 (CRC for Forestry: Hobart, Tas.)

Smith HG, Sheridan GJ, Lane PNJ, Bren L (in press) Wildfire and salvage harvesting effects on runoff generation and sediment exports from eucalypt and radiata pine forest catchments, south-eastern Australia. *Forest Ecology and Management*

## More information

For more information, visit the CRC for Forestry website at
*http://www.crcforestry.com.au/research/programme-four/water/index.html*
or contact the project scientist: Dr Hugh Smith, hgsmith@unimelb.edu.au