FREP

EXTENSION NOTE #44

MARCH 2025

Riparian Management for Post-fire Salvage Logging: Best Management Practices

Purpose

To minimize harvest-related effects to site level and downstream aquatic habitats through the development of guidance for riparian management in burned areas.

Introduction

Widespread wildfires across BC since 2017 have prompted the need for guidance to protect fish, wildlife and biodiversity values within riparian management areas during salvage harvesting. Current legislation allows harvesting within reserve zones if timber has been damaged by fire. However, it is now known that harvesting near streams after disturbance can lead to both short- and long-term impacts to aquatic and terrestrial ecosystems (McIver et al. 2000, Karr et al. 2004, Reeves et al. 2006).

Harvesting in riparian areas can result in physical and biological changes to aquatic and terrestrial environments, even in stands that have not been previously disturbed. In addition to delaying vegetative regrowth, soil compaction from machine disturbance increases overland flow, causing erosion and sediment transfer to stream channels (Sutherland 2003; Karr et al. 2004). Removal of trees in riparian areas reduces the supply of large woody debris (LWD), which results in decreases to fish and riparian habitat quality, invertebrate populations, and sediment trapping capability (Bilby and Bisson 1998; Hassan et al. 2005; Nordin et al. 2009a). It also leads to increases in water temperatures and streambank instability (Bunnell et al. 2004). Subsequent effects may include physical changes to channel morphology, flow regimes (Hassan et al. 2005) and functioning condition changes to the aquatic and riparian communities, both at the site level and at downstream reaches (Wipfli et al, 2007; Nordin 2009b).

These effects may be intensified in stands that have been previously disturbed, such as those impacted by fire or insects (Karr et al. 2004; Nordin 2008; Peterson et al. 2009; Wagenbrenner et al. 2015). The information and examples that are provided here are intended to support best practices for managing riparian areas in planned salvage areas.

Background

Given the importance of riparian vegetation, requirements for riparian reserves and riparian management zones were established with the Forest Practices Code and later recognized in the Forest and Range Practices Act (FRPA). Section 8 of the Forest Planning and Practices Regulation (FPPR) sets the objective for the conservation, at the landscape level, of water quality, fish habitat, wildlife habitat and biodiversity associated with those riparian areas, while Section 47 describes the riparian management areas for each class of stream, wetland and lake. The riparian reserve zone (RRZ) and the riparian management zone (RMZ) together make up the riparian management area (RMA). The RRZ must not be cut or modified except under certain conditions, while the RMZ may be cut in whole or in part, provided windthrow and stream stability considerations are addressed. *One of the conditions allowing harvest in a RRZ is if timber has been damaged by fire*, insects, disease or other causes (FPPR; Section 51(1)(g)).

The effects of salvage logging within the RMA have been studied in relation to trees killed both by insects and by fire (McIver et al. 2000; Karr et al. 2004; Reeves et al. 2006; Nordin 2009a). In both cases, the removal of the LWD supply is seen as one of the lasting impacts of harvest, which decreases habitat value not just for fish, but also amphibians and the mammals that rely on riparian vegetation for survival (Bunnell et al. 2004). Burnt trees

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may remain standing for 15+ years, reducing daytime net radiation reaching the stream surface (Leach and Moore 2010). Once down, the timber provides a consistent source of wood to a stream channel and the surrounding area, along with any surviving live trees that are often found in wetter riparian zones. In addition to habitat and nutrient value, the downed wood mitigates soil moisture loss in the riparian area, and when bridged across stream channels, provides much needed shade in a post-fire landscape (Frei 2018). The removal of this timber could mean the stream is deficient in LWD for a century or more until the new forest is mature enough to start contributing to the channel.

Another major, but shorter-term effect of salvage harvesting in riparian areas is soil disturbance from heavy machinery, which can have indirect, but damaging impacts to downstream fish habitat (Karr et al. 2004). Compaction severely reduces the infiltration capacity of the soil, thus increasing surface flow of water from precipitation and snowmelt until new vegetation is established (Wagenbrenner et al. 2015). The increased surface flow facilitates the transfer of the highly erodible and exposed fine sediments that are abundant after a burn to stream channels (Helvey 1980). The transport of large amounts of sediment to small non-fish reaches has significant effects as these streams are often direct conduits to downstream fish and fish habitat (Naiman and Latterell 2005; Reeves et al. 2006; Wipfli et al. 2007; Tripp et al. 2017.)

Considerations in determining retention strategies

Fire Severity

The following fire severity categories have been suggested in *Guidelines for Fire Salvage Kamloops TSA* (2003). These do not align with the fire severity categories in cruising manuals because the focus is the condition and ability of the *stand* to provide habitat value rather than individual *stem* value in terms of lumber and by-product.

Light burn

- less than 20% of ground burned
- negligible potential root damage
- trees have primarily "healthy" green foliage

Moderate burn

- 20 to 50% of ground burned
- numerous trees with root damage
- most trees have green foliage

Heavy burn

- > 50% of ground burned
- significant root damage
- green foliage may be present but:
  - not a useful indicator of tree/stand stability
  - unless Fir, most are dead

Coupling

"Coupling" refers to sediment transfer routes from face and side hillslopes to stream channels (Figure 1). From the *1:20 000 Fish and Fish Habitat Inventory Standards and Procedures* (Resources Inventory Committee Standards 2001), the degrees of coupling include:

- Decoupled (common on flats) – A channel is considered decoupled when sediment mobilized on the face or side hillslope would not normally enter the stream channel at any point, on either side.
- Partially Coupled – A channel is considered partially coupled when a portion of the sediment mobilized on the face or side hillslope may directly enter the stream channel at any point, on either side.
- Coupled – A channel is considered coupled when sediment mobilized on the face or side hillslope will directly enter the stream channel.

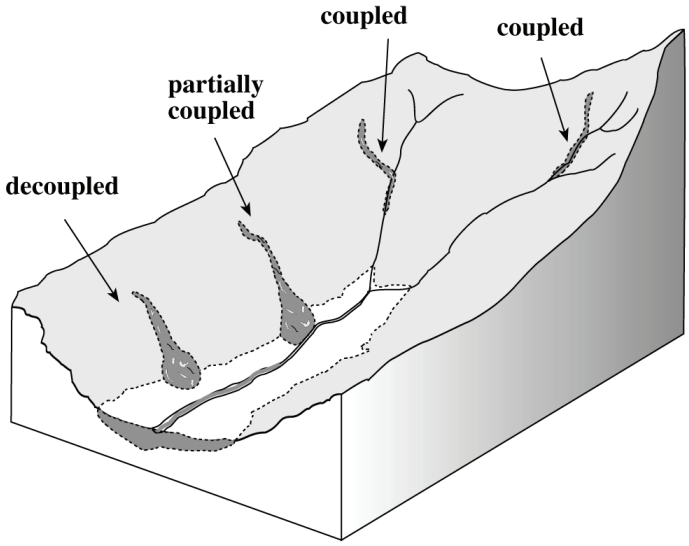

Figure 1. *An illustrated description of coupling from Channel Assessment Procedures Guidebook (1996).*

Resource Sensitivity

Aquatic features can be highly sensitive to disturbance depending on site level and downstream values. When planning salvage harvesting, a priority consideration is the location of community watersheds or other streams that drain directly into water license intakes designated for drinking water. To meet Section 59 in the FPPR regarding drinking water quality, a precautionary approach indicates that there should be no salvage harvesting in these highly sensitive watersheds unless guided by up-to-date watershed assessments and associated recommendations that incorporate the impacts of wildfire.

Streams, wetlands and lakes provide ecosystem value, both at the site level and to connected downstream reaches (Naiman and Latterell 2005; Wipfli et al. 2007). They are classified under FRPA based on size, BEC zone, and/or fish presence and their legislated RMAs are based on these classifications. See Part 4, Division 3 of the FPPR for the specific definitions pertaining to each class. In addition to streams that contain fish, those that contain habitat for regionally important wildlife or species at risk, or those that otherwise exhibit sensitive ecological or geomorphological attributes, are considered to be vulnerable to disturbance. These areas require enhanced retention and careful consideration of harvest timing and methods, especially when natural disturbances such as fire have impaired their resiliency. Direct tributaries to these sensitive habitats also have value and are recognized in other provincial (Water Sustainability Act) and federal (Fisheries Act) legislation to protect them and downstream values against detrimental effects. These tributaries may include watercourses that do not meet the definition of a stream under the FPPR, such as Fisheries Sensitive Zones (FSZ), Non Classified Drainages (NCD), Non Classified Lakes (NCL), or Non-Classified Wetlands (NCW).

Proposed Best Management Practices

General Guidance

Suggested general best management practices for post-fire salvage harvesting in riparian areas include the following:

- Do not salvage harvest riparian areas that are in community watersheds or within 1000 m of a downstream water licence intake designated for drinking water unless it can be demonstrated that the salvage harvesting activities will improve the water quality in the affected stream reaches.
- Do not salvage harvest in the RRZ; i.e. do not invoke Section 51 (1)(g) of the FPPR.
- Leave all green and scorched timber that is likely to recover within the entire RMA.
- Depending on the burn severity and degree of coupling with the hillslope, some burnt (dead) timber may be selectively harvested from the RMZ.
- Wherever salvage harvesting is conducted, the harvest timing and methods should be selected so as to not contribute sediment to any waterbody. Where soils are erodible and there is a question of hydrological connectivity to the channel, consider only winter harvesting over frozen soils covered with snow or aerial logging methods.

Specific examples of best management practices and strategies

Specific strategies with rationales for retention based on burn severity, coupling and resource sensitivity are suggested below and outlined by classification in Table 1. These strategies target the need to retain LWD supply and minimize erosion/sedimentation, and are based in part on data collected by the provincial *Forest and Range Evaluation Program* (Ministry of Forests), *Wildfire and Salvage Logging: Recommendations for Ecologically Sound Post-Fire Salvage Management and Other Post Fire-Treatments on Federal Lands in the West* (Beschta et al. 1995) and *Effectiveness of Post-Fire Salvage Logging Stream Buffer Management for Hillslope Erosion in the U.S. Inland Northwest Mountains* (Robichaud et al. 2020). **Note that the term "stream" used below also includes lakes and wetlands. The term "watercourses" include all of the above plus features that do not meet the FPPR definitions of a stream, wetland or lake but are a natural source of water and hydrologically connected to fish habitat or another otherwise sensitive waterbody.**

1) *Consider winter logging (on frozen ground with a minimum of 30 cm of snow), or use helicopter, boom or full suspension cable yarding to remove timber within riparian areas containing highly erodible soils that could be transferred to a watercourse with surface water runoff.*

2) *Maintain structure and function of streams and riparian areas with **legislated riparian reserves** by:*

   a) Retaining the full RRZ around streams in all types of burned areas, as measured from the edge of the floodplain or stream edge if there is no floodplain. Streams with legislated reserves contain fish and contribute significantly to downstream reaches that will be impacted by the removal of riparian timber. Maintaining an unharvested RRZ will maximize the LWD supply and minimize harvest-related disturbance.

   b) Maintaining full RMZ retention from the edge of the RRZ to a minimum of 10 m beyond the top of slope or to the end of the entire RMA, whichever is greater, in riparian zones that are coupled or partially coupled to streams in all types of burned areas (Fig. 2). Harvesting any trees within these retention areas could increase the transfer of exposed fine sediment to the stream.

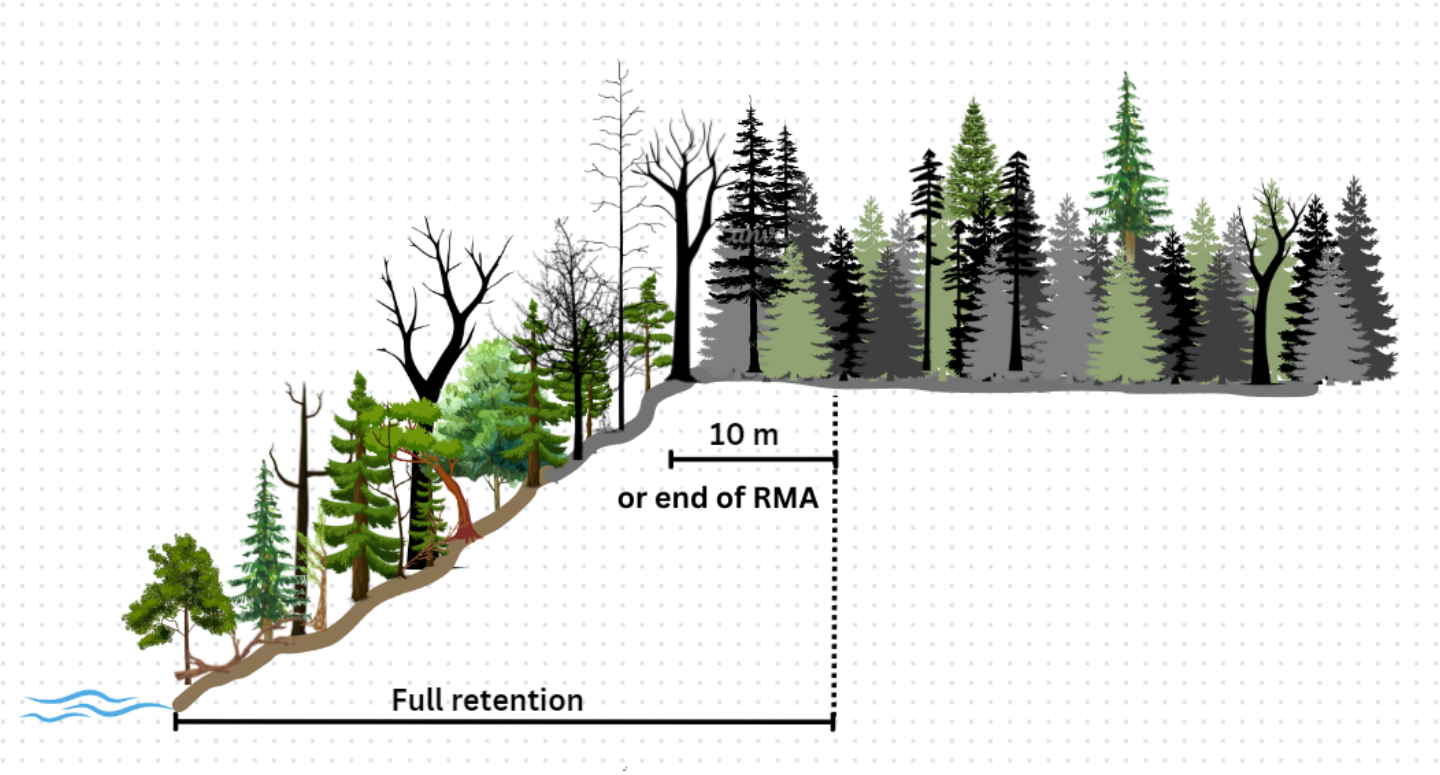

Figure 2. *Retention width on coupled slopes.*

c) Harvesting only dead trees in decoupled, light and moderately burned RMZ areas that are adjacent to RRZs (Fig. 3). Retaining all green and any scorched trees that are predicted to recover in the RMZ will provide an additional wind buffer to protect the RRZ.

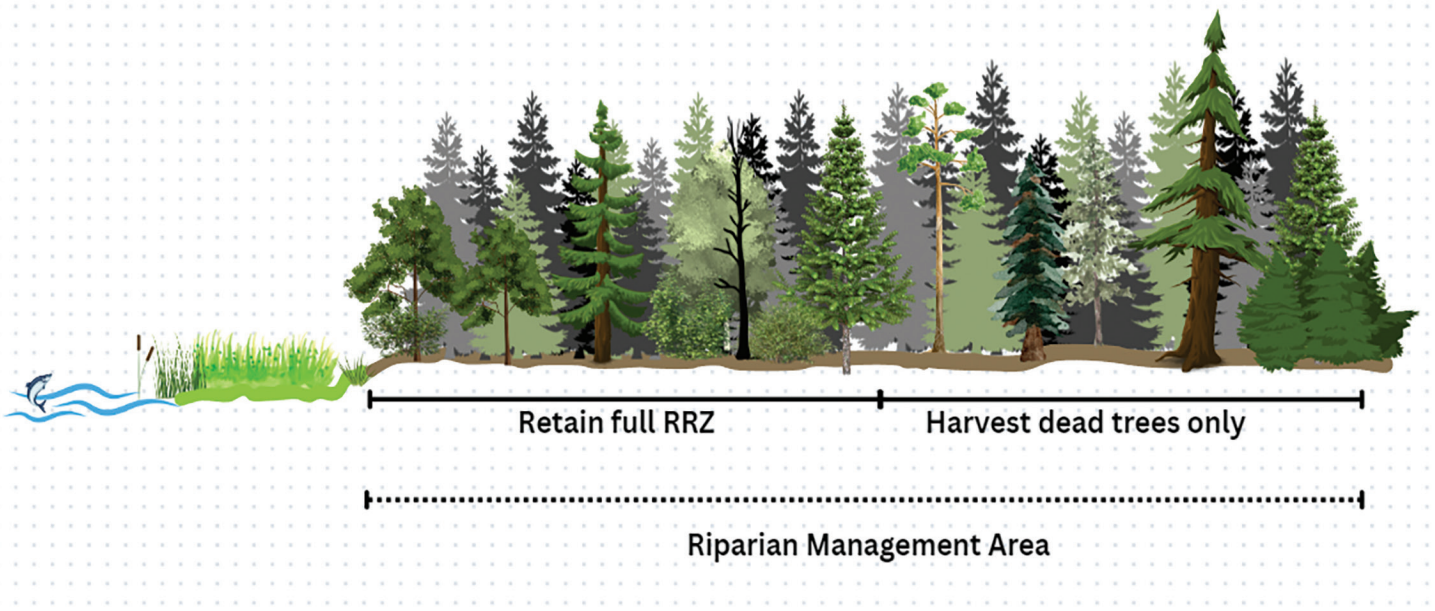

Figure 3. *Retention width of decoupled streams with reserves in light and moderate burns.*

d) Retaining all trees on decoupled, heavily burned adjacent RMZ areas that are closer than the average dominant tree height at maturity in distance from the stream (Fig. 4). Most of the trees in heavily burned areas are dead and will eventually fall over. Keeping trees in the RMZ that are close enough to contribute to the channel will supplement the LWD supply in the short and mid-terms while helping to buffer the RRZ. Once down, the logs will also help trap sediment, regulate surface water runoff, mitigate soil moisture loss, and enhance habitat in riparian areas. In addition, avoiding ground compaction in this area will facilitate faster natural regeneration.

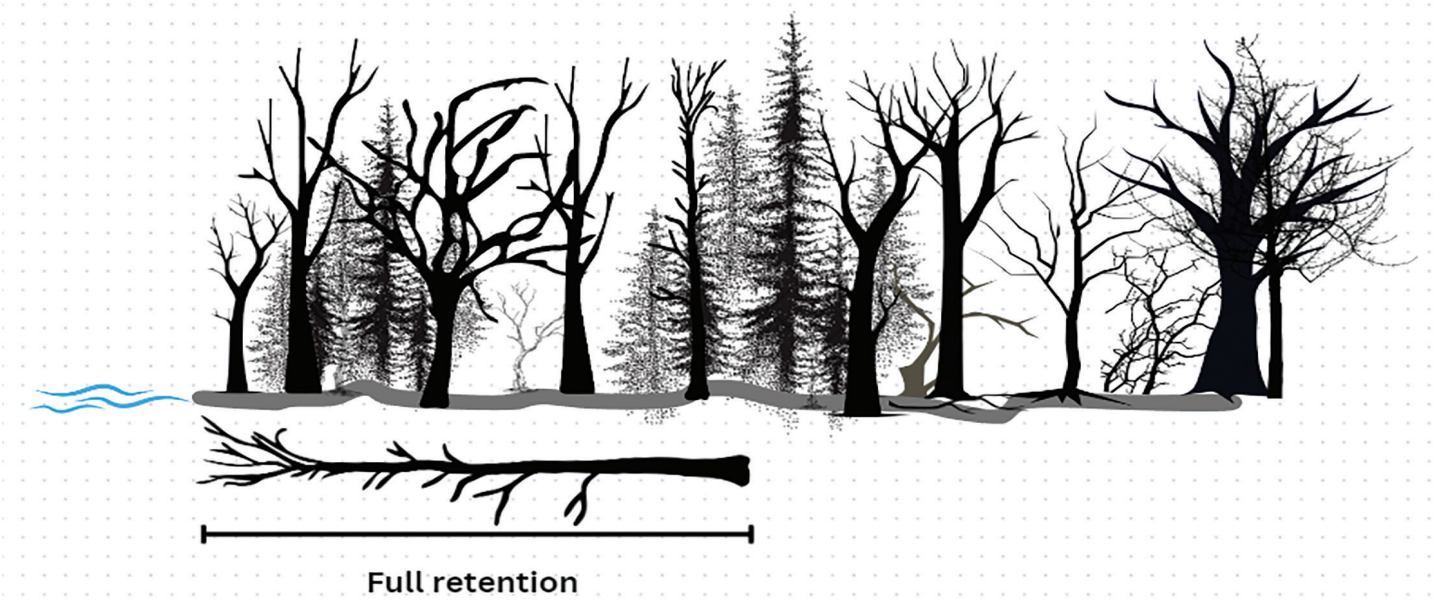

Figure 4. *Retention width of decoupled streams in heavy burns.*

3) *Maintain structure and function of watercourses **without a legislated riparian reserve** that contain fish, are hydrologically connected to fish bearing waters, or are otherwise considered sensitive by:*

a) Maintaining full retention from the watercourse or floodplain edge to a minimum of 10 m beyond the top of slope or end of RMZ, whichever is greater, in riparian zones that are coupled or partially coupled to streams in all types of burned areas (Fig. 2). FSZs, NCDs, NCLs, or NCWs that are hydrologically connected to fish bearing or otherwise sensitive streams should be similarly managed with retention to 10 m beyond the top of any coupled or partially coupled side slopes. Harvesting any trees within these retention areas could increase the transfer of exposed fine sediment to the watercourse and to downstream habitats.

b) Maintaining full retention within 10 m of watercourses that are decoupled and in light or moderately burned areas as measured from the edge of the floodplain or channel if there is no floodplain. Additionally, maintain all green or scorched trees predicted to survive in the remainder of the RMA of streams (Fig. 5), or adjacent 10 m for FSZs or hydrologically connected NCDs, NCLs, or NCWs. Retaining all trees closest to the bank and allowing for harvest of only dead timber in the remainder of the RMA will maximize LWD supply and buffering capacity where needed but allow for the harvest of dead timber where connectivity to the stream is less. Most trees will survive the burn in these areas, and in addition to supplying LWD and shade, they are critical to maintaining riparian habitat and buffering the effects of increased wind and surface water runoff on the post-fire landscape. In many cases, the effects of fire are less severe along riparian corridors because of cooler, wetter conditions compared to upland areas, so this strategy emphasizes the necessity of protecting surviving trees and maintaining habitat value, while providing for future seed supply and focusing harvest on timber outside of the RMA.

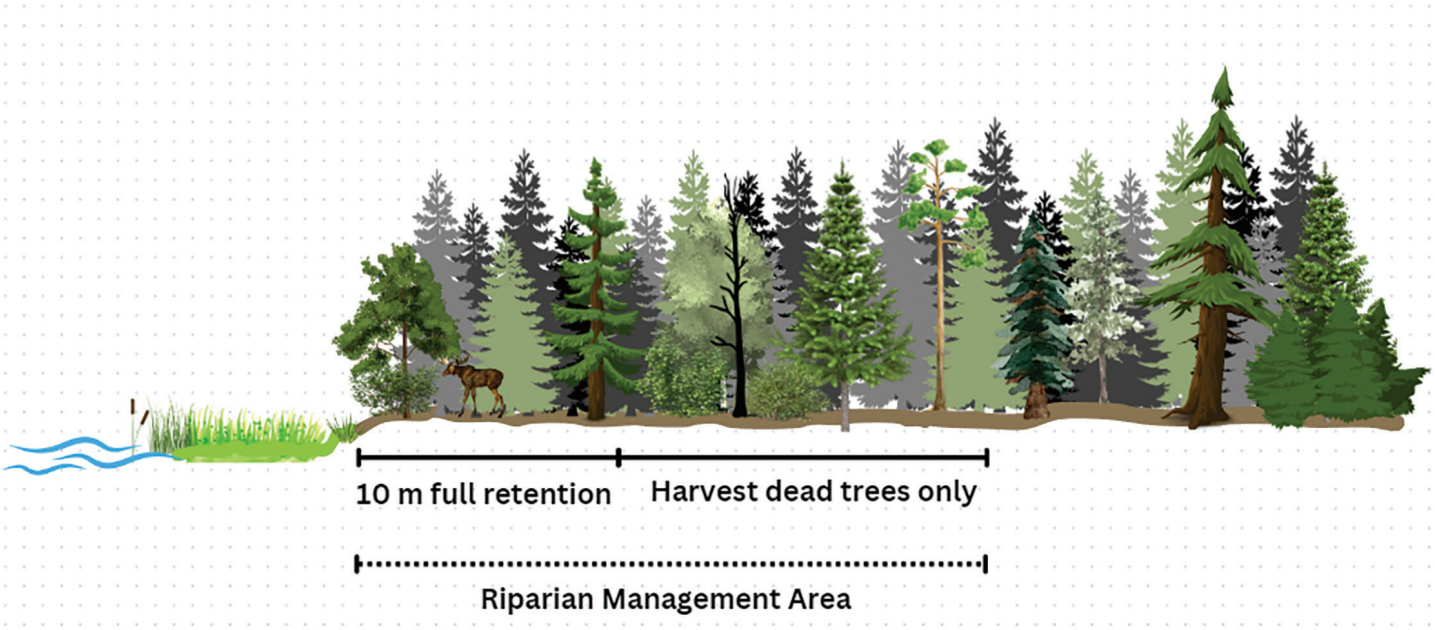

Figure 5. *Retention for watercourses without reserves.*

c) Retaining all trees on decoupled, heavily burned riparian areas that are closer than the average dominant tree height at maturity in distance from the stream (Fig. 4). Most of the trees in heavily burned areas are dead and will eventually fall over, and without a reserve, those closest to the stream are critical to supplying LWD, shade and buffering the reach from increases in surface flow or sediment. Keeping dead trees that are close enough to contribute to the channel will provide for a LWD supply in the short and mid-terms and once down, the logs will help trap sediment, regulate surface water runoff, mitigate soil moisture loss, and enhance habitat in riparian areas. In addition, channel spanning LWD will provide critical shade value to the stream and avoiding ground compaction will facilitate faster natural regeneration.

4) *Maintain a 10 m Machine Free Zone (MFZ) around all small non-fish streams that are not hydrologically connected to fish bearing waterways or otherwise sensitive to the removal of riparian timber, in all categories of burn severity (Fig. 6).* These aquatic features are generally isolated, small waterbodies that do not support fish, are not otherwise sensitive, and are not contributing to downstream habitat. Although the removal of riparian timber is not predicted to significantly impact these features, maintaining a 10 m MFZ will protect them from further disturbance and support natural regeneration.

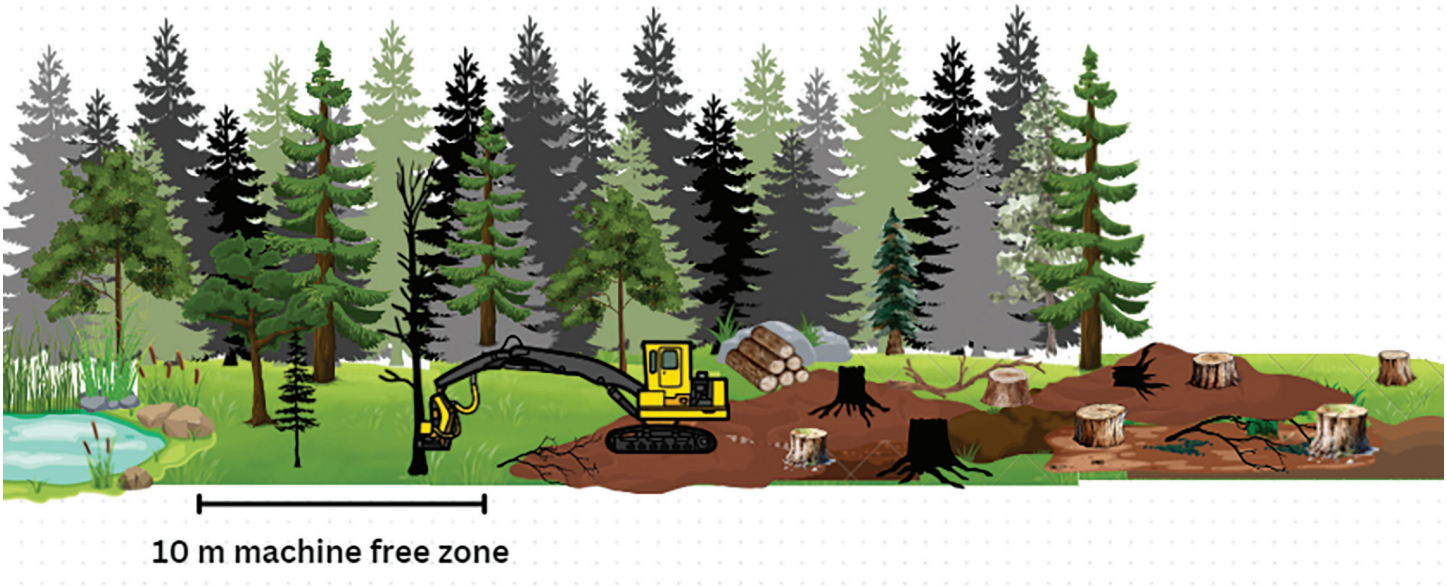

Figure 6. *Machine free zone for non-fish streams that are not connected to fish habitat and are not otherwise sensitive.*

Table 1. *Examples of riparian management for post-fire salvage harvesting by classification.*

Classification	Suggested Practices
S1-S3 (fish) streams; L1B & L2 lakes; W1, W2 and W5 wetlands (Features with reserves).	**Light and Moderate Burn:** • Retain full RRZ, as measured from the floodplain or stream edge where there is no floodplain. • In *coupled or partly coupled* riparian areas, retain full RMZ or to 10 m beyond the top of slope, whichever is greater. • In *decoupled* RMZ areas, harvest only dead trees. **Heavy Burn:** • Retain full RRZ, as measured from the floodplain or stream edge where there is no floodplain. • In *coupled or partly coupled* riparian areas, retain full RMZ or to 10 m beyond the top of slope, whichever is greater. • In *decoupled* riparian areas, retain all trees in RMZ within one tree height in distance away from the stream channel.
L3 lakes; W3 wetlands; all S4 and S5 streams; hydrologically connected S6 streams, FSZs, NCDs, NCWs or NCLs (Features without reserves).	**Light and Moderate Burn:** • In *coupled or partly coupled* riparian areas, retain full RMA or to 10 m beyond the top of slope as measured from the floodplain or watercourse edge where there is no floodplain. • In *decoupled* riparian areas, maintain full retention within 10 m of the floodplain or watercourse edge and harvest only dead trees in the remainder of the RMA (or adjacent 10 m for hydrologically connected non-classified features). **Heavy Burn:** • In *coupled or partly coupled* riparian areas, retain full RMA or to 10 m beyond the top of slope as measured from the floodplain or watercourse edge, whichever is greater. • In *decoupled* riparian areas, retain all trees within one tree height in distance away from channel.
L4 lakes, W4 wetlands, or S6 streams that are not hydrologically connected to fish habitat or not otherwise sensitive.	**Light, Moderate, and Heavy Burns:** • Maintain a machine free zone (MFZ) within 10 m of the bank at all sites. • Use hand falling, boom or aerial methods for harvesting all timber in *coupled or partially coupled* riparian management areas.

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