

# Implementation Monitoring Report: Implementation of hardwood conversion and individual conifer release riparian restoration treatments

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## Executive Summary

The Riparian Forest Restoration Strategy (RFRS; Washington State Department of Natural Resources 2006) provides guidance for the management of riparian areas to improve watershed protection, instream aquatic habitat, and near stream habitat. Previous forest management along reaches of fish bearing streams has removed sources of large woody debris which are important for instream and riparian habitat structure. Because of their size and decay resistance, conifers are generally desirable as material for riparian down wood. Reestablishing and/or supporting already established sources of conifer large wood within riparian areas that are hardwood dominated because of management history is one of the management objectives of the RFRS.

The RFRS describes two management prescriptions that guide these hardwood harvest activities. Hardwood conversion typically removes the hardwood overstory and replants conifers, or releases advance regeneration. Individual conifer release typically reduces inter-specific competition by removing competing hardwood trees surrounding already established conifer trees.

We identified the implementation of hardwood conversion and individual conifer release treatments for monitoring because:

- The RFRS commits to monitoring and recognizes the importance of monitoring in evolving management practices through the adaptive management process,
- The RFRS describes significant risk and uncertainty associated with implementing these activities. Prior to this project, only one unit that included both hardwood conversion and individual conifer release activities has been monitored, and
- The 2001 risk assessment identified managed riparian buffers as a medium priority for implementation monitoring (there are plans to update the 2001 programmatic implementation monitoring priority plan in the future) (Washington State Department of Natural Resources 2001).

The goals and objectives of this project were to:

- Use objective criteria to monitor implementation of hardwood conversion and individual conifer release treatments and determine if guidance was implemented as written,

- Identify aspects of the guidance for hardwood conversion and individual conifer release, if any, that are unclear, conflicting, or difficult to implement consistently, and discuss how this has affected implementation on the ground, and
- Suggest areas of possible improvement to existing guidance, and
- Suggest possible indicators and site characteristics to consider when deciding whether to implement future riparian hardwood harvests.

Of the 73 timber sales that have utilized riparian management provisions of the RFRS since its inception in 2006, 15 have been hardwood conversion and/or individual conifer release treatments. We found that there were limited objective criteria in the RFRS procedures to use for assessing operational compliance. The only objective criteria that we could assess were the integrity of the inner zone and equipment exclusion zone. While the RFRS was intentionally written to allow site-specific professional judgment to be used, we identified several aspects of the implementation procedures for riparian hardwood harvests that could be improved with further clarification. While it is recognized that increased specificity in implementation criteria does not guarantee increased success of meeting the management objective, improving the implementation procedures has the potential to increase the consistency of treatment application across management units.

During field reviews, we found that hardwood conversions associated with a predominance of upland vegetation may be able to be converted to conifer with less cost and risk; conversely, conversion units that support an abundance of vegetation adapted to wetter environments typically required an herbicide treatment and may have poorer long-term success. In individual conifer release units, the availability and accessibility of harvest trees appears to play an important role in successful treatment implementation. As described in the RFRS, site-specific analysis is required to determine the appropriateness of hardwood stand management.

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## Introduction

The Riparian Forest Restoration Strategy describes a suite of silvicultural activities that may take place within riparian management zones (RMZs) for the purpose of “improving instream and riparian habitat conditions” (RFRS, Washington State Department of Natural Resources 2006). Silvicultural prescriptions are divided into categories for conifer and hardwood dominated RMZs<sup>6</sup>. Within hardwood dominated RMZs, restoration is accomplished through management activities that accelerate the development of structurally complex stand structures. Hardwoods are an important part of riparian stand structure; however, the management history of some areas

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<sup>6</sup> RFRS applies to westside HCP planning units excluding the Olympic Experimental State Forest

may have resulted in riparian stands dominated by hardwoods that once supported long-lived conifers. In these areas, foresters have the option to remove hardwoods in order to support the development of a conifer dominated RMZ if site conditions allow.

Two different hardwood prescriptions are described in the RFRS: hardwood conversion (HWC), which typically removes a hardwood overstory and replants conifers, or releases advance regeneration, generally in stands with fewer than 25 conifer trees per acre (TPA), and individual conifer release (ICR), which typically reduces inter-specific competition by removing competing hardwood trees surrounding already established conifer trees in stands that initially have > 25 conifer TPA.

The prescriptions for HWC and ICR provide guidance regarding suitable areas for treatment implementation, and include criteria describing:

- Trees available for harvest
- Retention of conifers and bigleaf maple
- Maximum patch size and inter-patch spacing
- Protection of existing stand structures (snags, downed wood, etc.)
- Site consultation by natural resource specialist

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## Monitoring Methods

### Guidance review

We reviewed the implementation procedures for ICR and HWC to determine what measurable criteria could be used to assess compliance with the RFRS through field reviews (refer to the RFRS for implementation procedures). During this process, we identified areas of guidance that are potentially unclear; a result of our guidance review was recommendations to modify implementation procedures to improve clarity and better achieve the long-term restoration goals of the RFRS.

### Field data collection

We visited all timber sales where HWC and/or ICR were implemented since the inception of RFRS in 2006 and which were listed as completed in NaturE (a revenue tracking system) prior to August 12, 2013. These visits were intended to allow an assessment of operational compliance with the RFRS to occur. However, due to a lack of descriptive language in prescription processes for implementing ICR and HWC, collection of quantitative compliance data was limited to tallying instances of harvest activity within 25 feet of the 100-year floodplain (inner zone) and machine entries within 50 feet of the 100-year floodplain (equipment exclusion zone, EEZ), and

determining if patch sizes were no more than 2.5 acres. We collected additional data on the number and general location of uncut bigleaf maple, as well as documented instances when bigleaf maple or conifers were harvested. For one unit, harvest activity and machine entry data were collected in 2012 and reported in the 2013 Implementation Monitoring Report.

**Qualitative assessment of site characteristics**

During our field reviews, we noted what site characteristics tended to be associated with units that appeared most conducive to supporting conifer regeneration and/or a mixture of conifer and hardwood following harvest activities. We used this information to develop additional site criteria that may support, or deter, the decision to implement HWC and/or ICR.

**Document review**

We reviewed timber sale documents stored in the DNR Timber Sales Document Center (TSDC) electronic timber sales files and Planning and Tracking system. During this review, we noted whether there was documentation of a site consultation by a specialist. Additionally, we noted documentation regarding the harvest of conifers in a HWC or ICR unit.

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## Results

**Field reviews**

We found few instances of riparian hardwood management. Of the 73 timber sales to implement the RFRS since 2006, 15 applied HWC and/or ICR (Table 6).

**Table 6.** Number of timber sales that have implemented hardwood conversion and/or individual conifer release treatments from the inception of RFRS (April 2006) through August 2013, the approximate total acreage of HWC and ICR treatments, and the total number of timber sales to implement RFRS by Habitat Conservation Plan (HCP; Washington State Department of Natural Resources 1997) planning unit. Eastside planning units and the Olympic Experimental State Forest are not covered by RFRS.

<b>HCP planning unit</b>	<b>Number of timber sales to implement HWC and/or ICR</b>	<b>Total number of timber sales where RFRS has been implemented</b>	<b>Approximate total acreage that has received HWC and/or ICR treatment</b>
North Puget	9	30	26
Columbia	4	36	7
South Coast	2	8	12
South Puget	0	9	0
Straits	0	0	0

## **Assessment Criteria**

### **Integrity of the inner zone (0 to 25 ft. from 100-year floodplain)**

The integrity (defined as lack of ground, stream bank and/or vegetation disturbance) of the inner zone was maintained on all but one (14 out of 15) timber sales to implement riparian hardwood harvest guidance. The most common way this was implemented was by excluding the inner zone from harvest, accomplished by placing timber-sale boundary tags a minimum of 25 feet from the edge of the 100-year floodplain<sup>7</sup>. One management unit illustrated a common practice of placing the timber sale boundary tags on the upland side of the EEZ, recognizing that the low timber value in this area was not worth the risk of machine entry (this was documented in the timber sale packet). On one timber sale where the integrity of the inner zone was not maintained, three trees were harvested from within the inner zone of a hardwood conversion. This sale was reviewed in 2012 and the results reported in the 2013 Implementation Monitoring Report. These trees were harvested as result of placing timber sale boundary tags too close to the 100-year floodplain, which may have been hard to identify due to the shallow slope gradient adjacent to the stream.

### **Integrity of the equipment exclusion zone (0 to 50 ft. from 100-year floodplain)**

The integrity of the EEZ was maintained on all harvest units but one where mechanical harvesting methods were used (the previously discussed sale [2012] that had harvesting in the inner zone also had a single machine entry within 50 feet of the 100-year flood plain). The different ways this was implemented on the ground was through flagging and/or marking the trees along the edge of the EEZ, stating in the contract that the EEZ is a set distance off the timber sale boundary tag line, or by aligning the EEZ and the timber sale boundary tag line. Some timber sales communicated harvest prescriptions to operators with cutting cards (Figure 3).

### **Maximum size of HWC unit and total treated acres**

All reviewed HWC units were less than or equal to 2.5 acres in size. Under RFRS, approximately 45 acres of riparian restoration has occurred in hardwood dominated RMZs (Table 6); this constitutes less than 5% of the total acreage to receive restoration under RFRS.

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<sup>7</sup> It is acceptable, and potentially beneficial, to place timber sale boundary tags closer to the stream as long as the first cut stump beyond the tags is greater than 25 feet from the 100-year floodplain (this method may increase the risk of harvesting trees from the inner zone and is best used in places where the 100-year floodplain is easily identifiable).

**Cutting Card for**  
**Riparian Forest Restoration Strategy:**  
**Hardwood Conversion**

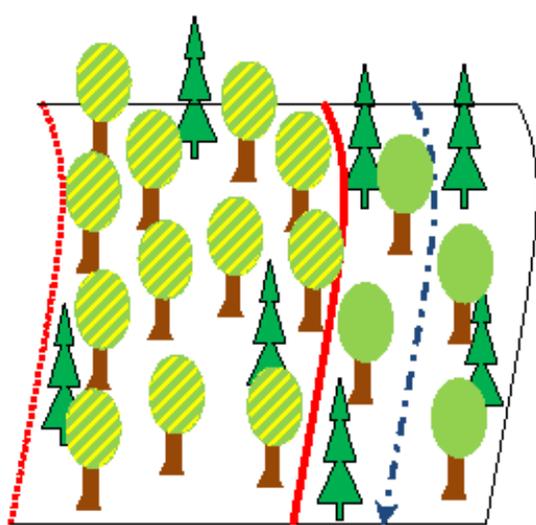
Sale Name: \_\_\_\_\_  
 Agreement # \_\_\_\_\_

**Units \_\_\_\_\_**

- No equipment shall operate within 25 feet of the white Timber Sale Boundary tags.
- All hardwoods except for blue painted bigleaf maple will be removed (those being removed include hardwoods with Special Management Boundary Tags and orange butt marks).
- All conifer and blue painted maple shall be retained.
- Conifer and blue painted bigleaf maple trees needing to be felled for operational or safety reasons shall be approved in writing by the Contract Administrator prior to felling.

Contract Administrator: \_\_\_\_\_  
 Phone Numbers: \_\_\_\_\_

**Units \_\_\_\_\_: Riparian Hardwood Conversion**



-  **Type 3 or Type 4 Stream**
-  **White Timber Sale Boundary Tags**
-  **Blue Special Management Area Tags**
-  **All Red Alder and Big leaf maple, except trees marked with blue paint, shall be Felled and Harvested**
-  **Leave Trees – Conifer and Blue Painted Bigleaf Maple shall be Retained**

**Figure 3.** Cutting card given to operators to clarify the harvest prescription in a hardwood conversion unit. This is an example of a sale that defined the EEZ as 25 feet from the tagged timber sale boundary.

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## Guidance review

Managing hardwood stands within riparian areas is ecologically complex and often silviculturally intensive. Hardwood stands are often a mosaic of site types and stand histories. Because of this, the RFRS was written to allow site-specific management plans to be designed and implemented by foresters and specialists; any approved plan would then be used as the basis for determining monitoring criteria. In the absence of a site-specific plan, the RFRS provides prescription processes that describe sideboards for management activities. As previously discussed, the RFRS provides limited objective criteria for assessing operational compliance in riparian hardwood harvest areas. For other aspects, the guidance is unclear and/or conflicting. In the following sections, we discuss some aspects of the guidance that may be causing confusion, and how the guidance has been implemented in harvest units (when available, orange boxes).

### Distinguishing ICR from HWC

The long term goal of the RFRS is “to manage for structurally complex riparian forests,” which are defined by a riparian desired future condition (RDFC). In riparian areas dominated by hardwoods (i.e., hardwood basal area > 50%) operations which remove hardwoods are appropriate when they result in a forest that is capable of reaching RDFC. In some areas these operations may require removal of all or most hardwoods, while in others only certain trees require removal. The RFRS provides two different prescriptions to differentiate these operations that appear to create two distinct types of hardwood treatments, HWC and ICR. Included in these prescriptions are different requirements that specify which hardwoods can be removed, which conifers can be removed, opening size, and need for specialist review.

We believe that the differentiation of HWC and ICR, as written in the RFRS, creates unnecessary confusion when attempting to implement restoration activities and may be a factor in why riparian hardwood harvests have been implemented on only 44 acres to date. Below are examples of confusion or operational difficulties that come from differentiating HWC and ICR.

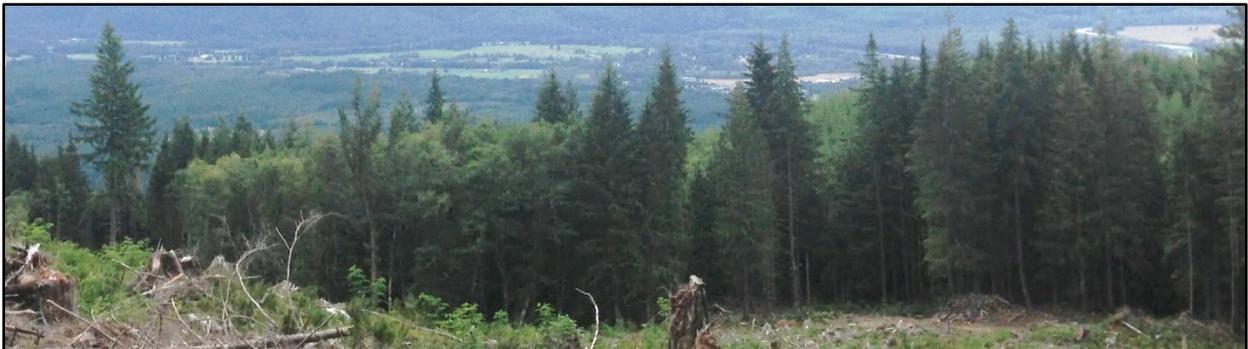
### Operations in areas with variable stand structure

The structural characteristic differentiating HWC and ICR prescriptions is the number of viable conifers per acre. HWC generally has fewer than 25 viable conifers per acre, while ICR has greater than 25 viable conifers. Few riparian reaches contain uniform stand conditions. Riparian management units may be largely homogeneous in structure and composition, however, more commonly RMZ reaches are a mosaic of pure conifer, areas of pure hardwood, and/or areas of intermixed conifer/hardwood (Box 1, Figure 4). The reality is most units likely contain characteristics of both a HWC and an ICR, and there is a resulting lack of clarity about which guidance to apply over what area. While these generalities in the guidance were designed to

allow for professional judgment to be employed by foresters, the lack of a clearly defined spatial context for distinguishing these treatments from one another at a scale lower than the stand level can confound objective implementation monitoring.

### Box 1

Two timber sales illustrated variable stand structure. For both sales, hardwood harvest units were tagged out and FMUs were made in the Planning and Tracking system with the prescription of hardwood conversion and a timber harvest activity type of variable retention harvest or variable thinning. These units were characterized as having a heterogeneous hardwood-conifer overstory, and relatively low hardwood-to-conifer basal area ratio (this was a qualitative measure noted during field reviews, and informed by the Forest Resource Inventory System (FRIS). Harvesting in these units typically removed small groups of hardwoods (~0.1-acre or smaller) and left the rest of the harvest unit either unharvested or lightly thinned along with upland harvest edge (significant portions of the FMUs were not harvested). While the interpretation could be made that these small group removals classify as small hardwood conversions, at the unit scale these treatments would be better classified as conifer release because the overstory removal likely released residual trees and the small gaps are likely difficult to regenerate.



**Figure 4.** An example of a hardwood harvest unit with a high level of variability. In a single management unit, there is a group of pure hardwood (left), a group of intermixed hardwood-conifer (middle), and a group of pure conifer (right). A site plan for this RMZ may describe a scenario that implements aspects of both HWC and ICR. (Photo Credit: Zak Thomas)

### Opening size

The RFRS uses the terms gaps and patches to differentiate two different classes of openings based on size. Openings are described, and the terms defined, in the introduction to the section titled “Specific Silvicultural Prescriptions” (p.24). The following summarizes this description:

- Gaps

- Uneven-aged management method to create structural heterogeneity
- In general, are 0.25 acres in size or less
- Shall only be used outside the 100-foot zone from the 100-year flood plain
- Patches
  - Even-aged regeneration method
  - Will only be used in the hardwood conversion scenario
  - Will not exceed 2.5 acres
  - Will not be implemented within the inner zone

These definitions have an operational impact because they appear to indicate an expectation to regenerate patches, most likely through planting, to ensure conifer establishment. Gaps, however, are not subject to planting as they are a mechanism to influence stand development.

In practice, the need to regenerate openings is based on more than opening size within the RMZ. Other factors include location and shape of the opening, presence and density of advance regeneration, overstory tree composition, and site-specific objectives. It is possible that planting in gaps, in addition to patches, is appropriate to reach RDFC.

The RFRS uses the terms gap and patch as a means to distinguish the silvicultural prescriptions for ICR and HWC. In ICR treatments the objective is expected to be achieved by gap creation or thinning, while HWC treatments call for the creation of patches 2.5 acres in size or less. This distinction may lead to unnecessary uncertainty over planting requirements. Monitoring found that planting of gap size canopy openings, particularly those adjacent to upland harvests being planted, was common. If a forester wishes to preclude certain gaps from planting to achieve the activity objective, it is recommended that these areas be described in the site plan and/or marked on the ground to assure the desired stand structure is retained following planting.

### **Conifers available for harvest**

The prescriptions for ICR and HWC provide slightly different guidance regarding which conifers may be harvested, if any. The prescription for ICR states that conifers may be harvested for the creation of yarding corridors and skid trails. For HWC, the guidance in the activity prescription states “All live conifers must be retained in the patch cuts and advance conifer regeneration shall be protected where operationally feasible” (p.32, the language of this sentence is not clear as to whether harvesting conifers for operational reasons is acceptable). In a section titled Summary of Riparian Forest Restoration Strategy Commitments, additional guidance is given that states: “No conifers will be cut during the restoration of hardwood-dominated stands except for operational

reasons” (p.70). It is not clear as to what types of activities may, or may not, warrant the harvest of conifers to facilitate operations.

A related issue is that the RFRS is unclear as to whether the harvest of non-viable conifers for non-operational purposes is an acceptable or prohibited action. At times, the presence of non-viable conifers has significantly limited the implementation of ICR treatments. In hardwood-dominated riparian harvest units with an intermixed conifer-hardwood overstory, it is not uncommon to have a non-viable conifer blocking the harvest of a group of hardwood trees that, if removed, would result in the release of viable conifers. In these types of stands, DNR has taken a conservative approach, removing only those hardwood trees in the outer most portion of the RMZ that was possible to harvest without cutting non-viable conifer trees.

Viable conifers have the following characteristics:

- DBH >6”
- Live crown >30 percent
- Height to diameter ratio <100
- Free of root rot

Our field reviews found that conifers were not harvested on most timber sales with the exception of two (Box 2). On other timber sales, operations either met the treatment prescription while avoiding conifers, avoided implementing the treatment in areas with higher conifer density, or had instances of both these situations within the same harvest unit. In some units, it was apparent that the requirement to avoid the harvest of any conifers hindered access to otherwise merchantable hardwoods. At times, this hindrance was significant and prevented achieving the activity objective at the unit scale. A discussion of the role of conifers that are likely “non-viable” for the long-term restoration goal of the RMZ would be helpful. Such conifer might be safer to leave as down wood at the time of hardwood removal.

## **Box 2**

There were two instances of viable conifers being harvested within hardwood-dominated RMZs. In the first instance, approximately five viable conifers were harvested in a hardwood conversion implemented in the RMZ of a Type 3 stream. This was an error on the part of the operator, was identified by Forest Practices and a Notice to Comply was issued. Mitigation requirements stated in the Notice to Comply have been implemented. In the second instance, three undocumented conifers were harvested within an ICR unit on a Type 4 stream. There was no apparent documentation in reference to these trees being removed, and there was no indication that they were removed for the creation of a skid trail or cable corridor.

## Hardwoods available for harvest

The considerations for removing hardwoods differ between HWC and ICR. In ICR, hardwood removal is limited to “selectively removing hardwood trees overtopping or otherwise competing with conifer trees for resources (i.e., space, light).” This is to be implemented by either: a) targeting individually marked trees for removal to release selected conifers (i.e., mark-to-take, the only method used by DNR to date), or b) prescribing a specified cutting radius around each conifer. As we understand this prescription as applied by DNR foresters, harvested hardwoods should be definably competing with conifer trees, but this is currently implemented using a subjective process. In the absence of definable criteria describing what constitutes a competing tree, objective implementation monitoring is difficult (Box 3).

### Box 3

Since the RFRS provides no guidance as to what a competing tree is, our field reviews were not able to determine if harvested trees were competing with a residual conifer or not. In areas where hardwood harvest activities consisted of thinning or gap creation (see previous discussion), hardwoods were harvested up to ~30 feet from the nearest residual viable conifer.

In HWC units, the RFRS calls for the harvest of “all hardwoods except 1-3 big-leaf maple per acre (if present)”<sup>8</sup>. This requirement is not replicated for ICR units as the RFRS makes no mention as to whether retention of bigleaf maple is required.

As written, the RFRS lacks detail about the size and location requirements of these retained bigleaf maple. This lack of detail confounds implementation monitoring, and may result in misapplication of the guidance as it was intended (Box 4). In particular, the prescription is unclear as to whether bigleaf maple present on the edge of a patch, but bound out of the timber sale with timber sale boundary tags, count towards the retention quota, or whether these trees need to be within the patch. Also, the guidance does not provide a lower bound to the diameter of bigleaf maple counted towards the retention quota; currently, bigleaf maple saplings and advance regeneration could be considered available to fulfill the retention quota. More explicit guidance describing the size and location of bigleaf maple that must be retained in HWC units may lead to a more consistent implementation of this aspect of the RFRS.

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<sup>8</sup> The RFRS also favors retention of bigleaf maple while harvesting conifer dominated RMZs.

#### **Box 4**

There were six timber sales that had bigleaf maple present within the RMZ as determined through field recon and/or documentation in the timber sale packet. Of these:

- Two timber sales retained the prescribed amount of bigleaf maple within the timber sale boundary.
- Two timber sales indicated that 1 to 3 bigleaf maple were to be marked to leave in the harvest area but, in at least one unit, were not retained (and there was no evidence of butt marking on harvested bigleaf maple). In these units, there were instances where bigleaf maple was present immediately adjacent to the treatment area but excluded from harvest with timber sale boundary tags.
- Two timber sales specifically targeted the removal of all bigleaf maple from within the harvest area as per contract schedule. Both of these sales had overstory bigleaf maple present immediately adjacent to the treatment area but excluded from harvest with timber sale boundary tags, or had unmerchantable 1" – 3" DBH bigleaf maple present within in the patch cut.

#### **Documentation of specialist consultation**

HWC and ICR have different requirements for specialist consultation. In order to help develop a site-specific management plan, consultation with a specialist is required for all HWCs but is only suggested for ICRs. When consultation does occur, the RFRS does not define what level of documentation is necessary, or whether this documentation needs to be included in the timber sale packet. Documentation need not be lengthy, but record of the consult in the timber sale packet or TSDC is recommended.

Additional clarification could also better define what positions can provide consultation. The RFRS states that appropriate specialists may include a biologist or silviculturist; however, it does not state whether other positions (for example, riparian designees or other riparian specialists) could also provide consultation. Additionally, DNR's Intensive Management Foresters (IMFs) have requested to be consulted for planning harvest activities in hardwood harvests units that will require planting.

We did not find documentation of consultations for HWC treatments within the timber sale packets of several sales (Box 5). We found no documentation of site consultations for any individual conifer release treatment.

## Box 5

Of the twelve timber sales that implemented hardwood conversions (and therefore required consultation with a specialist):

- Five sales had clear documentation that a specialist had reviewed the site plan
  - Four of these were reviewed by a region silviculture staff member and documented in the Planning & Tracking system
  - One was reviewed by a region riparian designee and documented with an email on TSDC
- Two sales had site plans reviewed by a specialist, but these reviews were not documented in the timber sale jacket
- Five sales had no apparent documentation or evidence of consultation with a specialist

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## Other operational considerations

### Herbicide application in HWC areas

The ability to utilize herbicide in hardwood conversion units, at times, increases the chance of success at meeting the activity objective; so, having an understanding of the rules and regulations pertaining to herbicide application, in particular to where spraying can and cannot occur, is generally a good practice. As previously discussed, IMFs have requested to be consulted for HWC treatments; these consultations are a good time to assess and discuss potential brush response and site preparation and regeneration plans.

Familiarizing DNR staff (foresters and silviculturists) with how the Forest Practices Rules for herbicide application apply to waters on state lands would be beneficial. For example, Forest Practice Rules for forest chemicals (WAC 222-38-020) prohibit hand spray from occurring within 50 feet of bankfull of a Type 3 stream, but there is no requirement to apply a buffer when hand spraying along a Type 4 stream or other surface water (including wetlands, Type 5 streams, seeps, and water holding topographic features) as long as herbicide is applied directly to target vegetation. A practice has been to maintain a no-spray buffer of at least 50 feet on Type 3 and 4 streams (as discussed in more detail in the following section, this is sometimes implemented by instructing herbicide applicators to stay 25 feet away from the timber sale boundary tag line), and a 25-foot buffer on other surface waters. While these conservative practices are appropriate in some situations, when implemented in hardwood conversion units, they can prevent the application of herbicide to harvested areas (which can be implemented up to 25 feet from the 100-year floodplain, as well as on seeps, Type 5s, etc.), which as previously discussed can inhibit treatment success. Two examples of how this has manifested on the landscape include 1) a strip of untreated brush along with streamside edge of the unit, and 2) unsprayed sections of hardwood conversion units around water holding/producing topographic features. These spray buffers can

represent a large portion of some of these units. Improved dissemination of spray rules and identifying these units as requiring more intensive contract administration may allow DNR to more effectively site-prepare hardwood conversion units for planting. Conversely, DNR could avoid implementing hardwood conversions in troublesome areas with potentially aggressive brush response.

### **Timber sale boundary tag line as basis of operational instructions**

Timber sale boundary tag lines can be used as a basis for instructing machine operators and chemical spray applicators about unmarked operational boundaries. For example, machine operators may be instructed to stay 25 feet from the tag line to ensure that they do not enter the EEZ (Figure 3). This is an acceptable practice; however, there are many occasions where the timber sale boundary tag line is more than 25 feet from the 100-year floodplain, in which case these directions are overly restrictive. For example, reasons why the tag line may be more than 25 feet from the 100-year floodplain include (but are not limited to) potentially unstable slopes, difficult topography, stand type break (maybe change to conifer dominance), poor timber quality, protection of bigleaf maple, or wet features that may prohibit spray (such as wetlands, Type 5 stream confluences, seeps, or poorly drained topography). In addition, the RFRS specifically states that the inner zone shall be expanded where necessary to minimize the short-term impacts to riparian functions, especially shade, on a site-specific basis; this may result in a tag line more than 25 feet from the 100-year floodplain<sup>9</sup>.

The opposite problem can occur when tags are placed closer than 25 feet from the 100-year floodplain. Tags can be placed closer than 25 feet from the 100-year floodplain as long as the first harvested trees in more than 25 feet from the 100-year floodplain. In this case, there is a potential for machines to enter the EEZ or chemicals to be applied too close to the stream.

This problem can be resolved by noting areas where distance from the tags is appropriate for determining the EEZ or chemical use buffer, and areas where machine use and/or chemical application is appropriate to the tag line.

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<sup>9</sup> In this case the width of the EEZ would also be greater than 50 feet as the RFRS states that “no ground equipment will be allowed within 25 feet of the inner zone.” Future revision of the RFRS should consider if this stipulation is necessary since widening the inner zone to retain shade does not inherently require additional restrictions on machine use.

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## **Considerations for riparian hardwood harvest unit site selection**

### **Hardwood conversion**

Site selection is crucial for determining where to implement HWC due to the specific management commitment to regeneration that persists until the new stand is in free-to-grow status. The RFRS gives some general guidance in regards to where to apply hardwood conversions. This guidance is limited to the presence of conifer stumps and presumed history of forest practices. This guidance may result in the application of these prescriptions to inappropriate areas.

While there are many locations on state lands where hardwood conversion is possible, it is important to realize that treatment response can be highly variable, and once implemented, DNR is committed to the conversion effort. The primary management concern following the removal of the hardwood overstory is the regeneration of a new cohort of conifer trees, and the most significant factor effecting the regeneration of conifers is brush response (which can be aggressive within moist, nutrient-rich areas). As previously discussed, the ability to treat the brush within the harvest area with herbicide can be a significant factor to whether the treatment objective will be achieved. In consideration of these two criteria, it becomes apparent that some potential hardwood conversion locations are significantly more conducive to treatment than others, as well as significantly less costly.

The following criteria may be helpful when considering whether to implement hardwood conversion, and where. These criteria were developed through qualitative assessment during field reviews and discussions with region staff.

### **Stumps as indicators of historical forest conditions**

While the simple presence or absence of old conifer stumps can indicate the historical forest structure and composition, it is important to consider both the density and species of the stumps present. A high density of conifer stumps may indicate with greater certainty that the site was historically conifer dominated; conversely, a low density of conifer stumps may indicate a historical condition dominated by hardwoods. Also, the presence of conifer stumps from species better conditioned to wetter environments, such as redcedar, may provide further insight into the past forest condition. Another important consideration is that it was common practice in the past to broadcast-burn harvest areas to remove slash; therefore, the absence of stumps should not preclude the implementation of hardwood conversion in an area. It may also be useful for foresters to consider how past management practices changed the site's growing conditions; it is

possible that the initial removal of conifers changed the growing conditions to make the site more conducive to supporting hardwood species.

### **Understory plant composition and potential for aggressive shrub response**

While it can be difficult to predict how understory woody and herbaceous species will respond to the removal of the hardwood overstory, considering some general characteristics of the pre-harvest stand may inform a better management decision. An understory dominated by upland vegetation associated with drier sites (sword fern, salal, Oregon grape, etc.<sup>10</sup>) is the best indicator that the post-harvest silvicultural effort will be minimal (Figure 5). Conversely, a dominance of facultative brush species may indicate a need to aggressively treat vegetation prior to planting (and potentially re-treat to release seedlings), particularly when the vegetation has the potential for significant vertical growth (such as salmonberry, elderberry, vine maple, etc.). As previously discussed, considering the post-harvest silvicultural effort while planning where HWC will be implemented is recommended. As DNR gains more experience implementing hardwood conversions consistently and identifying sites conducive to treatment with minimal cost, it may be beneficial to develop guidance that associates a high likelihood of treatment success with particular plant associations.

### **Topographic indicators**

Implementing the treatment in a “raised” RMZ associated with an incised or gorged stream can be beneficial because a) these sites may be drier than other areas nearer to streams, and b) laying out the units can be done more efficiently since the 100-year flood plain is more easily identifiable. Additionally, it may be advisable at times to avoid water channeling or holding topography (such as Type 5 streams, seeps, poorly drained soil, etc.) that may preclude management activities to facilitate conifer establishment.

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<sup>10</sup> Species listed as facultative upland (FACU) in the National Wetland Plant List maintained by the US Army Corps of Engineers (available to DNR staff on the “Westside Wetlands” SharePoint page), or not listed in the National Wetland Plant List (and therefore considered upland obligates) are indicative of drier sites.



**Figure 5.** This hardwood conversion unit had a pre-harvest dominance of sword fern, a facultative upland species, and required little-to-no herbicide application in order to get the unit prepped for planting. This picture was taken from the upland edge of the RMZ facing towards the inner zone (line of standing trees). The primarily upland condition within the RMZ was supported by an incised stream channel that created separation between riparian and upland vegetation. (Photo Credit: Zak Thomas)

### **Individual conifer release**

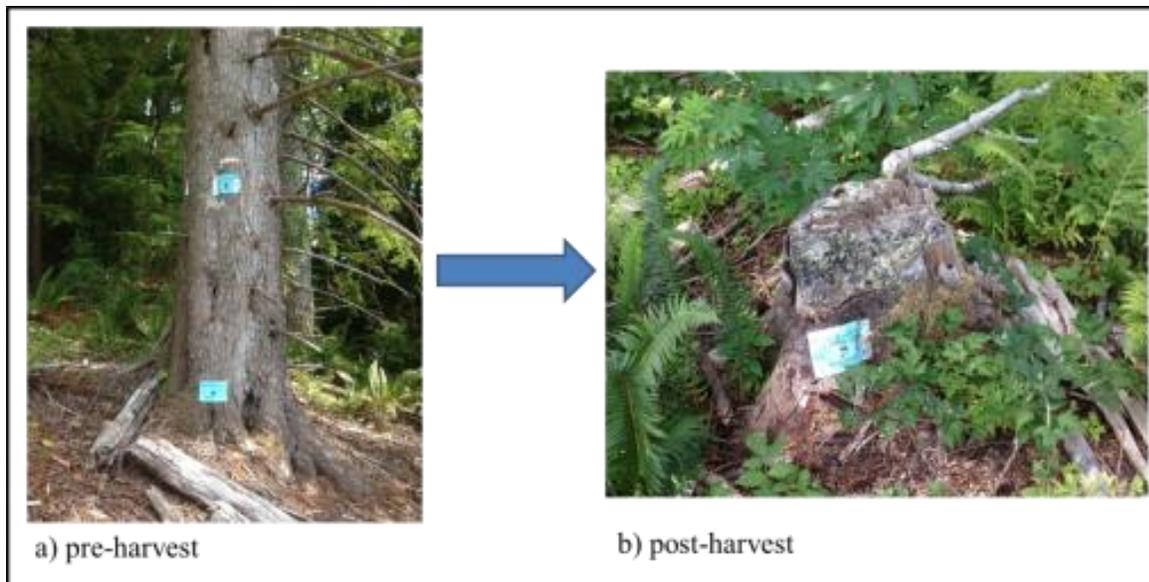
Achieving the activity objective for ICR at the unit scale is largely a function of the structure and composition of the riparian unit before harvest. Specifically, the relative dominance of hardwoods compared to conifers and the spatial distribution of these trees are important factors to consider when determining whether a unit is conducive to treatment from an operational perspective. The RFRS allows the ICR prescription to be applied to a wide range of stand conditions, including harvest units with 25 viable conifers per acre to harvest units where hardwoods barely possess more basal area than conifers. These largely intermixed hardwood-conifer harvest units are less conducive to ICR than areas with a more pronounced dominance of hardwood trees. Additionally, stands where hardwoods are grouped together and accessible from the upland side of the unit are potentially more conducive to treatment. Additionally, as utilizing

mark-to-take prescriptions in common, being knowledgeable of what an operator or cutter can or cannot harvest is useful for maximizing harvest efficiency and volume removal.

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## Best Management Practices (BMPs)

- Slash accumulation in hardwood-dominated harvest areas can be significant. To assure an adequate number of planting locations, consider piling slash or include a contract stipulation to create a sufficient number of planting locations per acre in the RMZ. If machine piling, consider precluding slash removal from the EEZ to limit the risk of machine entry.
- Determining the upland edge of a riparian special management unit (SMU) can be difficult post-harvest, particularly in hardwood conversions where many, if not all, of the tagged trees may be removed. Being able to identify this line post-harvest has operational significance in that the managed RMZs may have different planting prescriptions, stipulations for herbicide application, or specific management commitments (e.g., a concurrence letter). Assuming that silviculture staff are able to consistently and accurately re-establish SMU tag lines places unnecessary risk on DNR. An effective method to reduce the risk of misidentifying SMU lines post-harvest is to double-tag some of the boundary trees that may be harvested (Figure 6). This method is especially useful when large sections of the boundary are available for harvest. Flagging the SMU line can also be effective, but be aware that flagging can be incidentally shifted, damaged, or removed during operations.
- Biotic and abiotic factors can act as barriers to treatment success in hardwood harvest units. The removal of competing trees in ICR treatments increases the likelihood of windthrow of the residual overstory, particularly in wet riparian areas. If the harvest unit is in a wind prone area, consider the orientation of the upland edge of the harvest unit in relation to prevailing winds, or use a wind buffer. Ungulate browse pressure can be significant, particularly where redcedar is planted (planting redcedar is a common practice in HWC units). If browse pressure is likely, consider using barrier protection (vexar tubes, fencing, etc.) or regenerate species, such as spruce, which are less susceptible to browse.



**Figure 6.** Double tagging potentially harvestable trees along a SMU tagline can be beneficial because it permits identification of the SMU following after a harvest, which allows a more effective application of post-harvest management activities. (Photo Credit: Zak Thomas)

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## Conclusions

The guidance, which monitoring was able to assess objectively during field reviews, is being implemented with a high degree of operational compliance. When confronted with unclear guidance, DNR has taken an approach that assures the protection of resources. While being the most conservative and involving the least amount of disturbance, this approach, at times, has hindered the achievement of the activity objective at the unit scale as well as potentially reduced the volume of timber removal. It is apparent that when implemented under the right conditions these treatments are a valuable tool that can be used to attain multiple management objectives, including ecological restoration and revenue production. Hardwood harvests are relatively rare activities within riparian areas on state lands in western Washington (~5% or less of RFRS acres); consistent with the ecological risks identified within the RFRS and potential management costs, this appears to be as intended in the conservation strategy.

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## References

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