

Hazel
Watershed Administrative Unit
Prescriptions

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Washington Department of Natural Resources
919 North Township Street
Sedro-Woolley, WA 98284

OVERVIEW

HAZEL WAU PRESCRIPTIONS

The attached prescriptions guide forest practice activities on state and private forest lands within the Hazel watershed administrative unit (WAU). These prescriptions apply to specific areas of resource sensitivity (ARS) identified through the assessment process. Areas of resource sensitivity include portions of the landscape prone to changes in watershed inputs such as coarse and fine sediment, large woody debris, and shade. Watershed processes that influence the routing of these inputs are assessed; public resources such as water quality and fish habitat that are vulnerable to changes in inputs are also assessed. Combining the watershed process hazard with the public resource vulnerability yields a resource management response or "rule call" which determines the appropriate level of management activity for each ARS. In the Hazel WAU, 18 ARS have been identified: 10 mass wasting units, 1 road erosion unit, 1 hillslope erosion unit, 3 large woody debris units, 2 shade units, and 1 fish passage/migration barrier unit.

Map Resolution Issues

The mass wasting assessment is based on the latest scientific information related to the effects of forest practices on landslide initiation. As a result, forestry-related landsliding is expected to be reduced when prescriptions are followed. However, in some cases, areas of potential landslide hazard may not have been identified accurately due to: (1) the dependence on remote-sensed data (i.e., aerial photos); (2) the relatively short (50 years) and unique history of storms that triggered landslides used in delineating mass wasting units; and (3) the incomplete scientific understanding of all landslide mechanisms. For all these reasons, map units developed during this analysis may not capture all potentially unstable areas. Conversely, there may be inclusions of stable, low hazard areas within mapped units that do not meet the written description of the mass wasting units. As a result, implementation of prescriptions requires the identification of mass wasting unit boundaries in the field. The identification and field verification of map unit boundaries can be accomplished by foresters or other resource managers using the descriptions included in the mass wasting assessment report (Appendix A, Forms A-2).

Signs of Instability

Road construction prescriptions for ARS 4 (mass wasting map unit 4) require the proponent to adhere to more stringent standards when road construction is to proceed in areas exhibiting signs of instability. The following list includes signs of instability commonly found in forest settings:

- convergent or hollow topography
- landslide scar morphology
- emergent groundwater
- hydric vegetation
- perched groundwater conditions
- streambank erosion at the toe of slope
- evidence of accelerated soil creep
- tension cracks in the soil
- jackstrawed or pistol-butted trees

Signs of Instability (cont'd)

The determination of instability for any given location should be made using a "weight-of-the-evidence" approach. That is, a single sign from the above list may not serve as proof of instability, yet the presence of several signs provides a higher level of certainty of instability.

Cable Yarding Corridors

In some instances, the creation of cable yarding corridors through mass wasting units (e.g., inner gorges of mass wasting units 3, 4, or 6) or riparian management zones may be preferred if their use results in a higher level of resource protection compared to other alternatives. For example, if by using corridors, one or more inner gorge road crossings could be eliminated, timber harvest to facilitate yarding in an otherwise "no-harvest" area may be permitted. The decision whether or not to permit corridors will lie with the DNR forest practices forester, who may seek technical inputs from specialists where he/she feels such input is warranted. In cases where corridors are permitted, the width and total area in corridors is to be minimized so as to limit the cutting of live trees. When corridors cross a mass wasting unit, full suspension yarding techniques must be utilized at all times.

AREA OF RESOURCE SENSITIVITY: 1

DESCRIPTOR: Mass Wasting Map Unit #1: large, active, deep-seated landslides along river bends.

PRESCRIPTION:
No forest practice activity.

AREA OF RESOURCE SENSITIVITY: 2

DESCRIPTOR: Mass Wasting Map Unit #2: groundwater recharge areas associated with MWMU #1

RESOURCE PROTECTION OBJECTIVE:

Forest practice activities should produce no decrease in the factor of safety within the potentially active portion of the associated landslide (MWMU #1).

NOTE: *The baseline or "background" factor of safety should be determined for current topographic, canopy, and river conditions. Identifying the potentially active portion of the landslide will require field reconnaissance/mapping as part of the factor of safety evaluation (described below).*

PRESCRIPTION:

A detailed, site-specific operation plan shall be developed for any proposed forest practice activity within this MWMU. The plan and associated activity shall meet the resource protection objective stated above. The proposed forest practice activity shall be evaluated to determine if and to what extent the operation results in a change in the factor of safety within the associated deep seated landslide (MWMU #1). The evaluation shall follow the methods established by Miller and Sias (1997) or an equivalent or better method. The evaluation shall explicitly define, describe, and map the groundwater recharge area (MWMU #2) and potentially active portion of the landslide (all or part of MWMU #1). The forest practice application package shall include a detailed report describing the results of this evaluation and a statement confirming the operation meets the above stated resource protection objective.

In addition to the factor of safety analysis required above, a monitoring plan shall be developed and implemented in conjunction with any proposed forest practice activity. The plan shall be implemented for a minimum of five years, although a period of 10 years *is recommended*. The plan shall include, at a minimum, the following monitoring parameters:

- 1) a record of daily precipitation at or in close proximity to the site;
- 2) a record of monthly groundwater levels at a point within the groundwater recharge area.

It is recommended that monitoring of stream discharge on Headache Creek and daily precipitation be carried out in order to better calibrate the hydrologic model that is part of the overall slope stability (factor of safety) evaluation.

CITATION:

Miller, D. and J. Sias. 1997. Environmental factors affecting the Hazel landslide - level 2 watershed analysis, Hazel, Washington. Unpublished report. M2 Environmental Services, Seattle, WA.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 3

DESCRIPTOR: Mass Wasting Map Unit #3: inner gorges with steep (>50%) uninterrupted sideslopes; vertical distances from the channel bottom to the slope break greater than 25 feet; associated with colluvial soils over bedrock and till.

PRESCRIPTION:

Harvest:

Uninterrupted slopes greater than 50%-

No timber harvest. Where small, sporadic, deep-seated landslides occur, and where the upslope margin (scarp) of the slide is located near the inner gorge slope break, an undisturbed buffer equivalent to the area of the slide from head to toe shall be left above the slide in an effort to maintain the natural hydrologic regime in the groundwater recharge area. If there is evidence that the groundwater recharge area does not originate directly uphill of the failure, then arrangement of the buffer should be adjusted to include the actual groundwater recharge area. NOTE: depending on the location of the feature relative to the inner gorge slope break, this buffer may extend beyond (upslope of) the defined MWMU

Roads:

Decisions regarding proposed new road construction within MWMU #3 shall be made in the following order:

- 1) select alternative road locations that avoid the MWMU.
- 2) if access through the MWMU is essential, select locations free of instability.

If roads are constructed or reconstructed within the MWMU:

- 1) full bench, end haul construction techniques shall be utilized;
- 2) all roads shall be designed and staked in the field by a qualified engineer (i.e., possesses a forest or civil engineering degree) with referable experience in forest road design and construction;
- 3) design drawings are required and shall be reviewed for approval by the DNR;
- 4) debris or soil deposits placed at the upper slope break adjacent to the MWMU shall be pulled back to a stable location(s);
- 5) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills.

AREA OF RESOURCE SENSITIVITY: 4

DESCRIPTOR: Mass Wasting Map Unit #4: inner gorges with steep uninterrupted sideslopes (>50%); vertical distances from the channel bottom to the slope break greater than 25 feet; associated with low-gradient (3-6%) Type 3 or larger streams and glacial lakebed silt.

PRESCRIPTION:

Harvest:

Uninterrupted slopes greater than 50%-

No timber harvest. Where small, sporadic, deep-seated landslides occur, and where the upslope margin (scarp) of the slide is located near the inner gorge slope break, an undisturbed buffer equivalent to the area of the slide from head to toe shall be left above the slide in an effort to maintain the natural hydrologic regime in the groundwater recharge area. If there is evidence that the groundwater recharge area does not originate directly uphill of the failure, then arrangement of the buffer should be adjusted to include the actual groundwater recharge area.

NOTE: depending on the location of the feature relative to the inner gorge slope break, this buffer may extend beyond (upslope of) the defined MWMU.

Roads:

Decisions regarding proposed new road construction within MWMU #4 shall be made in the following order:

- 1) select alternative road locations that avoid the MWMU.
- 2) if access through the MWMU is essential, select locations free of instability.
- 3) if access is essential and the only practical route shows signs of instability, the proponent must demonstrate that the road will not increase the likelihood of mass wasting.

If roads are constructed or reconstructed within the MWMU:

- 1) full bench, end haul construction techniques shall be utilized;
- 2) all roads shall be designed and staked in the field by a qualified engineer (i.e., possesses a forest or civil engineering degree) with referable experience in forest road design and construction;
- 3) design drawings are required and shall be reviewed for approval by the DNR;
- 4) where construction is permitted at locations showing signs of instability, construction shall be supervised in the field by a qualified engineer or designee with equivalent experience;
- 5) debris or soil deposits placed at the upper slope break adjacent to the MWMU shall be pulled back to a stable location(s);
- 6) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills.

AREA OF RESOURCE SENSITIVITY: 5

DESCRIPTOR: Mass Wasting Map Unit #5: slopes (>50%) on terrace flanks of lower elevation gorges and glacial terrace edges that typically have been deeply incised by streams.

PRESCRIPTION:

Harvest-

Uninterrupted slopes greater than 50%-

No timber harvest. Where small, sporadic, deep-seated landslides occur, and where the upslope margin (scarp) of the slide is located near the inner gorge slope break, an undisturbed buffer equivalent to the area of the slide from head to toe shall be left above the slide in an effort to maintain the natural hydrologic regime in the groundwater recharge area. If there is evidence that the groundwater recharge area does not originate directly uphill of the failure, then arrangement of the buffer should be adjusted to include the actual groundwater recharge area.

NOTE: depending on the location of the feature relative to the inner gorge slope break, this buffer may extend beyond (upslope of) the defined MWMU.

NOTE: due to the resolution of mapping, inclusions of low hazard areas (areas with no deliverability) exist within this unit. In those areas, the harvest prescription noted above will not apply.

Roads-

- 1) full bench, end haul construction techniques shall be utilized;
- 2) where roads cross streams, fills shall be dipped;
- 3) where roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures;
- 4) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet.

Note: Inclusions of MWMU #3, #4, and #6 exist within MWMU #5. Refer to prescriptions for those MWMUs for road construction standards.

AREA OF RESOURCE SENSITIVITY: 6

DESCRIPTOR:

Mass Wasting Map Unit #6: incised steep-gradient (>12%) confined stream channels with uninterrupted sideslopes (>50%), and vertical distances from the channel bottom to the slope break between 10 and 25 feet.

PRESCRIPTION:

Harvest:

*Uninterrupted slopes greater than 50%-
No timber harvest.*

Roads:

Decisions regarding proposed new road construction shall be made in the following order:

- 1) select alternative road locations that avoid the MWMU.
- 2) if access through the MWMU is essential, select locations free of instability.

New Roads

If proposed new road construction or reconstruction of a **permanent road** falls within MWMU #6, the following prescriptions shall apply:

- 1) full bench, end haul construction techniques shall be utilized;
- 2) all roads shall be designed and staked in the field by a qualified engineer (i.e., possesses a forest or civil engineering degree) with referable experience in forest road design and construction;
- 3) stream crossings shall be located in areas free of signs of instability;
- 4) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills.

If proposed new construction or reconstruction of a **temporary road** falls within MWMU #6, the following prescriptions shall apply:

- 1) full bench, end haul construction techniques shall be utilized;
- 2) stream crossings should avoid areas that exhibit signs of instability; if access is essential and the only practical route shows signs of instability, the proponent must demonstrate that the road construction will not increase the likelihood of mass wasting;
- 3) temporary stream crossing structures shall be bridges or culverts with dipped native fills with armoring on both the upstream and downstream sides;
- 4) temporary stream crossing structures shall be removed by October 30 of the same year; bridges, culverts and fill materials will be removed and the road within the MWMU will be stabilized.

Existing Roads

- 1) existing roads that within the area of the proposed Forest Practice shall be evaluated for culvert sizing and fill materials; all prescriptions for **permanent roads** (above) shall apply;
- 2) existing roads within the area of the proposed Forest Practice shall be examined and where appropriate, corrective action to decrease the likelihood of mass wasting shall be taken prior to the conclusion of the operation.

Mass Wasting Prescriptions Rescinded
Use as Screening Tool

AREA OF RESOURCE SENSITIVITY: 7

DESCRIPTOR: Mass Wasting Map Unit #7: steep (>50%), high elevation, naturally unstable, predominately concave slopes.

PRESCRIPTION:

Harvest:

Slopes greater than 65% with convergent or hollow topography-
No timber harvest.

Slopes greater than 65% with planar topography-

Timber harvest shall not reduce canopy cover below 70% and the residual stand shall be comprised of dominant and/or co-dominant trees evenly spaced throughout the unit.

Roads:

- 1) no road construction on convergent or hollow topography;
- 2) full bench, end haul construction techniques shall be utilized;
- 3) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet;
- 4) where roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures;
- 5) existing roads within the area of the proposed Forest Practice shall be examined and where appropriate, corrective action to decrease the likelihood of mass wasting shall be taken prior to the conclusion of the operation.

AREA OF RESOURCE SENSITIVITY: 8

DESCRIPTOR: Mass Wasting Map Unit #8, sub-units a and b: highly variable slopes, channels, and materials of Rollins Creek headwaters.

PRESCRIPTION (MWMU #8a):
No forest practice activity within Unit 8a.

PRESCRIPTION (MWMU #8b):

Harvest:

Slopes greater than 65% with convergent or hollow topography-
No timber harvest.

Slopes greater than 65% with convex or planar topography-
Timber harvest shall not reduce canopy cover below 70% and the residual stand shall be comprised of dominant and/or co-dominant trees evenly spaced throughout the unit.

Roads:

New Roads-

No new road construction; however, existing road grades may be utilized but must meet the following construction standards:

- 1) full bench, end haul construction techniques shall be utilized;
- 2) permanent stream crossing structures shall be bridges or culverts with solid, keyed rock fills;
- 3) where roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures;
- 4) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet.

Existing Roads

- 1) existing roads within the area of the proposed Forest Practice shall be evaluated for culvert spacing, sizing, and armoring. All prescriptions for *New Roads* (above) shall apply.
- 2) existing roads within the area of the proposed Forest Practice shall be examined and where appropriate, corrective action to decrease the likelihood of mass wasting shall be taken prior to the conclusion of the operation.

Note: Inclusions of MWMU #6 exist within MWMU 8b. Refer to prescriptions for MWMU #6 for conditions.

AREA OF RESOURCE SENSITIVITY: 9

DESCRIPTOR: Mass Wasting Map Unit #9: very steep (>55%), high-elevation bedrock slopes, including type 5 streams commonly on bedrock floors, and generally planar slopes between.

PRESCRIPTION:

New Roads-

Avoid new road construction within MWMU #9.

If new roads are constructed:

- 1) no road construction on slopes greater than 65% which exhibit signs of instability (see list of signs of instability in overview);
- 2) full bench, end haul construction techniques shall be utilized;
- 3) on slopes less than 65%, cross-drain spacing shall not exceed 450 feet; on slopes greater than 65%, cross-drain spacing shall not exceed 160 feet;
- 4) where new roads cross stream channels or seeps, water shall be kept in its original channel or location by installing appropriate drainage structures.

Existing Roads-

An inventory of road-related mass wasting hazards shall be conducted within 12 months of DNR approval of this watershed analysis. Where necessary, corrective action to decrease the likelihood of mass wasting shall be taken within 24 months of approval of this watershed analysis.

Note: Inclusions of MWMU #3 and #6 exist within MWMU #9. Refer to the prescriptions for those MWMUs for road construction conditions.

AREA OF RESOURCE SENSITIVITY: 10

DESCRIPTOR: Mass Wasting Map Unit #10: gently-sloping glaciated highlands (less than 40%), headwaters of Rollins and Dicks Creek.

PRESCRIPTION:

An inventory of road fills associated with stream crossings shall be conducted within 12 months of DNR approval of this watershed analysis. Where road fills greater than 6 feet deep exist, and where the channel immediately downstream of the crossing is confined and has a gradient less than 35%, corrective action to decrease the likelihood of mass wasting shall be taken within 24 months of DNR approval of this watershed analysis. Corrective action includes fill reduction (dipping) on active roads or fill removal on non-essential inactive roads.

AREA OF RESOURCE SENSITIVITY: 11

DESCRIPTOR: Road Erosion Unit: Brooks and Segelsen sub-basins

PRESCRIPTION:

Future Road Construction-

- 1) all mineral soils exposed by road construction shall be seeded with appropriate ground cover within 6 months (including cut slopes, fill slopes, and other scarified surfaces within 200 feet of any stream channel);
- 2) ballast of new roads should closely follow pioneering of the grade; during wet conditions, road ballast shall be no more than 500 feet from the pioneering;
- 3) whenever new roads intercept stream channels or seeps, the water shall be kept in its original channel or location;
- 4) on slopes between 40% and 60%, cross drain spacing shall not exceed 450 feet; on slopes greater than 60%, cross drain spacing shall not exceed 160 feet;
- 5) road construction shall be carried out in a manner that prevents road drainage from entering inner gorge areas.

Existing Roads [active secondary (AS, 6S) and inactive (6I) road segments (refer to Map B-5)]-

- 1) on inactive roads, to the extent necessary to prevent damage to public resources:
 - a) culverts and ditches shall be kept functional;
 - b) road surface shall be maintained as necessary to minimize erosion of the surface and subgrade by crowning, outsloping, or waterbarring.
- 2) existing roads shall be upgraded to meet *Future Road Construction* prescriptions (see above) when they receive use in future forest practice activities;
- 3) existing roads noted above shall receive road maintenance which achieves the standards specified in (1) above within 12 months of DNR approval of this watershed analysis.

VOLUNTARY PRESCRIPTION:

Orphaned and/or Abandoned Roads-

It is recommended these roads be abandoned in accordance with DNR Northwest Region Road Maintenance Guidelines dated 6/20/94. Refer to A. Zander's orphaned road inventory (on file with DNR-NW Region) for specific road segment recommendations.

AREA OF RESOURCE SENSITIVITY: 12

DESCRIPTOR: Hillslope Erosion Unit: moderate and high hazard hillslope erosion units

PRESCRIPTION:

General Prescription for all Operations:

- 1) the number of stream crossings shall be minimized;
- 2) landings shall be located a minimum of 50 feet from any stream channel;
- 3) all Type 4 and 5 waters and stream crossings shall be identified on the Forest Practice Application;
- 4) on Type 4 streams, a minimum of 25 trees 6 inches DBH or larger per 1,000 feet stream length within 25 feet of the OHWM shall be retained on each side of stream; it is preferred that these trees be within 10 feet of the OHWM;
- 5) adjacent to stream channels, harvest techniques should follow standard fall away, yard away practices wherever feasible;
- 6) stream channel integrity shall be maintained during all harvest operations which may require the use of temporary crossing structures when water is present.

Ground Based Operations:

- 1) with the exception of stream crossings, no equipment shall be allowed within 25 feet of any stream channel;
- 2) with the exception of stream crossings, no skid trails shall be allowed within 50 feet of any stream channel;
- 3) no ground-based yarding on slopes greater than 30%;
- 4) equipment shall not operate on any wetland soils connected with stream channels;
- 5) at the conclusion of the operation, skid trail drainage shall be established at intervals not exceeding 200 feet; within 200 feet of any stream channel, skid trail drainage shall be established at intervals not exceeding 75 feet.

Cable Operations:

- 1) a minimum of front end suspension shall be used on all cable yarding operations;
- 2) if the use of front end suspension will not ensure the maintenance of stream channel integrity, full suspension yarding shall be utilized;
- 3) on slopes less than 50% adjacent to streams, a 15 foot buffer measured horizontally from the OHWM shall be maintained where no soil disturbance is allowed;
- 4) on slopes greater than or equal to 50% adjacent to streams, a 25 foot buffer measured horizontally from the OHWM shall be maintained where no soil disturbance is allowed.

VOLUNTARY PRESCRIPTION:

It is recommended that livestock be excluded from riparian areas in order to limit streambank erosion. Where fencing along streams currently exists, it should be maintained to limit

livestock access. Eliminating this sediment source will require cooperative efforts between state and federal agencies, local governments, tribes, and landowners.

AREA OF RESOURCE SENSITIVITY: 13

DESCRIPTOR: Riparian zones adjacent to Geomorphic Units
1 and 10

Note: channel migration zones are likely to be associated with geomorphic units 1 and 10, in which case, the following prescription should be applied beginning at the outer edge of the channel migration zone as opposed to the ordinary high water mark of the channel.

PRESCRIPTION:

Conifer-Dominated Stands¹:

A 100-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 45 feet of the ordinary high water mark. Timber harvest is permissible in the outer 55 feet of this zone under the following conditions:

- 1) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
- 2) the 75 largest trees per acre must be retained;
- 3) residual trees must be evenly distributed.

Hardwood-Dominated Stands²:

A 100-foot riparian management zone, measured horizontally from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 30 feet of the ordinary high water mark. Timber harvest is only permissible in the outer 70 feet of this zone under the following conditions:

- 1) no conifer removal;
- 2) a maximum of 50% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
- 3) the 50 largest trees per acre must be retained;
- 4) residual trees must be evenly distributed;
- 5) the residual stand must be underplanted with shade-tolerant conifer species within one year of the harvest operation;
- 6) a detailed plan describing brush (competition) control techniques to ensure seedling survival must be submitted with the Forest Practice Application and approved by the DNR prior to commencing the harvest operation.

Mixed Conifer/Hardwood Stands³:

A 100-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 35 feet of the ordinary high water mark. Timber harvest is permissible in the outer 65 feet of this zone under the following conditions:

- 1) no conifer removal;
- 2) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
- 3) the 75 largest trees per acre must be retained;
- 4) residual trees must be evenly distributed.

- 1 - Conifer-dominated stands include those stands where coniferous tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
- 2 - Hardwood-dominated stands include those stands where hardwood tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
- 3 - Mixed stands include all stands not conifer- or hardwood-dominated.

JUSTIFICATION:

The width of the riparian management zone (100 feet) corresponds to the distance from which nearly 100% of the conifer large woody debris will be recruited in the near-term (10-20 years). This is based on data from McDade et al. (1990) and McKinley (1997), where large woody debris source distances were evaluated in western Washington and Oregon. While all stands within the designated Area of Resource Sensitivity are not conifer-dominated, the width of the riparian management zone was based on recruitment under conifer-dominated situations. This was done because it is recognized that conifers within the 100-foot zone are more likely to be recruited to the stream channel than hardwoods due to differences in height. In addition, the 100-foot zone will conserve future conifer recruitment in cases where hardwood-dominated stands are actively converted to conifer.

The width of the no-harvest portion of the riparian management zone varies according to the dominant vegetation type and corresponds to the distance from which 75% of the large woody debris will be recruited in the near-term. These distances were also based on data from McDade et al. (1990) and McKinley (1997) for conifer-dominated and hardwood-dominated stands. Distances for mixed stands were interpolated between conifer- and hardwood-dominated curves in the aforementioned studies.

Under this prescription, the riparian management zone is divided into two sub-zones; the zone closest to the stream serves as a "core" area where timber harvest is restricted and natural processes (i.e., windthrow, bank undercutting, mortality) guide forest stand development. This is also the zone that provides the large majority of woody debris recruitment. The outer zone serves as an area where some timber harvest (i.e., thinning) is permissible to increase the size and/or quality of potentially recruitable trees.

The specific objective of thinning varies depending on the dominant vegetation type. In conifer-dominated stands, the objective is to accelerate the growth of the residual stand to increase the likelihood that a functional debris piece will be recruited to the stream channel. In hardwood-dominated stands, the objective of thinning is to remove enough of the overstory to accommodate the growth of a conifer understory that will eventually replace the hardwood. A secondary objective is to accelerate the growth of the residual hardwoods to increase the likelihood that a functional debris piece will be recruited to the channel.

The primary assumptions used in developing the prescription for this Area of Resource Sensitivity are as follows:

- 1) Large woody debris is an important component of fish habitat in geomorphic units 1 and 10 and these channels are most sensitive to large woody debris inputs relative to other channels in the WAU.
- 2) It is necessary to maintain the zone which supplies nearly 100% of the potential near-term conifer recruitment in a condition that supports the continuous recruitment of large woody debris to the stream channel.
- 3) It is necessary to provide a minimum of 75% of the potential near-term conifer recruitment to create and maintain desired in-stream habitat conditions for anadromous and resident fish populations.
- 4) That portion of the riparian management zone that supplies between 75% and nearly 100% of the potential near-term large woody debris recruitment is an important source area for woody debris recruitment and is also an area in which thinning will enhance the size and/or quality of potentially recruitable trees.

REFERENCES:

- McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. *Can. J. For. Res.* 20:326-330.
- McKinley, M. 1997. Large woody debris source distances for western Washington Cascade streams. Undergraduate senior research project, unpublished report, University of Washington College of Forest Resources. 36 p.

AREA OF RESOURCE SENSITIVITY: 14

DESCRIPTOR: Riparian zones adjacent to Geomorphic Units 2, 3, 4, 7, 8, and 9

Note: channel migration zones may be associated with portions of geomorphic units 2, 3, and 9, in which case, the following prescription should be applied beginning at the outer edge of the channel migration zone as opposed to the ordinary high water mark of the channel.

PRESCRIPTION:

Conifer-Dominated Stands¹:

An 80-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 45 feet of the ordinary high water mark. Timber harvest is permissible in the outer 35 feet of this zone under the following conditions:

- 1) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
- 2) the 75 largest trees per acre must be retained;
- 3) residual trees must be evenly distributed.

Hardwood-Dominated Stands²:

An 80-foot riparian management zone, measured horizontally from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 30 feet of the ordinary high water mark. Timber harvest is only permissible in the outer 50 feet of this zone under the following conditions:

- 1) no conifer removal;
- 2) a maximum of 50% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
- 3) the 50 largest trees per acre must be retained;
- 4) residual trees must be evenly distributed;
- 5) the residual stand must be underplanted with shade-tolerant conifer species within one year of the harvest operation;
- 6) a detailed plan describing brush (competition) control techniques to ensure seedling survival must be submitted with the Forest Practice Application and approved by the DNR prior to commencing the harvest operation.

Mixed Conifer/Hardwood Stands³:

An 80-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 35 feet of the ordinary high water mark. Timber harvest is permissible in the outer 45 feet of this zone under the following conditions:

- 1) no conifer removal;
- 2) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
- 3) the 75 largest trees per acre must be retained;
- 4) residual trees must be evenly distributed.

- 1 - Conifer-dominated stands include those stands where coniferous tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
- 2 - Hardwood-dominated stands include those stands where hardwood tree species comprise at least 70% of the stand based on density (i.e., trees per acre).
- 3 - Mixed stands include all stands not conifer- or hardwood-dominated.

JUSTIFICATION:

The width of the riparian management zone (80 feet) corresponds to the distance from which 95% of the conifer large woody debris will be recruited in the near-term (10-20 years). This is based on data from McDade et al. (1990) and McKinley (1997), where large woody debris source distances were evaluated in western Washington and Oregon. While all stands within the designated Area of Resource Sensitivity are not conifer-dominated, the width of the riparian management zone was based on recruitment under conifer-dominated situations. This was done because it is recognized that conifers within the 80-foot zone are more likely to be recruited to the stream channel than hardwoods due to differences in height. In addition, the 80-foot zone will conserve future conifer recruitment in cases where hardwood-dominated stands are actively converted to conifer.

The width of the no-harvest portion of the riparian management zone varies according to the dominant vegetation type and corresponds to the distance from which 75% of the large woody debris will be recruited in the near-term. These distances were also based on data from McDade et al. (1990) and McKinley (1997) for conifer-dominated and hardwood-dominated stands. Distances for mixed stands were interpolated between conifer- and hardwood-dominated curves in the aforementioned studies.

Under this prescription, the riparian management zone is divided into two sub-zones; the zone closest to the stream serves as a "core" area where timber harvest is restricted and natural processes (i.e., windthrow, bank undercutting, mortality) guide forest stand development. This is also the zone that provides the large majority of woody debris recruitment. The outer zone serves as an area where some timber harvest (i.e., thinning) is permissible to increase the size and/or quality of potentially recruitable trees.

The specific objective of thinning varies depending on the dominant vegetation type. In conifer-dominated stands, the objective is to accelerate the growth of the residual stand to increase the likelihood that a functional debris piece will be recruited to the stream channel. In hardwood-dominated stands, the objective of thinning is to remove enough of the overstory to accommodate the growth of a conifer understory that will eventually replace the hardwood. A secondary objective is to accelerate the growth of the residual hardwoods to increase the likelihood that a functional debris piece will be recruited to the channel.

The primary assumptions used in developing the prescription for this Area of Resource Sensitivity are as follows:

- 1) Large woody debris is an important component of fish habitat in geomorphic units 2, 3, 4, 7, 8, and 9; however, these channels are less sensitive to large woody debris inputs relative to geomorphic units 1 and 10 (ARS 13).
- 2) It is necessary to maintain the zone which supplies 95% of the potential near-term conifer recruitment in a condition that supports the continuous recruitment of large woody debris to the stream channel.
- 3) It is necessary to provide a minimum of 75% of the potential near-term conifer recruitment to create and maintain desired in-stream habitat conditions for anadromous and resident fish populations.
- 4) That portion of the riparian management zone that supplies between 75% and 95% of the potential near-term large woody debris recruitment is an important source area for woody debris recruitment and is also an area in which thinning will enhance the size and/or quality of potentially recruitable trees.

REFERENCES:

- McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. *Can. J. For. Res.* 20:326-330.
- McKinley, M. 1997. Large woody debris source distances for western Washington Cascade streams. Undergraduate senior research project, unpublished report, University of Washington College of Forest Resources. 36 p.

AREA OF RESOURCE SENSITIVITY: 15

DESCRIPTOR: Riparian zones adjacent to Geomorphic Unit 6

PRESCRIPTION:

A 25-foot riparian management zone, measured from the ordinary high water mark, shall be established adjacent to the stream channel. No timber harvest is allowed within 15 feet of the ordinary high water mark. Timber harvest is permissible in the outer 10 feet of this zone under the following conditions:

- 1) a maximum of 30% of the trees within this zone greater than 4 inches in diameter at breast height may be harvested in any 50 year period;
- 2) residual trees must be evenly distributed;
- 3) harvested trees must be felled and yarded away from the stream channel.

JUSTIFICATION:

This Area of Resource Sensitivity influences channels within Geomorphic Unit 6 which includes first order channels with gradients greater than 12%. Based on information contained in the Fish Habitat and Riparian Function assessment reports, this Geomorphic Unit is limited to small, non-fish-bearing streams. In these channels, large woody debris serves as a roughness element, creates sediment storage sites, and helps to stabilize channel beds and banks (see Stream Channels report). The retention of trees adjacent to these channels is necessary to provide a recruitable supply of large woody debris to fulfill these various functions. It is assumed that providing a minimum of 50% of the potential large woody debris recruitment is sufficient to create and/or maintain desired channel characteristics.

The width of the riparian management zone (25 feet) corresponds to the distance from which 50% of the conifer large woody debris will be recruited in the near-term (10-20 years). This is based on data from McDade et al. (1990) and McKinley (1997). Although none of the riparian zones associated with this Geomorphic Unit were evaluated for woody debris recruitment potential in the Riparian Function assessment (none are Type 1-3 waters), it is assumed that most are conifer-dominated. This is based on the physical characteristics of the channels (high gradient, confined), adjacent hillslopes (relatively steep), and soils (shallow, generally well drained) which result in conditions more conducive to conifer growth.

REFERENCES:

- McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. *Can. J. For. Res.* 20:326-330.
- McKinley, M. 1997. Large woody debris source distances for western Washington Cascade streams. Undergraduate senior research project, unpublished report, University of Washington College of Forest Resources. 36 p.

AREA OF RESOURCE SENSITIVITY: 16

DESCRIPTOR: Channel Migration Zones associated with Geomorphic Units 1, 2, 3, 9 and 10

Note: only channel migration zones associated with geomorphic unit 10 appear on the Area of Resource Sensitivity map; channel migration zones associated with geomorphic units 1, 2, 3, and 9 will require field identification.

PRESCRIPTION:

No timber harvest is allowed within 45 feet of any active stream channel within the channel migration zone. In the remaining portions of the channel migration zone, timber harvest is permissible under the following conditions:

- 1) a maximum of 30% of trees within this zone may be harvested in any 50 year period;
- 2) harvest is limited to hardwood species only (i.e., no conifer removal);
- 3) the 75 largest trees per acre must be retained;
- 4) residual trees must be evenly distributed;
- 5) operations must be conducted during periods of low soil moisture between July 1 and September 30 or during periods of low soil moisture as approved by the Department of Natural Resources;
- 6) yarding of timber is limited to low impact harvest methods (i.e., shovel, cable or helicopter);
- 7) no road or skid trail construction is allowed.

JUSTIFICATION:

The channel migration zone is an area that channels have occupied in the recent past or could reasonably be expected to occupy again in the near future. This zone serves as source area for large woody debris in addition to providing critical habitat for salmonid fish species. As a result, timber harvest within this zone is limited. Large trees serve as a potentially recruitable source of woody debris, help stabilize streambanks, and help reduce flow velocities during overbank flood events, thus decreasing erosion. The conditions placed on timber harvest within this zone are intended to maintain the large majority of potential woody debris recruitment while at the same time increasing the growth and vigor of the residual post-harvest stand to provide even greater wood debris recruitment potential in the future.

No-harvest portions of the channel migration zone are intended to protect side-channels, off-channel areas, and overflow channels by providing a minimum of 75 percent of the potential large woody debris recruitment potential based on data from McDade et al. (1990) and McKinley (1997). Since much of the channel migration zone is dominated by hardwood forests, it is likely that the 45-foot no-harvest zone will supply closer to 90 percent of the potentially recruitable wood. In the remainder of the channel migration zone, limiting harvest operations to 30 percent of the stems in any 50 year period ensures the maintenance of a

residual stand that will: (1) decrease water velocities during overbank flows, (2) maintain rooting strength thereby stabilizing floodplain landforms, and (3) provide a recruitable supply of large woody debris if and when the channel migrates laterally.

AREA OF RESOURCE SENSITIVITY: 17

DESCRIPTOR:

Riparian zones adjacent to the following channel segments and/or geomorphic units: channel segments 12, 65, 66, 67, and 68 of geomorphic unit 2; channel segments 5, 7, 81, and 152 of geomorphic unit 3; channel segment 57e of geomorphic unit 8; channel segments 6, 57, 65a, and 159 of geomorphic unit 9; all of geomorphic unit 10 (mainstem North Fork Stillaguamish)

PRESCRIPTION:

Stream shade shall be retained at levels equal or exceeding those specified in WAC 222-30-040. Required shade levels shall be achieved irrespective of riparian management zone (RMZ) width or shade levels shall not be reduced below current levels.

VOLUNTARY PRESCRIPTION:

Segments 57 and 65a (non-forested riparian zones):

It is recommended that a conifer dominated riparian zone be actively reestablished adequate to supply 80% shade cover to the channel. Suggested species include western redcedar and/or sitka spruce planted at a spacing of 15 feet between trees. In areas with severe grass competition, cottonwood whips may be a more appropriate species for planting.

AREA OF RESOURCE SENSITIVITY: 18

DESCRIPTOR:

Riparian zones adjacent to channel segments 1, 53, and 54 of geomorphic unit 1

VOLUNTARY PRESCRIPTION:

It is recommended that a conifer dominated riparian zone be actively reestablished adequate to supply 83% shade cover to the channel. Suggested species include western redcedar and/or sitka spruce planted at a spacing of 15 feet between trees. In areas with severe grass competition, cottonwood whips may be more appropriate. Channel morphology indicates active channel migration within the area; when planting, one should account for possible channel migration and may consider these areas for planting.

JUSTIFICATION:

These channel segments are within agricultural areas where no commercial timber harvest is expected in the near future. As a result, only voluntary prescriptions were written to address the rule call. Target shade levels noted above were derived from Forest Practices Board Manual (page M-4).

AREA OF RESOURCE SENSITIVITY: 19

DESCRIPTOR: Road stream crossing structures that serve as partial or complete barriers to fish migration/passage

PRESCRIPTION:

Fish blockages associated with existing forest roads shall be corrected when (1) the road receives active log haul, or (2) in accordance with a five-year culvert correction plan mutually agreed upon by all interested TFW participants in the watershed administrative unit (WAU). The correction plan shall be established within six months of approval of this watershed analysis and must include an explicit timeline for remediating fish blockages associated with forest roads in the WAU.

RECOMMENDATION:

It is recommended that fish blockages associated with non-forest roads (i.e., state, county or private) be corrected to provide for fish passage. The responsible parties should work in cooperation with Tribes and WDFW to ensure that WDFW juvenile and adult fish passage standards are met or exceeded. In addition, a plan to identify and prioritize blockages should be established within one year of approval of this watershed analysis.

