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Field Guide

for

Riparian Management

Willamette National Forest

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for
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Prepared by:

Dr. Stan Gregory
Linda Ashkenas
Department of Fisheries and Wildlife
Oregon State University

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CHAPTER 1

INTRODUCTION

The Willamette National Forest (WNF) and the U.S. Forest Service (USFS) recognize that riparian areas in national forests support a wide array of resources with high economic and ecological values. Riparian areas provide clean water, fish and wildlife habitat, timber, and recreational opportunities. These multiple functions of riparian areas need to be recognized for effective land management.

This field guide summarizes site objectives and practices for riparian management in the WNF, and briefly discusses techniques to restore degraded riparian conditions. The field guide is intended to supplement the Standards and Guidelines for Riparian Management Areas. A more complete description of riparian management at harvest unit, basin, and landscape scales is provided in the Riparian Management Guide for the WNF.

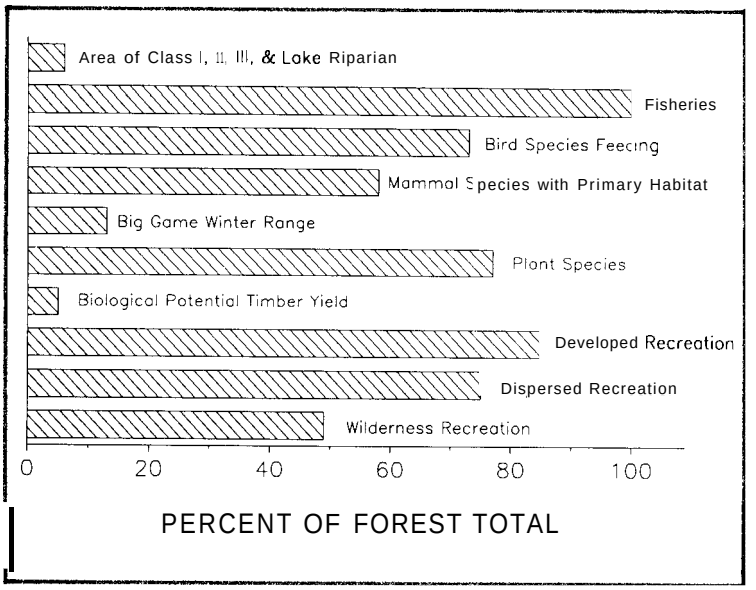
The primary objective in riparian management is protection of unique riparian resources, as established in the National Forest Management Act. U.S. Forest Service policy mandates management of "riparian areas in the context of the environment in which they are located, recognizing their unique value" (FSM 2526.021, and requires its managers to "give preferential consideration to riparian dependent resources when conflicts among land use activities occur" (FSM 2526.03).

The WNF encompasses approximately 1.7 million acres of land. Of this total, riparian areas along perennial streams lakes and wetlands comprise about 100,000 acres, or 6% of the WNF (Table 1). Despite this small acreage, riparian areas provide numerous economic, social, and ecological benefits to the Forest (Fig. 1).

Table 1. **Riparian management zone acreages** in different habitat types on the Willamette National Forest. Riparian widths include both sides of the stream; these values are used in FORPLAN. Acreage for Class IV streams was not determined.

Habitat	Length (miles)	Riparian Width (feet)	Riparian Habitat (acres)
Streams			
Class I	426	400	19,496
Class II	940	200	21,252
Class Ill	1,295	200	21,252
Class IV	6,621		
Lakes	270 (shoreline)	150	4,457
Wetlands			23,950
TOTAL			98,782

Figure 1. **Proportion of selected forest resource uses** located in riparian areas of the Willamette National Forest.



CONCEPTS & DEFINITIONS

Ecosystem perspectives of riparian areas incorporate concepts from geomorphology, terrestrial plant succession, and aquatic ecology. Riparian areas are defined as three-dimensional zones of influence between terrestrial and aquatic ecosystems (Fig 2). These zones of influence extend outward from the streambed or lakeshore and upward into the canopy of strearnside vegetation. The boundaries of riparian areas include land on which the vegetation within the zone of influence occurs.

Using this ecological approach, the WNF considers riparian areas to include the aquatic ecosystem and the adjacent terrestrial areas directly affecting the aquatic system. The influences of forests progressively decrease away from the stream, lake, or wetland. Thus, riparian areas cannot be defined by discrete lines on the ground. Specific boundaries established by the Forest Service for management practices within riparian areas are termed riparian management zones. Riparian management zones are contained within but may not necessarily include all of the riparian area (Fig 3).

Figure 2. **Three-dimensional zones of influence** for selected riparian processes, such as shading, litter inputs, and delivery of woody debris.

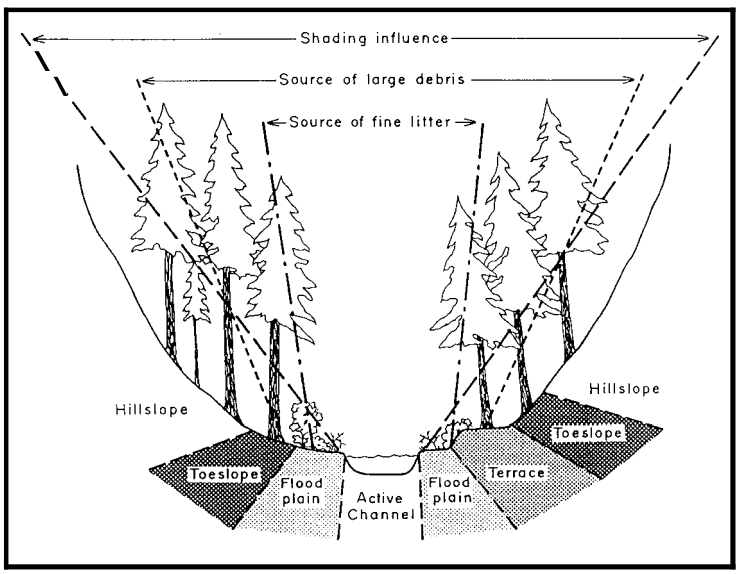
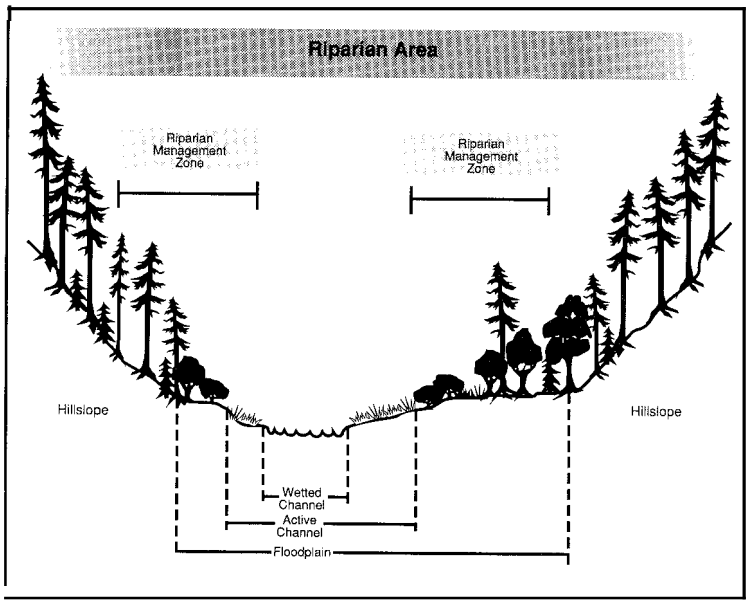


Figure 3. **Cross-section of a riparian area** and adjacent hillslope. Note that the actual riparian area may extend well up the hillslope, encompassing zones of influence for shading, litter inputs, and wood loading. The riparian management zone may be significantly narrower than the riparian area.



Selected Definitions

Active Channel
The part of the valley floor inundated annually, including low flow wetted channel and streambanks. The approximate equivalent to bankfull channel (Fig. 4).

Basin
The area of land that drains water, sediment and dissolved materials to a common point along a stream channel.

Class I Streams
Perennial or intermittent streams with one or more of the following: 1) direct source of water for domestic use; 2) habitat for spawning, rearing or migration for large numbers of fish; or 3) sufficient discharge to have a major effect on water quality of another Class I stream (Fig. 5).

Class II Streams
Perennial or intermittent streams with 1) habitat for spawning, rearing or migration of moderate though significant numbers of fish; and/or 2) sufficient discharge to have moderate influence on other Class I or II streams. Game fish are present for at least part of the year or the stream has the potential for establishment or re-establishment of a game fish population.

Class III Streams
Any perennial streams not meeting the criteria for Class I or II streams.

Figure 4. **Major landforms of a river valley.** AC - active channel; FP - floodplain; T - terrace; HS - hillslope.

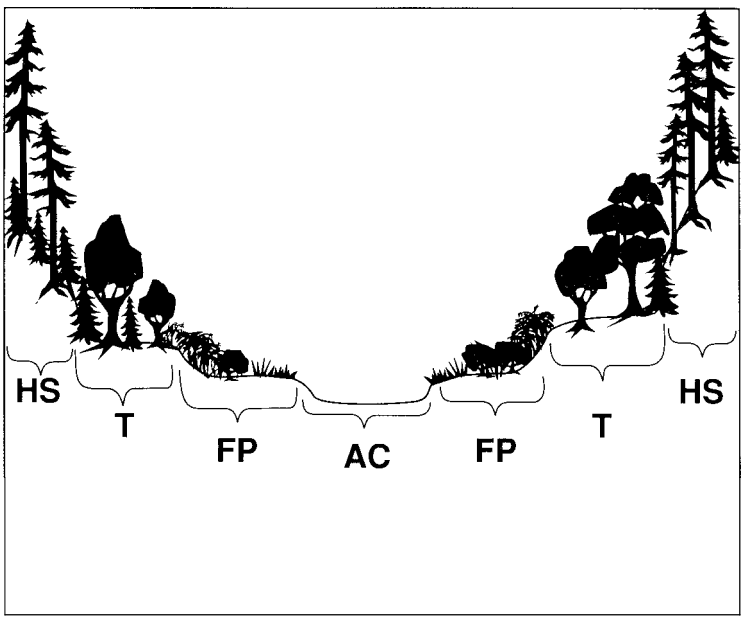
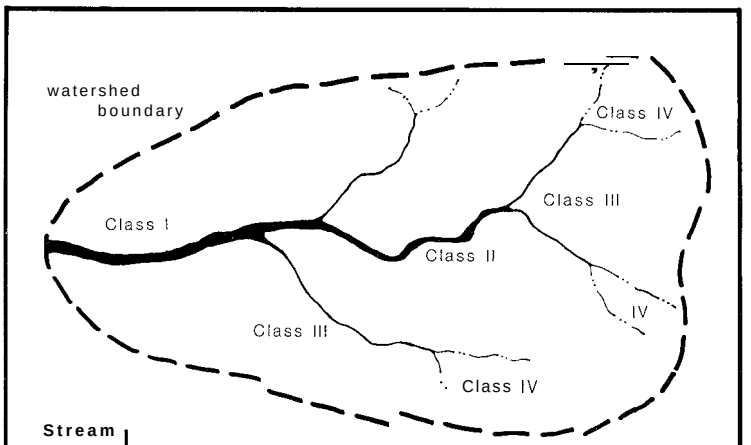


Figure 5. **The U.S. Forest Service stream classification system.**



Stream Class	Qualifying Criteria
I	municipal/ domestic supply, large volume, anadromous fishery
II	resident trout fishery, significant volume to affect Class I
III	perennial stream, no fish present
IV	intermittent flow

Class IV Streams
Any intermittent or ephemeral streams not meeting the criteria for Class **I, II,** or III streams.

Constrained Reach
A narrow valley floor limited in width by adjacent landforms, such as bedrock, hillslope, earthflows, or alluvial fans (Fig. 6). Valley walls are usually steep, and the valley floor width is generally less than two active channel widths. The stream cannot meander and is often a single, simple channel.

Cumulative Effects
Effects on the environment resulting from individually minor but collectively significant events taking place over a period of time or space. For example, increases in stream temperature occurring within an individual harvest unit may be slight, but the additive temperature increases over an entire basin may cause significant downstream warming.

Ephemeral Streams
Streams carrying water only during or immediately after a rainstorm or snowmelt. Channels are not well defined, and usually are covered with a litter layer characteristic of the surrounding forest (Fig. 7).

Floodplain
Relatively flat surfaces adjacent to active channels, formed by deposition of sediment during major flood events. Some floodplain areas are inundated only during extremely large, infrequent floods. Floodplain boundaries are defined by the break in slope between the hillsides and the relatively flat floor of the river valley (Fig. 4).

Figure 6. **Stream channels in constrained and unconstrained valleys.** Note the more complex channels in the valley with the broad floodplain. S - stream; FP - floodplain; HS - hillslope; VF - valley floor.

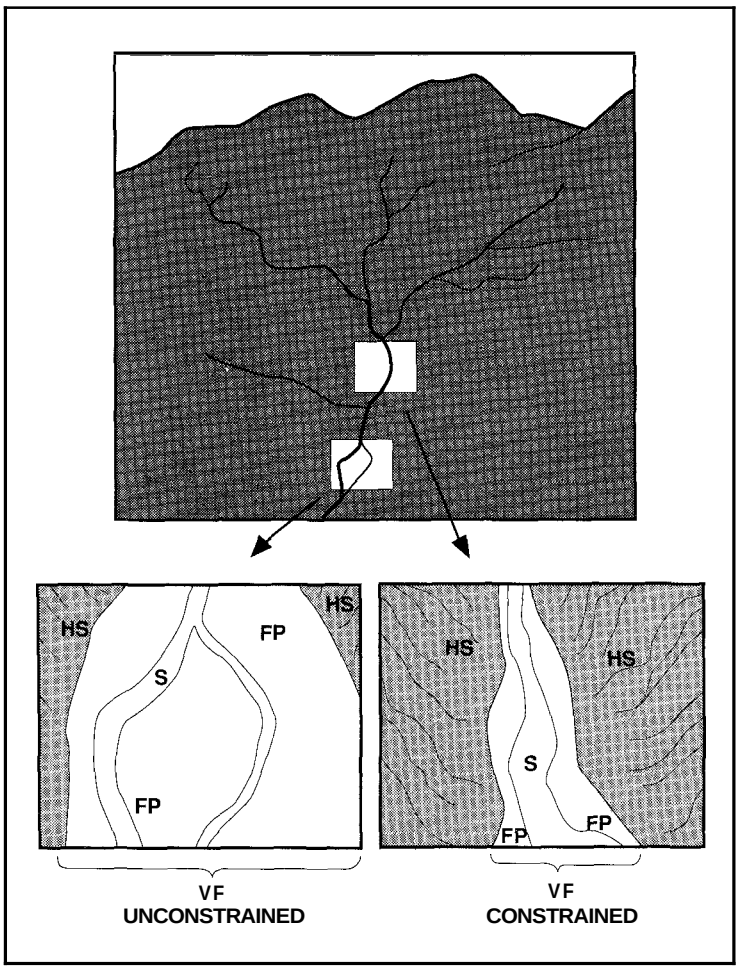
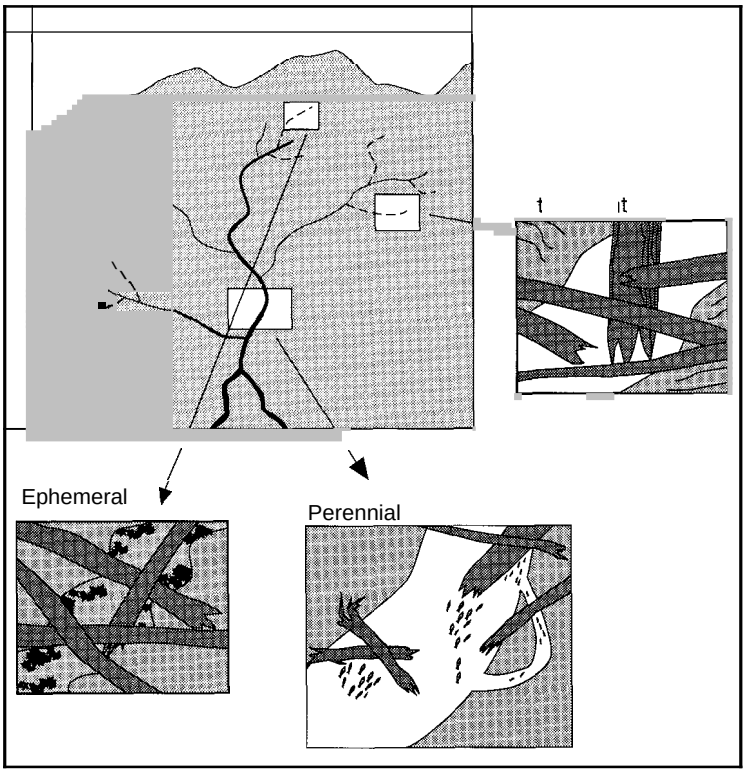


Figure 7. **Location and characteristics** of perennial, intermittent, and ephemeral streams within a drainage.



Intermittent Streams
Streams that carry water most of the year, but do not flow during part of the summer (Fig. 7). In contrast to ephemeral streams, these channels are obviously dry stream beds during periods of low rainfall.

Perennial Streams
Streams that normally flow year long and have well defined channels (Fig. 7).

Riparian Area
The aquatic ecosystem and the adjacent upland areas that directly affect it or are affected by the aquatic environment (Fig. 3). This includes streams, rivers, and lakes and their adjacent side channels, floodplains, and wetlands. The riparian area includes portions of hillslopes that serve as streamside habitats for wildlife.

Riparian Management Zone
Site-specific boundaries established to meet riparian management objectives (Fig. 3). Riparian management zones are contained within but do not necessarily include the entire riparian area.

Terrace
Sediment deposits between the valley walls and the floodplain or the active channel that are rarely inundated (Fig. 4).

Unconstrained Reach
An area of very wide valley floor with extensive floodplain surfaces. Valley floor width is generally more than two active channel widths. The stream can braid and meander to form complex channel and valley floor structures (Fig. 6).

Valley Floor
The part of the landscape containing the stream, floodplain, and terraces.

Wetland
Areas covered by shallow water or periodically saturated by the water table. Wetlands generally have wetted soils and support plant communities tolerant *of* water-saturated soils.

Woody Debris
Dead woody material usually composed of boles and large branches. Various terms, such as large woody debris (LWD), coarse woody debris (CWD), and large organic debris (LOD), have been used *to* describe this material.

Class	Diameter	Length	Source
Large	>20 in	>33 ft	Boles
Small	4-20 in	3-33 ft	Branches/Boles
Fine	<4 in	**<3** ft	Twigs/Slash

CHAPTER 2

HARVEST UNIT MANAGEMENT

Site-specific riparian management prescriptions can be developed after basin management objectives are identified. The WNF Standards and Guidelines are designed to ensure many of the functions and attributes of riparian areas. A single prescription or cookbook approach is not appropriate for riparian management. To be most effective, current and desired future conditions for the site should be considered.

MANAGEMENT OBJECTIVES

Site planning must meet the requirements of the National Environmental Policy Act and all Executive Orders directed at riparian resources (EO 11988 and 11990). Riparian management zone guidelines for streams, lakes, and wetlands of the WNF are summarized in Table 2. Stream size and flow regime strongly influence both unit and basin management objectives. Consequently, riparian management of streams is based in part on stream class.

Evaluation of riparian areas within a site should consider specific objectives for:

- water quality
- active channel and floodplain
- woody debris
- fish
- wildlife
- vegetation
- recreation

Table 2a **Perennial streams and rivers:** summary of standards and guidelines for riparian management zones

Riparian Management Guidelines	Class I	Class II	Class III	
			Stable[1]	Moderate[1] & Unstable
Location				
Range of width from active channel[2]	150-400 ft	100-200 ft	50-100 ft	75-125 ft
Average width[3]	200 ft	100 ft	75 ft	100 ft
Objectives				
Extent of 100-vr floodplain within RMZ[4]	100%	100%	100%	100%
Temperature[5]	M & E	M & E	M & E	M & E
Input of woody debris	100%	90%	75%	90%
Input of terrestrial food resources	100%	100%	100%	100%
Bank stability	100%	100%	100%	100%
Operations				
Overstory vegetation remaining within RMZ	100%	100%	100%	100%
Understory vegetation remaining within RMZ	100%	100%	100%	100%
Directional falling along RMZ	Yes	Yes	Yes	Yes
Yarding suspension over banks	Full	Full	Full	Full
Yarding and line corridors	Yes	Yes	Yes	Yes
Stream cleanout[6]	NO	NO	NO	NO
Salvage within RMZ[7]	NO	NO	NO	NO

1 Stability ratings. See Appendix II for soil types and slope stability analysis.
2 These riparian widths represent the horizontal distances commonly required to meet management objectives.
3 These widths represent the expected averages and were used in the FORPLAN model for the Forest and Resource Management Plan
4 100-yr floodplains are assumed to be less than 400 ft wide on a single bank. Where floodplains extend beyond 400 ft, specific site conditions will be evaluated relative to the Executive Order on Floodplain Development.
5 Objectives for shade are to maintain or enhance water temperatures. At a minimurn. 80% of the existing shade will be maintained.
6 Stream cleanout is permitted immediately upstream of culverts.
7 Salvage within an RMZ after catastrophic events should be considered only to restore degraded riparian habitat and benefit riparian-dependent resources Evaluate specific site conditions.

Table 2b. **Intermittent and ephemeral streams:** summary of standards and guidelines for riparian management zones

Riparian Management Guidelines	Class IV				
	Intermittent			Ephemeral	
	Stable[1]	Moderate[1]	Unstable[1]	Stable[1] & Moderate	Unstable[1]
Location					
Range of width from active channel[2]	0 ft	25-50 ft	25-100 ft	0 ft	25-100 ft
Average width[3]	0 ft	30 ft	50 ft	0 ft	50 ft
Objectives					
Provide floodplain functions[4]	NO	NO	NO	NO	NO
Temperature[5]	M & E	M & E	M & E	NO	No
Input of woody debris	0%	20-40%	30-50%	0%	0%
Input of terrestrial food resources	None	Partial	Partial	None	Partial
Bank stability	Locally Reduced	100%	100%	Locallv Reduced	100%
Operations					
Overstory vegetation remaining within RMZ	None	Partial	All	None	Partial
Understory vegetation remaining within RMZ	Partial	Partial	All	Partial	Partial
Directional falling along RMZ	Yes	Yes	Yes	No	Yes
Yarding suspension over banks	Full-Partial	Full-Partial	Full	Partial	Partial
Yarding and line corridors	Yes	Yes	Yes	Yes	Yes
Stream cleanout[6]	No	NO	No	NO	NO
Salvage within RMZ[7]	NO	NO	NO	NO	No

1 Stability ratings. See Appendix II for soil types and slope stability analysis
2 These riparian widths represent the horizontal disfances commonly required to meet management objectives
3 These widths represent the expected averages and were used in the FORPLAN model for the Forest and Resource Management Plan.
4 Intermittent and ephemeral channels are assumed to have no floodplains.
5 Intermittent channels may flow during summer when stream temperatures are critical. Consider retention of vegetation for shade.
6 Stream cleanout is permitted immediately upstream of culverts.
7 Salvage within an RMZ after catastrophic events should be considered only to restore degraded riparian habitat and benefit riparian-dependent resources. Evaluate specific site conditions.

Table 2c. **Lakes and wetlands:** summary of standards and guidelines for riparian management zones

Riparian Management Guidelines	Lakes	Wetlands
Location		
flange of width from mean high water[1]	500-700 ft	150-600ft
Average width[2]	600 ft	NA
Objectives		
Extent of 100-yr floodplain within RMZ	100%	100%
Temperature[3]	M&E	M & E
Input of woody debris	100%	100%
Input of terrestrial food resources	100%	100%
Bank stability	100%	100%
Operations		
Overstory vegetation remaining within RMZ	100%	100%
Understory vegetation remaining within RML	100%	100%
Directional falling along RMZ	Yes	Yes
Yarding suspension over hanks	Full	Full
Yarding and line corridors	Yes	Yes
Debris cleanout	No	No
Salvage within RMZ[4]	No	No

1 These riparian widths represent the distances commonly required to meet management objectives.

2 These widths represent the expected averages and were used in the FORPLAN model for the Forest and Resource Management Plan. Wetland areas have not been delineated, and average widths were not established.

3 Objectives for shade are to maintain or enhance water temperatures. At a minimum, 80% of the existing shade will be maintained.

4 Salvage within an RMZ after catastrophic events should be considered only to restore degraded riparian habitat and benefit riparian-dependent resources. Evaluate specific site conditions

Water Quality

Water quality objectives are designed to:

- minimize increases in water temperature
- minimize increases in sediment transport
- prevent decreases in dissolved oxygen.

In all salmonid fish-producing streams, stream temperature must be maintained at or below 58^0F (Oregon DEQ Standards). If the temperature is 56^0F or less, a 2^0F increase is permissible. At stream temperatures of 58^0F or more, no measurable increases are allowed. In non-salmonid fish-producing waters, no increases above 64^0F are allowed.

No more than a 10% cumulative increase in natural stream turbidity is allowed (Oregon DEQ Standards). Compliance with this standard is based on annual patterns of turbidity, not simply the immediate post-operation conditions.

Dissolved oxygen concentrations cannot decrease to less than 6 mg 0_2/1 in salmonid-bearing streams. In addition, the dissolved oxygen concentration shall not be less than 90% of saturation at seasonal low or less than 95% of saturation in spawning areas during spawning, incubation, hatching, and fry stages of salmonid fishes (Oregon DEQ Standards).

To meet these standards on all Class I and II streams, water quality of upstream Class III and IV channels must be maintained. During summer low flows, small streams and areas of subsurface flow (i.e., springs,

floodplains, and wetlands) help provide cool, well-oxygenated water to downstream reaches.

Water quality objectives can usually be met through stringent riparian area protection. Where standards cannot be met or in emernencies, exceptions or permits must be obtained from the Oregon Department of Environmental Quality.

Use of forest chemicals (e.g., fertilizers, herbicides, road oils) near riparian areas is discussed by specific WNF and USFS Standards and Guidelines.

Channel and Floodplain

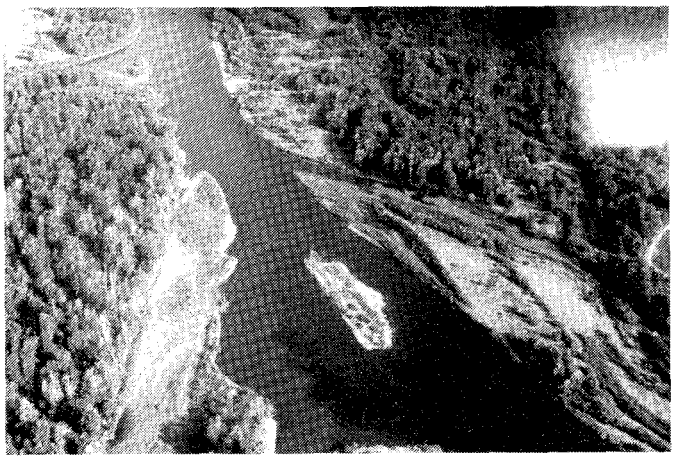
The overall objectives for channels and floodplains are to:

- maintain channel complexity and stability
- maintain full floodplain functions
- minimize risks of cumulative effects

In Class **I, II,** and III streams, the geomorphic objectives are: 1) maintain physical characteristics of the stream channel and floodplain, and 2) minimize sediment delivery to the channel.

Management of Class IV streams should: 1) maintain local geomorphic stability, 2) impede downstream movement of debris flows, and 3) provide large woody debris to create stable channel structure in downstream deposits.

Figure 8. **Riparian forests** of the active channel and floodplain of the McKenzie River.



Riparian areas around lakes are managed to maintain shoreline integrity. Riparian management should also retain the complex edges often associated with wetlands.

Active Channels

Management should not change existing stream channel characteristics of:

- width and depth
- stream course
- channel gradient
- stream bed topography
- streambed and bank materials
- large woody debris

Floodplains

Maintenance of floodplain functions is an extremelv important and freauentlv overlooked component of riparian management. Floodplains are formed by deposits of sediment during extremely high flood events (Fig. 8). Removal of floodplain vegetation through harvest or road construction makes these areas vulnerable to massive erosion during floods.

The riparian management zone should include the entire floodplain. Failure to do so will seriously jeopardize riparian management objectives during major floods. The Forest Service is required by Executive Orders 11988 and 11990 (FSM 2527.03) to:

"Recognize floodplains and wetlands as specific management areas."

"Avoid adverse impacts which may be associated with the occupancy and modification *of* floodplains and with the destruction, loss, or, degradation of wetlands."

"Not permit floodplain development and new construction in wetlands wherever there is a practicable alternative."

Woody Debris

Of all the ecological functions of riparian areas, the process of woodv debris loading into channels, lakes, and floodplains requires the longest time for recovery after harvest (Fig. 9). Most future riparian functions will be guaranteed if natural abundances and distributions of all sizes of woody debris are maintained in streams, lakes, floodplains, and lower hillslopes.

For large woody debris management alone, riparian management zone widths of approximately 100 feet are required to maintain long-term inputs to streams and lakes (Fig. 10). Additional consideration of floodplain functions and wildlife habitats may require wider management zones.

Figure 9. **Years required for ecological recovery** of riparian functions after timber harvest.

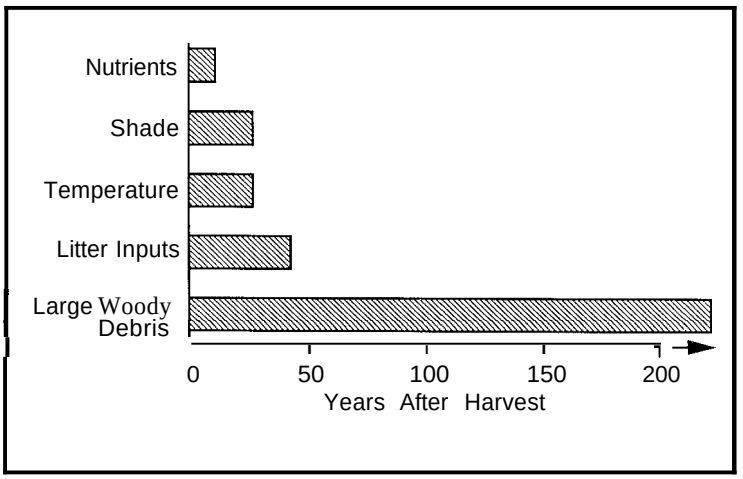
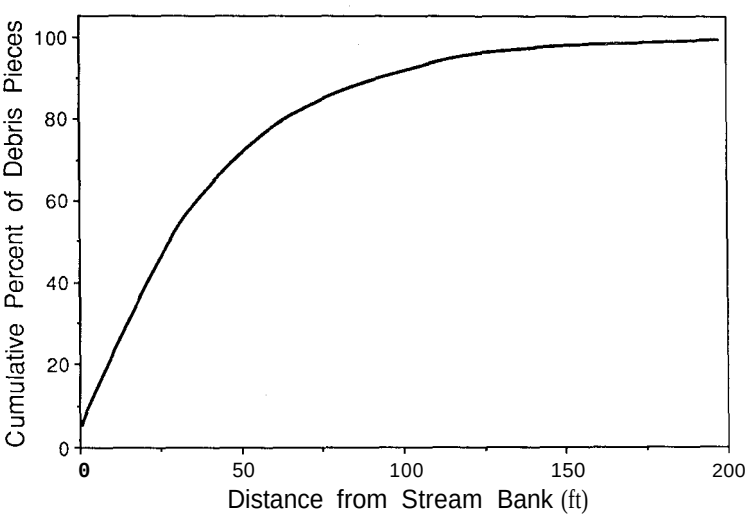


Figure 10. **Proportion of total loading of woody debris** from the riparian forest as a function of the distance from stream edge (adapted from McDade et al. 1989).

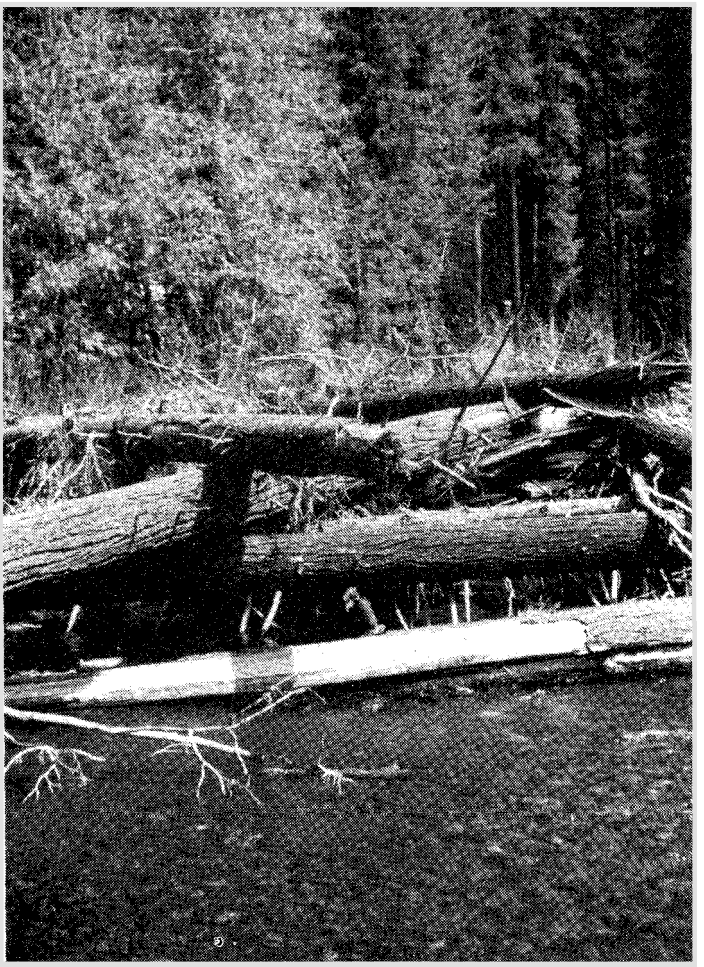


The WNF strives to maintain future sources of woody debris in perennial streams and lakes through a policy of no programmed narvest in riparian management zones (Fig. 11). However, woody debris also is important in small ephemeral and intermittent Class IV streams. In these small channels, woody debris stabilizes the stream bed and creates new habitat within debris flows when they occur.

Stream Clean-up

Where timber harvest is permitted along streams (e.g., some Class IV's), large amounts of woody debris may accumulate locally. Logging slash has the potential to retard streamflow, reduce dissolved oxygen concentrations, dam culverts and bridges, and initiate landslides and debris flows. At the same time, large pieces of wood can add to the physical stability of the channel, and small debris is redistributed and stored by high flows. Appropriate riparian management avoids substantial delivery of wood, and excessive debris loading should not occur.

Figure 11. **Massive accumulations of logs** are natural features of streams that contribute to the stability of channels and floodplains.



Fish

The primary objective for fish management on the WNF is to maintain the quality of habitat and food supply for all anadromous and resident fish populations. Historically, there were some 257 miles of stream habitat accessible to anadromous fish on the WNF. Currently, there are 119 miles of anadromous and 1,160 miles of resident fish habitat. These streams and rivers, as well as the 22,500 acres of natural lakes and reservoirs should be managed to provide:

- spawning gravels of specific size ranges
- low rates of sedimentation
- rearing areas for young fish (complex side channels, backwaters, and shallow edges; see Fig. 12)
- cover and food resources for adult fish (pools, debris jams, stable undercut banks)
- refuge from floods and predators (large woody debris, backwaters, and side channels).

Good water quality is critical for fish production. Water quality must be protected or enhanced, both in lakes and streams actually containing fish (Class I and 11) as well as smaller tributaries to fish-bearing waters (Class III and IV).

Figure 12. **Backwater and edge habitat** created by wood and boulders along stream margins.

Wildlife

A fundamental objective of riparian management is to maintain wildlife species diversity, habitat, and migration and travel corridors. Riparian management zones established for water qualitv and fisheries needs may not meet wildlife habitat requirements. Because our knowledge of wildlife use of riparian areas is limited, riparian management zones should be designed to ensure diverse types and amounts of habitat.

Specific consideration should be given to:

- preserving a complex, multi-layered canopy for structural diversity
- protecting snags and adjoining forest, particularly those used by species such as eagles or ospreys
- ensuring downed woody debris cover for small mammals, amphibians and reptiles
- protecting beaver dams and bank dens
- maintaining dense cover required for nesting and fawning
- protecting ponds, seeps, and springs, which are often important water sources for wildlife
- protecting lakeshores or streambanks used for nesting areas by waterfowl species.
- preserving continuous migration routes for species such as elk.

Vegetation

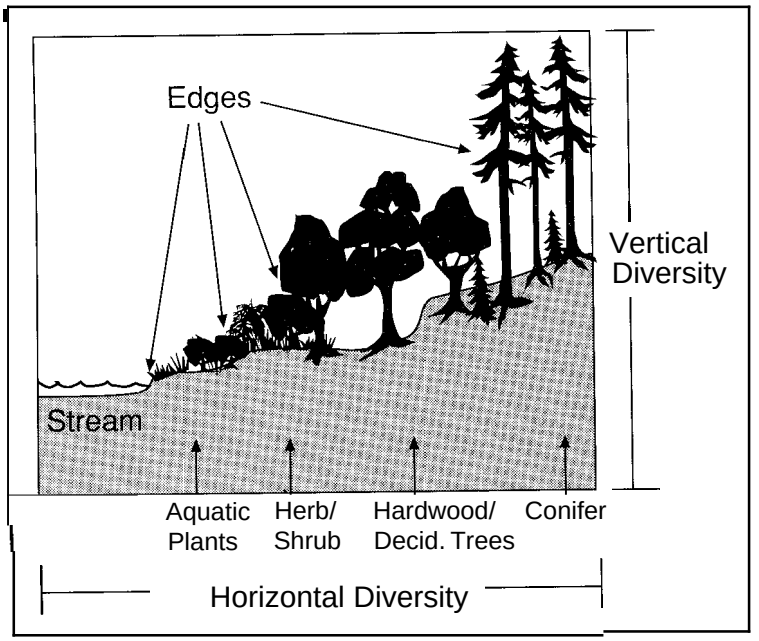
Streamside stands in the WNF contain approximately twice the number of species found in upslope forests. The main objectives of riparian vegetation management are to maintain the species diversity, age composition, and structural complexity of riparian forests (Fig. 13).

In addition to sustaining the plant species diversity in riparian areas, vegetation management should retain the structural characteristics of different canopy layers along streams and lakes. Management should maintain existing snags and snag sources. Harvest practices should minimize changes in riparian microclimate and soil moisture conditions so recruitment of young plants will not be decreased. Future responses of riparian plant regeneration, growth and mortality to current management practices are uncertain.

Recreation

Riparian areas are among the most heavily used recreation sites in the Willamette National Forest. Present and future recreational opportunities (e.g., hiking, fishing, camping, boating) should not be impaired by management activities. To this end, visual quality, user access, unique features, and future recreational potential should be evaluated for individual harvest units. Influence of harvest activities on recreational values of adjacent areas should be considered.

Figure 13. **Horizontal and vertical diversity** created by the normal sequence of plant communities extending from the active channel to the lower hillslopes.



SITE PRACTICES

Site prescriptions should be designed to achieve basin goals and long-term conditions desired for the site. The major components of riparian management for specific harvest units include:

- habitat type classification
- layout
- vegetation management
- woody debris management
- logging systems
- timing of activities

Habitat Type Classification

Habitat class for a harvest unit must be determined as the basis for developing the site prescription. Specific riparian management guidelines have been developed for major types of aquatic habitats (Management Area 15): streams, wetlands, and lakes.

Streams and rivers include both perennial and intermittent flowing waters. Four major classes of streams are recognized:

Class I streams - Perennial or intermittent streams that: 1) serve as the direct source of water for domestic use (cities, small communities, recreation sites with more than 25 users); 2) provide habitats for either spawning, rearing, or migration of large numbers of fish; and/or **3)** contain sufficient flow to have a major influence on water quality of another Class **I** stream.

Class II streams - Perennial or intermittent streams that: 1) provide habitats for either spawning, rearing, or migration for moderate though significant numbers of fish; and/or *2)* contain sufficient flow to have a moderate influence on water quality of a downstream Class I or II stream.

Class III streams - All other perennial streams that do not meet the criteria for Class I or II streams.

Class IV streams - All other intermittent or ephemeral streams that do not meet the criteria for Class I, II, or III streams.

Shallow wetlands include ponds, swamps, marshes, bogs, and wet meadows and the adjacent riparian area. They support vegetation or aquatic life requiring permanently or periodically saturated soil conditions for growth and reproduction (FSM 2527.05).

Lakes include major bodies of standing water represented on topographic maps of the Forest (either USGS quadrangles or National Forest maps). They include both natural lakes and man-made reservoirs.

Correct classification is important because habitat type is a major determinant of riparian management zone boundaries. In most cases, the WNF has already determined stream class for major perennial streams. In smaller headwater streams, existing information on presence of fish or type of flow regime may be inadequate. The site must then be reviewed on the ground to determine stream class.

Criteria for distinguishing Management Areas are contained in the Riparian Standards and Guidelines. Additional criteria for identifying riverine wetlands are described in *Federal Manual for identifying and Delineating Jurisdictional Wetlands* and in *Classification of Wetlands and Deepwater Habitats of the United States.*

Layout

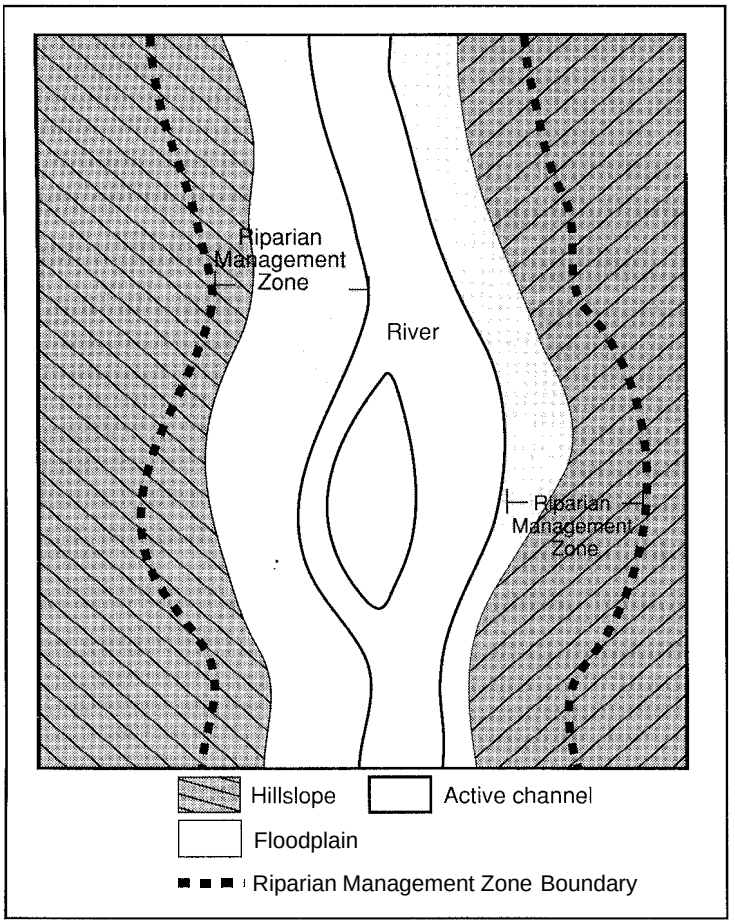
Harvest unit layout must maintain riparian continuity within the basin and preserve riparian floodplain functions. In unit layout, the location of riparian management zone boundaries, roads, and landings are established.

Riparian Management Zone Boundaries

Delineating the boundaries of the riparian management zone will largely determine the effectiveness of subsequent management to meet riparian objectives. The following sequence of decisions is required to establish boundaries of riparian management zones:

- identify floodplain boundaries
- locate margins of active channels and shorelines
- establish riparian management zone boundaries
- modify boundaries to reduce blowdown risk.

Figure 14. **Layout of a riparian management zone** along a stream with complex channel and floodplain.



Floodplain Boundaries

The entire floodplain should be included within the riparian manaaement zone (Executive Orders 11988 and 11990; FSM 2527.03) (Fig. 14). The topographic break in slope between hillsides and the relatively flat floor of the river valley defines floodplain boundaries. Several floodplains of increasing heights may occur between the active channel and the hillslope. Floodplain soils and substrates are characterized by rounded edges on gravels, cobbles, or boulders from being tumbled by streams. Vegetation may change in age or composition at floodplain edges. However, many floodplains have forests as old or older than upslope stands.

Floodplain boundaries (100-year flood recurrence interval) have been identified by the state of Oregon for all major rivers and lakes. Small, deeply incised streams frequently lack floodplains.

Floodplains may not exist along non-riverine wetlands and lakes. In the absence of floodplains, historical high water levels should be considered. They may be indicated by evidence of erosion by wave action, reduced plant cover, or sharp transitions in plant composition.

Active Channel and Shoreline Boundaries

After floodplains have been considered, widths of riparian management zones are established along active stream channels. Delineation of the riparian manaaement zone starts at the edge of the active channel or mean high water level and extend horizontallv on both sides.

Active channels consist *of* all portions of the stream channel carrying water at normal high flows, not just the current wetted channel. This includes side channels and backwaters which mav not carrv water duringl summer low flow. All islands and gravel bars are part of the active channel and not Dart of the riparian management zone.

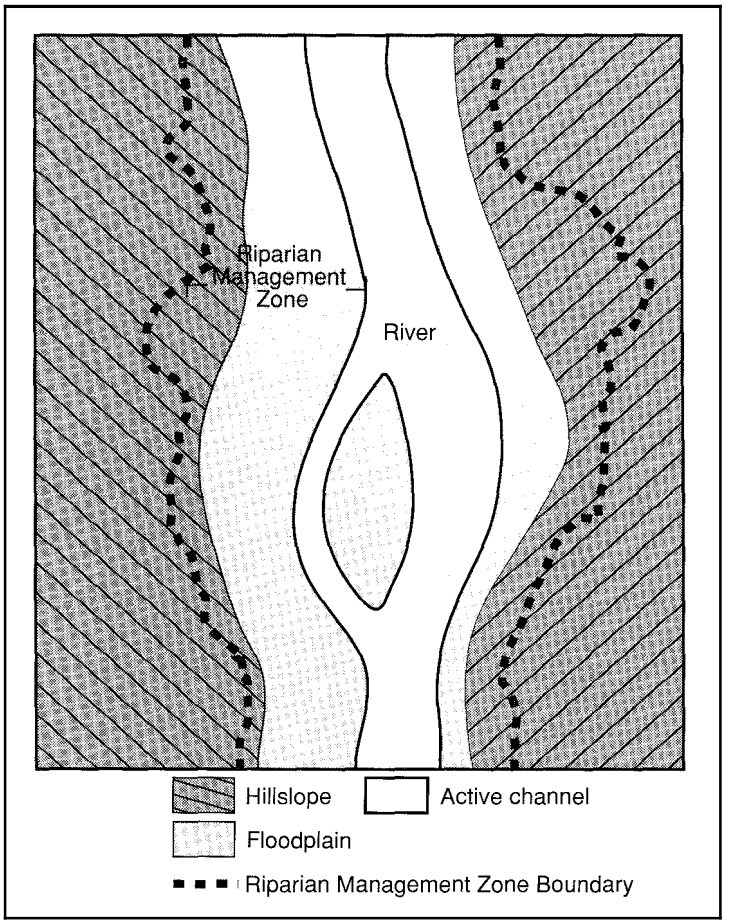
Active channel boundaries are indicated by abrupt topographic breaks where frequent channel scour has steepened streambanks. Frequently, plant abundance is reduced and communities are dominated by herbs and forbs.

Riparian management zones around wetlands and lakes should be measured from the mean annual high water level. In wetlands, this zone is difficult to identify: breaks in plant community structure and topographic features should be used. In lakes, it is indicated by evidence of recent wave action and absence of extensive plant cover.

Riparian Management Zone Boundaries

For optimal management of riparian resources, riparian management zones should have variable widths delineated at ecoloaical boundaries, not at arbitrarv distances from the stream, lake or wetland (Fig. 15). Consideration of natural topographic irregularities can both protect riparian resources and simplify harvest unit layout. Straight, uniform riparian management zones resembling picket fences should be avoided. Locally within a unit, boundaries may be less than the recommended average width, but should not be reduced to the point that continuity of riparian areas is lost.

Figure 15. **Riparian management zone with variable-width boundaries.** Note that the floodplain is entirely contained within the riparian management zone.



Widths of boundaries described for aquatic habitats delineate the area intended for all riparian management activities. Riparian management boundaries are summarized in Table 2. Guidelines for widths are based on horizontal distances; see Appendix II for conversions from horizontal distance to slope distance.

Class I and II Streams

Management zones along Class I streams may range in width from 150 to 400 feet horizontally on both sides of the active channel. Widths of riparian management zones along Class II streams range from 100 to 200 feet. In most cases, these distances will encompass the entire 100-year floodplain. On some large Class I streams, a portion of the floodplain may extend beyond the 400-foot riparian management zone. This portion of the floodplain also will be managed in accordance with Executive Orders pertaining to floodplains.

Class III Streams

Riparian management zones on Class III streams will vary depending on the soil stability rating (see Appendix I for definitions). Those streams on soils classified as stable will have a riparian management zone ranging from 50 to 100 feet horizontally on both sides of the active channel. Those Class III streams on moderately stable or unstable soils will require a wider management zone, ranging from 75 to 125 feet.

Fish may move into small perennial and intermittent streams during certain seasons for spawning, rearing, or winter refuge. Tributary junctions with Class I or II streams should be closely examined for fish use. Areas of small perennial and intermittent streams that are

important seasonally for fish habitat are classified as Class I or II streams and are managed accordingly.

Class IV Streams

Delineation of riparian management zone boundaries in Class IV streams depends on the soil stability rating. Wider riparian management zones are required on streams in watersheds with unstable soil types (see Appendix I). The streamside boundary *of* the riparian management zone should begin at the slope break for Class IV streams. Where timber harvest is permitted to the stream's edge, boundaries are established for other management activities (e.g., understory vegetation, directional falling).

In watersheds with stable and moderately stable soils, riparian management practices are designated for a zone ranging from 25 to 50 feet wide horizontally on both sides of the active channel, in both intermittent and ephemeral Class IV streams. In watersheds classified as unstable, riparian management zones range from 25 to 100 feet wide horizontally.

Lakes

To maintain all riparian functions, including recreation, lakes have a riparian management zone ranging from 500 to 700 horizontal feet, but generally averaging 600 feet. This distance may be less if an adjacent ridgeline creates a logical topographic boundary.

Wetlands

Small wetlands (e.g., springs, seeps, ponds, bogs, marshes, wet meadows) vary greatly. Such sites are evaluated on an individual basis. Riparian management zones can range from 150 to 600 feet, and frequently will vary in width within a given site.

Unique Local Habitats

Unique riparian resources, such as small springs, seeps, osprey nest trees, or sites of active beaver use, frequently exist outside average riparian management zone boundaries. In these instances, managers should consider modifying boundaries to include such areas.

Boundary Modification to Reduce Blowdown

The abrupt break in tree height between riparian management zones and upslope harvest units increases their susceptibility to windthrow, Catastrophic blowdown of the majority of trees within the riparian management zone will result in a more abrupt and pulsed loading of debris than intended.

The stability of riparian management zones in the western Cascades is correlated with seven major variables (Steinblums et al 1984):

- distance to uncut forest in wind direction
- change in elevation from RMZ to ridge
- distance to major ridge in wind direction
- stream aspect
- elevation of RMZ
- visual estimate of natural stability
- timber volume and site moisture class.

In the western Cascades, western red cedar generally is the most windfirm, followed by western hemlock, Douglas-fir and true firs, although this pattern may vary locally.

Layout of riparian management zones can be modified to reduce risk of blowdown. The boundaries can be positioned close to natural windbreaks (e.g., mature forests, ridgelines, rock outcrops) and can be blended into upslope patches of mature trees within the harvest unit. Areas of maximum width of riparian management zones can be shifted upstream or downstream to take advantage of shelter created by adjacent streamside forests.

Road Design and Location

Road failures and road-associated landslides contribute more sediment to riparian areas than any other management activity. Road failure has been a major cause of debris torrents in streams of the WNF. Sound road location and construction methods can significantly reduce potential for long-term cumulative effects. Roads with high use during rainy portions of the year should be constructed and maintained to minimize sedimentation increases. Proper location of roads adjacent to riparian management areas and on upslopes is a crucial component of effective riparian management.

- Minimize road construction on floodplains.
- Locate roads outside the riparian area.
- Limit stream crossings to areas where no practical alternative is available.
- Put temporary spur roads to bed after harvest.
- Limit use of equipment in the stream channel and riparian areas.

- Consider additional surface, fill, and drainage stabilization measures for roads contributing sediment to Class I or II streams.

- Consider closure or putting existing roads to bed in areas of unstable soils.

- Construct and maintain all roads and structures to minimize direct or indirect additions of sediment to streams.

- Sidecast and end haul material should not enter the riparian management zone, except where road entry is intended.

- Use water bars and other erosion control structures to prevent sediment delivery.

- Design culverts and other stream crossings to maintain fish passage on fish-bearing streams.

- Restrict in-stream construction activities to specified flow periods.

- Schedule dust oil application to minimize direct or indirect delivery into streams, lakes and wetlands.

Landing Location

Landings should always be located outside riparian areas and beyond a point where sidecast could enter the riparian area. Sites should be selected on the least amount of excavation required and potential erosion.

Landings should be located as far from riparian areas as possible if logs are yarded through the management zones. The proportion of a riparian management zone affected by cable corridors for a specific length of stream is reduced as the landing is placed farther from the stream.

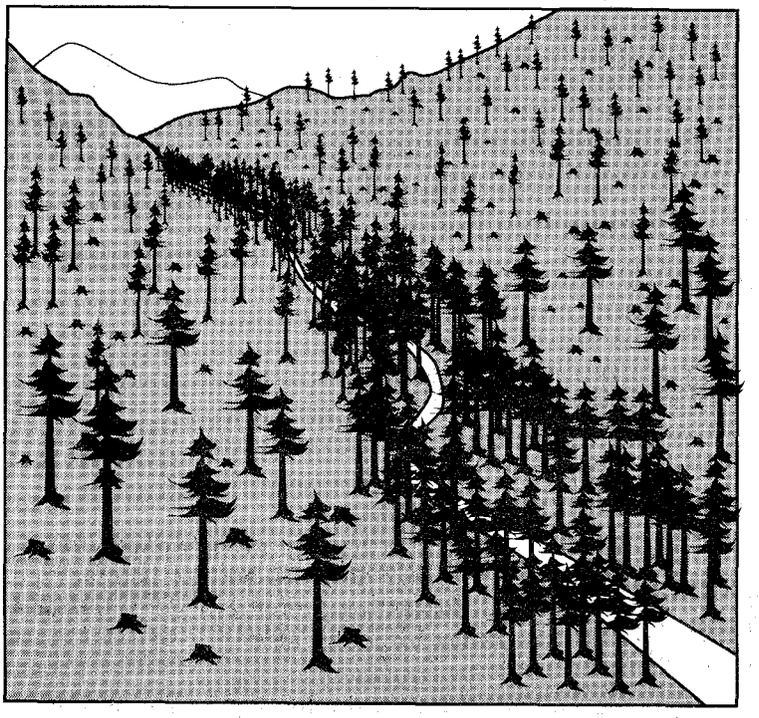
Vegetation Management

Timber Harvest

The levels of timber harvest programmed within riparian management zones differ by aquatic habitat type. Programmed timber harvest and other practices in riparian management are summarized in Table 2.

No timber harvest is programmed from riparian management zones on Class I, II and III streams, intermittent Class IV streams in unstable watersheds, lakes, or wetlands (Fig. 16). This policy is designed to ensure that management objectives for riparian-dependent resources will be achieved.

Figure 16. **A no-harvest riparian management zone** along a Class IV stream in an unstable watershed.



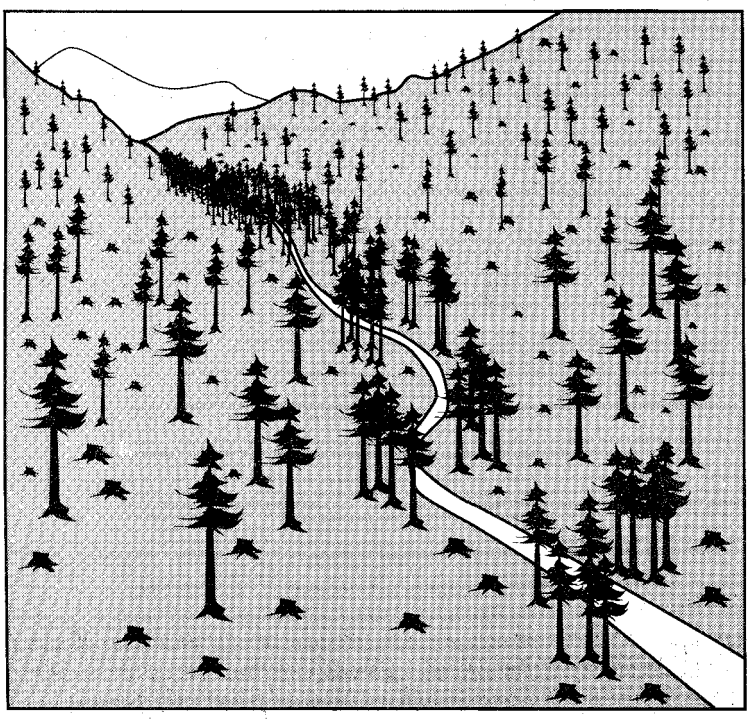
Partial harvest of vegetation **(<50%** of stand in the riparian management zone) is permitted on: **1)** intermittent Class IV channels in moderately stable watersheds and **2)** ephemeral Class IV streams in unstable watersheds. Trees should not be harvested in the immediate vicinity of locally unstable areas, and trees in riparian ares can be partially harvested in downstream reaches (Fig. 17). Trees left within areas of partial harvest should be distributed in locations that maximize the resistance to debris flows and floods.

Complete harvest of overstory vegetation is permitted in: **1)** intermittent Class IV streams in watersheds with stable soils; **2)** ephemeral Class IV streams in watersheds with stable or moderately stable soils.

Salvage

In general, no timber should be salvaged from any riparian area of the WNF. Given the numerous functions and benefits of riparian vegetation and woody debris, there is no reason to remove salvaged timber from riparian areas. Salvage in riparian areas is generally detrimental to both the site and the basin.

Figure 17. **Partial harvest** in a riparian management zone along a Class IV stream. Note the occurrence of both individual trees and clumps downstream of the leave area around the unstable site.



When live trees are damaged or killed by blowdown, wildfire, disease, or insect outbreaks, merchantable trees are frequently salvage harvested. However, in riparian areas these trees should be retained to provide future snags and downed woody debris.

Trees that present safety hazards for recreational or commercial users may be felled to eliminate the hazard, but should be left on the ground or in the stream channel. Under no circumstances should they be removed from the riparian area.

Blowdown in Riparian Management Zones

Blowdown is not a management failure and downed trees should not be removed from riparian management zones. The zone was designed for the trees to die and fall into the stream channel. Despite careful planning, a large portion of remaining riparian vegetation may blow down on some units. The blowdown event accelerates debris loading, but it is NOT a disaster from an ecological view, just a change in timing.

If catastrophic blowdown creates a detrimental situation for riparian-dependent resources (e.g., major debris jams that block anadromous fish migration), modification of the debris accumulation can be considered for a specific case. Partial debris removal is preferable to complete salvage. Managers should modify debris accumulations as little as possible.

Shade Management

Along those Class IV streams where complete or partial harvest is permitted, understory vegetation should be maintained to the maximum extent possible for shade to maintain cool water temperatures. In all harvest operations, removal of vegetation for safety paths is required around a tree to be felled.

Silviculture

Since timber harvest is not programmed in most riparian management zones of the WNF, immediate silvicultural regeneration of the riparian area is not required in most cases. In riparian management zones with partial harvest, vegetation should be replanted. Species composition of the pre-harvest stand should be reestablished.

In cases where there is no evidence of regeneration, active silvicultural management may be required (e.g., replanting, stand manipulation, broadcast burning, fertilization). In addition, riparian areas degraded because of past practices or natural events can benefit from silvicultural management (see Chapter IV).

Large Woody Debris Management

Large woody debris is absolutely crucial to numerous riparian functions over both the short-term (seasons to decades) and long-term (decades to centuries) life of the forest. The policy of no harvest in the riparian management zone is designed to guarantee the long-term supply of woody debris to wetlands, streams, lakes, and floodplains of the WNF. If stream clean-up is prescribed, large woody debris present before harvest should remain in place.

Residue Management

Logging slash should not present a problem in wetlands, lake margins, perennial stream channels and unstable Class IV streams because no timber harvest is programmed within these riparian management zones. Direct inputs of logging slash should be minimal, and riparian management zones will intercept slash from upslope harvest units.

Timber harvest in areas immediately adjacent to streams (some Class IV's) often adds quantities of slash and large debris to channels. Techniques that minimize debris loading into the channel should be used (e.g., directional falling, log suspension, minimal site disturbance; see Table 2).

Land managers should be cautious about removing slash from any riparian management zone, stream channel, lake or wetland. If residue accidentally accumulates in riparian zones, it should be left in place and not piled. No clean-up should be prescribed for any stream, lake or wetland under normal conditions.

Broadcast burning normally should not be prescribed to extend into the riparian management zone. Prescribed use of fire within the zone may be recommended to maintain some plant communities.

High Risk Areas

In rare instances, residue will need to be removed from the site to prevent damage to downstream resources or impairment of water quality. Areas with shallow soils, unstable headwalls, or tension cracks in the soil surface are potentially unstable. Also, decomposition of slash in low gradient, swampy areas may reduce dissolved oxygen levels to lethal limits for aquatic life.

In such cases, logging slash should be removed only to the extent that streamflow is no longer blocked. Slash in the riparian area can be hand piled (PUM) outside the active channel. Yarding of slash to landings (YUM) should be considered as a last resort. Imbedded large woody debris present before yarding should be left in place.

Large woody debris in the active channel or flood channel may be removed within three channel widths of the upstream side of permanent road crossings to prevent culvert or bridge failure.

Riparian areas are noted for their resistance to burning, but if fuel loading is a concern at a particular location, slash in the riparian area can be hand piled (PUM) outside the riparian management zone and burned.

Logging Systems

The choice of logging system for a particular site should consider the riparian area and its degree of protection. The best planned riparian management zone in the WNF will be useless if logs are carelessly felled into or yarded through it.

Falling and Bucking

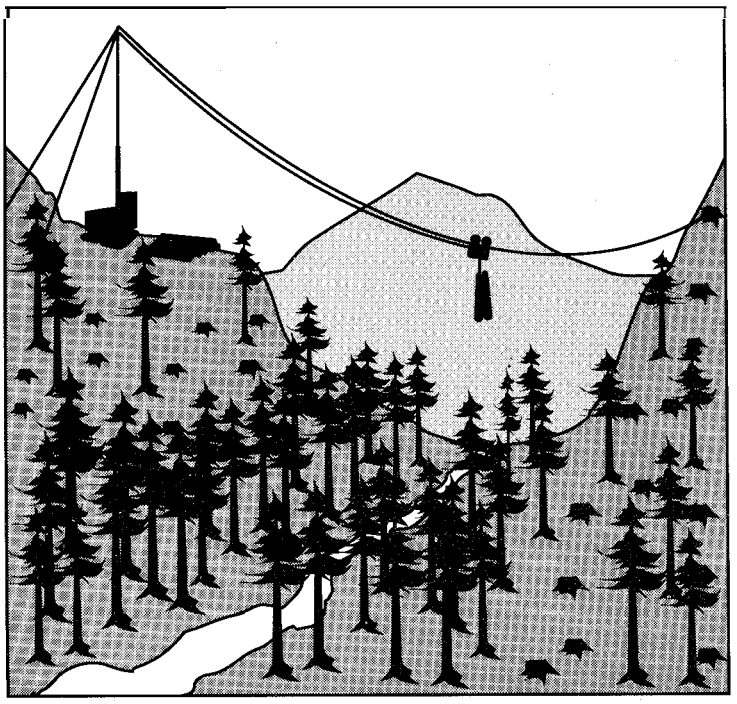
No trees in the harvest unit should be felled in a direction that would result in their entry into the riparian management zone, except along stable and moderately stable Class IV streams. If a tree is accidentally felled into the riparian management zone, it should be left. Attempts to retrieve such logs frequently result in severe damage to planned riparian management zones.

Yarding, Suspension, and Cable Corridors

All efforts should be made to protect riparian vegetation during yarding operations. Dragging logs through streams and riparian areas causes damage that takes decades to heal, and should be avoided if possible.

Logs should be yarded uphill if possible when passing over or through riparian management zones (Fig. 18). On slopes susceptible to erosion, yarding should be restricted to the dry season unless full suspension can be achieved.

Figure 18. **Yarding logs with full suspension** across unharvested riparian management zone.



Carriage location during in-haul must be situated to yard away from the riparian management zone. Lines should be removed from the management zone prior to restringing for next line placement.

In some harvest units, cable corridors may need to be cut through the riparian management zone. The number of these crossings should be kept to a minimum. Corridors should not be cut through stable debris accumulations, and should not destroy side channels and backwaters important to fish-rearing.

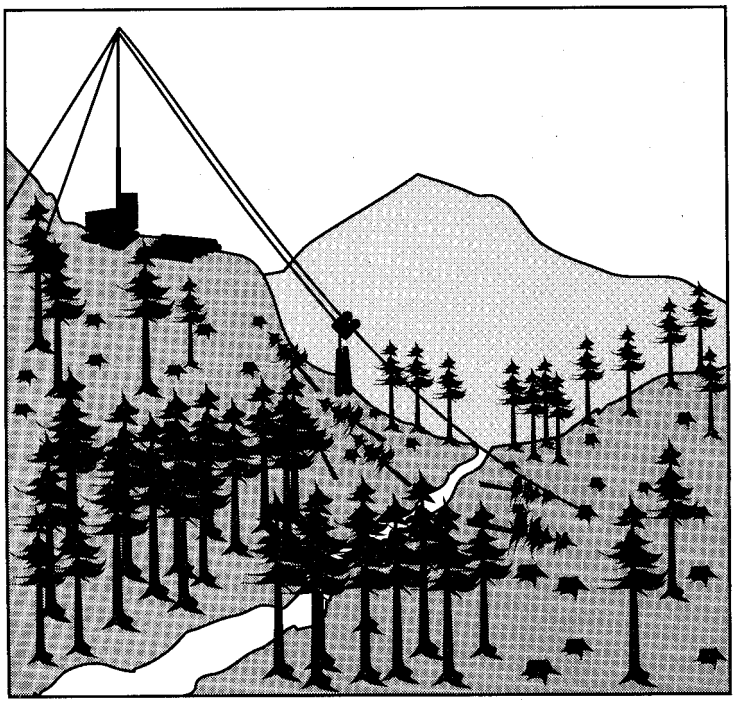
When a suspension corridor is cut, these logs should be placed in the channel and riparian management zone if the area is deficient in large woody debris (Fig. 19). The amount of woody debris left in the channel and forest floor within the suspension corridor should approximate natural site volumes.

Created openings within the riparian management zone (such as cable corridors) should be limited to 20 feet in width each and should total no more than 10% of the channel within the activity area.

Class I, II & III Streams, Lakes, and Wetlands

Yarding logs across any perennial stream or portion of a lake or wetland requires specific site evaluation, on-the-ground review, and full documentation in the environmental assessment. Predicted impacts from proposed skyline anchors and corridors must be explicitly stated. Full suspension of logs above the canopy of the riparian management area is required; care should be taken to minimize vegetation damage.

Figure 19. **A riparian management zone with cable corridors.** Note that natural levels of woody debris are left in the stream channel and forest floor.



Class IV Streams

Full to partial suspension is required on all intermittent Class IV streams. On ephemeral streams, partial suspension is necessary over the channel. In streams on unstable soils, the care should be taken to avoid damage to the retained vegetation.

Timing of Activities

Seasonal impacts of logging activities need to be evaluated. Those that may generate excessive fine sediment should be carried out in dry periods of the year so erosion control practices can be completed before the rainy season.

Class I & II Streams and Lakes

From October 15 through July 15, logging-related sedimentation is more likely to interfere with salmonid spawning, egg incubation, or emergence of fry. Therefore construction activities in the stream (e.g., bridges, culverts, rehabilitation efforts) normally should be limited to the period from July 15 to October 15. Activities on the hillslope but likely to contribute sediment to stream channels should adhere to the same operating season, and should use special installations to prevent sediment from reaching the stream.

In stream reaches used by spring chinook salmon for spawning, the period of activity should be limited to July 15 to September 15. In reaches used for spawning by bull trout, construction activities should be completed before September 1.

APPENDIX I

SOIL STABILITY CLASSIFICATIONS

Table I.1. Soil stability classifications for slope and rock type categories in the Soil Resource Inventory.

SRI #	Slope	Rock Type	Stability
1	30-100	A,b (r.o.)	S
2		Br (r.o.)	S
3	Steep Headwall	Talus (r.o.)	M
4	0-30	Lava Flow	S
5	40-80+	Cinder Cone	M
6	Gentle-Steep	Marshy, Boulders	S
7	Ridgetop	Glacial Cirque	S
8	Steep	GBr, RBr	U
9	Steep	A, B, Br	M
12	0-25	A, B	S
13	0-40	Br,T	M
14	15-35	A,B, Br,T	S
15	0-20	Al	M
16	20-70	A,B,Br,T	M
17	0-20	Al	m
19	0-45	Br	M
21	60-90	RBr,T	U
22	0-20	RBr,T	S
23	20-60	RBr,T	M
25	15-40	Br,T	M
31	60-90	T,GBr	U
33	20-60	GBr,T	M
35	5-40	GBr,T	M
44	40-80	Br	M
54	35-65	Br,A,B	M
55	40	Br,T	M
56	0-30	A	S
57	30-60	A	S
61	60-90+	A	M
62	0-35	Lava Flow	S

SRI #	Slope	Rock Type	Stability
63	0-35	A, B	M
64	40-80	A, B	5
66	0-40	A, B	5
67	0-40	A, B	5
68	30-40	A, B	5
69	0-30	A, B	5
71	45-90	A, B	M
73	0-30	A, B	5
74	35-55	A, B	5
75	0-35	A,B	5
81	40-90+	A,B	M
82	0-30	A, B	5
85	0-15	A,B	5
91	55-90+	A, B	M
92	0-35	A, B	5
93	0-40	A,B	5
94	35-60	A, B, Br	5
95	0-35	A,B,Br	5

Rock Types: A = Andesite; Al = Alluvium; B = Basalt; Br = Breccia; GBr = Green Breccia; RBr = Red Breccia; r.o. = rock outcrop; T = Tufts
Stability Classes: S = Stable; M = Moderately stable; U = Unstable

Table I.2. **Additional SRI** stability classifications.

SRI #	**Stability**	**Description**
142 143 563 564 646-721 821-852 920-954	Stable	Gentle slopes (<60%); moderate slopes (40-60%) with hard rock (basalt, andesite flows); or rock outcrops
All SRI types not listed as Stable or Unstable	Moderately Stable	Steep slopes (>60%) with hard rock; or moderate slopes with soft bedrock (tuffs & breccias)
168 212 213 214 216 301-305 332 603	Unstable	Steep slopes on soft rock

APPENDIX II

RELATIONSHIPS BETWEEN HORIZONTAL AND SLOPE DISTANCES

Table II.1. **Side slope distances for riparian management** zones (RMZ) on different hillslope angles and selected RMZ horizontal distances.

	Slope Distances			
Slope (Percent)	50-ft RMZ	1OO-ft RMZ	150-ft RMZ	200-ft RMZ
10	50 ft	100 ft	150 ft	200 ft
15	51	101	152	202
20	51	102	153	204
25	52	103	155	206
30	52	104	156	208
35	53	106	159	212
40	54	108	162	216
45	55	110	165	220
50	56	112	168	224
55	57	114	171	228
60	59	117	176	234
65	60	119	179	238
70	61	122	183	244
75	63	125	188	250
80	64	128	192	256
85	66	131	199	262
90	68	135	203	270
100	71	141	212	282
110	75	149	224	298
120	78	156	234	312
130	82	164	246	328
140	86	172	258	344
150	90	180	270	360
160	95	189	284	378
180	103	206	309	412
200	112	224	336	448

Table II.2. **Relationship between distance of side slope and hillslope angle** expressed as percent slope.

Slope (Percent)	Slope (Degrees)	Percent of Horizontal Distance
5	2.9	100.1%
10	5.7	100.5%
15	8.5	101.1%
20	11.3	102.0%
25	14.0	103.1%
30	16.7	104.4%
35	19.3	105.9%
40	21.8	107.7%
45	24.2	109.7%
50	26.6	111.8%
55	28.8	114.1%
60	31.0	116.6%
65	33.0	119.3%
70	35.0	122.1%
75	36.9	125.0%
80	38.7	128.1%
85	40.4	131.2%
90	42.0	134.5%
100	45.0	141.4%
110	47.7	148.7%
120	50.2	156.2%
130	52.4	164.0%
140	54.4	172.0%
150	56.3	180.3%
160	58.0	188.7%
180	60.9	205.9%
200	63.4	223.6%

Table II.3. **Relationship between distance of side slope and hillslope angle** in degrees.

Slope (Degrees)	Slope (Percent)	Percent of Horizontal Distance
2.5	4.4	100.1%
5.0	8.8	100.4%
7.5	13.7	100.9%
10.0	17.6	101.5%
12.5	22.2	102.4%
15.0	26.8	103.5%
17.5	31.5	104.8%
20.0	36.4	106.4%
22.5	41.4	108.2%
25.0	46.6	110.3%
27.5	52.1	112.8%
30.0	57.7	115.4%
32.5	63.7	118.6%
35.0	70.0	122.0%
37.5	76.7	126.0%
40.0	83.9	130.5%
42.5	91.6	135.6%
45.0	100.0	141.4%
47.5	109.1	148.0%
50.0	119.2	155.6%
52.5	130.3	164.3%
55.0	142.8	174.3%
57.5	157.0	186.1
60.0	173.2	200.0%

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