Appendix A

Best Management Practices for Water Quality

MONITORING AND MITIGATION

BMP's and Contract "C" clauses will be included to insure minimal ground disturbance and to provide adequate mitigation. Effectiveness/implementation monitoring will be performed by TMA/resource personnel (the presale technician will assure BMPs are met during sale preparation and the sale administrator will assure BMPs are met during timber sale operations). Forwarding- mechanical harvesting systems will be utilized to protect soils from excessive disturbance. Regional Standards require that C clause C6.6# be included to prevent adverse cumulative soil impacts (<15%) and protect soils. Logging slash and large wood should be left and scattered on forwarder trails, landings and throughout the harvested area to meet Forest Plan Guidelines.

Specific resource protection measures and mitigation's listed below would be implemented in any action alternative. These resource protection measures and mitigation's are consistent with the Umatilla National Forest LRMP standards and guidelines. The general discussion of Best Management Practices (BMP's) are found in the General Water Quality Best Management Practices, Pacific N.W. Region, 1988. BMP's and resource protection measures are identified below, as well as an estimation of the ability to implement BMPS's, their anticipated effectiveness, timing and responsibility for monitoring.

1. Maintain all Riparian Habitat Conservation Areas (RHCAs), with no removal of timber from these areas. PACFISH provides default standard widths for RHCAs based on one of four categories: fish bearing; perennial, non-fish bearing; ponds, lakes, wetlands greater than 1 acre; and intermittent or small wetlands. The following standard widths, applied to each side of the stream, define the RHCAs for this project:

Category 1 - **Fish-bearing streams**: RHCA's consist of the stream and the area on either side of the stream extending 300 feet slope distance from the edges of the active stream channel, regardless of Forest Type.

Category 2 - **Perennial non-fish-bearing streams**: RHCA's consist of the stream and the area on either side of the stream extending 150 feet slope distance from the edges of the active stream channel, regardless of Forest Type.

Category 3 - **Ponds, lakes, reservoirs, and wetlands greater than 1 acre**: RHCA's consist of the body of water or wetland and the area extending 150 feet slope distance from the edge of the maximum pool elevation of constructed ponds and reservoirs or from the edge of the wetland, pond or lake, regardless of Forest Type.

Category 4 - **Seasonally flowing or intermittent streams, wetlands less than 1 acre, landslides, and landslide-prone areas:** This category includes features with high variability in size and site-specific characteristics, and assumes listed stock. At a minimum the RHCA's must include: the area from the edges of the stream channel, wetland, landslide, or land-slide prone area to a distance equal to 150 feet for Moist Forest, 120 feet for Dry Forest, and 100 feet for Cold Forest Types.

In the GIS stream layer, Class I and II streams are Category 1, Class III streams are Category 2, and Class IV streams are Category 4.

2. Follow PACFISH standards and guidelines in RHCAs.

- TM-1 Prohibit timber harvest, including firewood cutting in RHCAs.
- RF-3 Determine the influence of each road on the Riparian Management Objectives (RMOs). Meet RMOs and avoid adverse effects on listed anadromous fish.
- RF-5 Provide and maintain fish passage at all road crossings of existing and potential fishbearing streams.
- FM-1 Design fuel treatments and fire suppression strategies, practices and actions so as to not prevent attainment of RMOs, and to minimize disturbance of riparian ground cover and vegetaiton. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel managment actions a could perpetuate or be damaging to long-term ecosystem function, listed anadromous fish, or designated critical habitat.
- FM-4 Design prescribed burn projects and prescriptions to contibute to the attainment of the RMOs.

3. Design harvest systems to minimize crossing stream channels and ephemeral draws. Do not cross channels or ephemeral draws where equipment will cause bank breakdown. All drainage crossings, including ephemeral draws, are to be approved on the ground by the Sale Administrator in consultation with the Hydrologist.

4. Do not operate equipment or remove stabilizing vegetation on or near the edge of the dissection or within the inner gorge of dissected ephemeral draws.

1. Prevent soil disturbance form management activities near and on the edge of dissected ephemeral draws.

6. Ephemeral stream channels should have protections to minimize equipment disturbance of duff and soil, and should not be used as skid trails, landing sites, or as road locations. Ephemeral draws, not within RHCAs, are to meet the following down wood requirements to reduce risk of upward migration and channel initiation: retain all wood embedded in the soil; retain at least 5 pieces of wood >12" diameter and >20' in length per 1000' of draw bottom (average 1 piece per 200'); retain at least 20 pieces of wood >6" diameter and >10' in length per 1000' of draw bottom (average 1 piece per 50'). Ephemeral draws with a gradient of 5% or more will need to be visited by the hydrologist to determine if any additional site specific mitigation is required.

7. All temporary roads and landings shall be obliterated at the completion of their intended use (see BMP R-23) - NFMA requires that all temporary roads be returned to resource production within 10 years. Reclose all roads, with sufficient drainage structures, which are opened for project activities. For all temporary roads:

- obliterate as soon as feasible after use
- season of use shall be specified to minimize rutting, erosion, sedimentation, and water concentrations
- plan, locate, design, and construct temporary roads with ease of obliteration as a priority - stockpile topsoil and duff for re-shaping after use or obliteration
- horizontal and vertical alignments should conform to the natural contour as closely as possible - outsloped rolls in the grade effectively break up water concentrations during use and can be crafted into silt traps and planting pockets during obliteration

8. Wet meadows and dry meadows or scabrock flats would not be skidded across or have landings located within them, unless approved by the Sale Administrator. BMP VM-2,

9. The following BMP's are identified for the timber sale portion of the project, along with an estimation of the ability to implement them, as well as their anticipated effectiveness, timing and responsibility for monitoring.

T-1 - Timber Sale Planning Process
Estimates will be made on the potential changes to water quality and instream beneficial uses.
Responsibility: Hydrologist and Fisheries Biologist
Timing: Prior to activity
Ability to Implement: High
Effectiveness: High

T-2 - Timber Harvest Unit Design
Unit design will ensure favorable conditions of water flow, water quality, and fish habitat through PACFISH RHCAs.
Responsibility: Hydrologist and Fisheries Biologist
Timing: Prior to activity
Ability to Implement: High
Effectiveness: High

T-4 - Use of Sale Area Maps for Designating Water Quality Protection Needs
The Sale Area Map will include locations of streams to be protected and the required harvest method (ephemeral draws would be protected during forwarder route design, but not under the protected stream course provision).
Responsibility: Presale Technician
Timing: Prior to activity
Ability to Implement: High
Effectiveness: High

T-5 - Limiting the Operating Period of Timber Sale Activities
The Timber Sale Contract (TSC) will specify the Normal Operating Season (June 1 to October 31).
Responsibility: Presale Technician
Timing: Prior to activity
Ability to Implement: High
Effectiveness: Moderate

T-8 - Streamcourse Protection (Implementation and Enforcement)
Location, method and timing of streamcourse crossing will be agreed upon in advance by the Forest Service and Purchaser.
Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: High
Effectiveness: High

T-10 - Log Landing Location

Harvest plans will include proposed landing locations. Landing locations and size will be approved by the Forest Service in advance.

Responsibility: Presale Technician and Sale Administrator
Timing: Prior to and during activity
Ability to Implement: High
Effectiveness: High

T-12 - Suspended Log Yarding in Timber Harvesting

Contract will require forwarder, skyline, or helicopter. Full suspension will occur where forwarder and helicopter logging is required and partial suspension will occur where skyline logging is required so as to create minimal soil disturbance.

Responsibility: Presale Technician and Sale Administrator
Timing: Prior to and during activity
Ability to Implement: High
Effectiveness: High

T-13 - Erosion Prevention Measures During Timber Sale Operations

Equipment shall not operate when ground conditions are susceptible to detrimental soil disturbances (not more than 15% of the logged area is permitted to have detrimental soil disturbance). Erosion control work will be kept current.

Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: High
Effectiveness: High

T-14 - Revegetation of Areas Disturbed by Harvest Activities

The TSC will include provisions for seeding and fertilizing severely disturbed areas. The Forest Service will designate disturbed areas where seeding and fertilizing are required (generally landing and temporary roads or other areas where more than 200 sq. ft. of exposed mineral soil due to harvest operations).

Responsibility: Presale Technician and Sale Administrator
Timing: Prior to and during activity
Ability to Implement: High
Effectiveness: Moderate

T-15 - Log Landing Erosion Prevention and Control

The Forest Service will designate areas for landing scarification and erosion control seeding as well as any necessary water bars or other drainage structures.

Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: High
Effectiveness: High

T-18 - Erosion Control Structure Maintenance

The Purchaser will provide maintenance of soil erosion control structures as required in the TSC.

Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: Moderate
Effectiveness: High

T-19 - Acceptance of Timber Sale Erosion Control Measures Before Sale Closure

The effectiveness of erosion control measures will be evaluated periodically during the life of the TSC.

Responsibility: Sale Administrator and Hydrologist
Timing: During activity
Ability to Implement: High
Effectiveness: High

T-20 - Reforestation

Suitable land will be reforested within five years of harvest.

Responsibility: Reforestation Technician
Timing: Prior to activity
Ability to Implement: High
Effectiveness: High

T-21 - Servicing and Refueling of Equipment

The Forest Service will designate refueling and servicing areas. A Spill Prevention Control and Countermeasures Plan is required if on site fuel storage exceeds 660 gallons in a single container or if total storage exceeds 1320 gallons.

Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: High
Effectiveness: High

T-22 - Modification of the TSC

The TSC will be modified if new evidence indicates that unacceptable damage is likely to occur as currently planned.

Responsibility: District Ranger
Timing: During activity
Ability to Implement: High
Effectiveness: High

R-1 - General Guidelines for the Location and Design of Roads

Road reconstruction will assure design creates minimal resource damage.

Responsibility: Engineering Technician
Timing: Prior to activity
Ability to Implement: High
Effectiveness: High

R-2 - Erosion Control Plan

Limit erosion and sedimentation through effective planning and contract administration.

Responsibility: Engineering Technician
Timing: Prior to and during activity
Ability to Implement: High
Effectiveness: Moderate

R-3 - Timing of Construction Activities

Road reconstruction will occur during minimal runoff periods to minimize erosion.

Responsibility: Engineering Technician
Timing: During activity
Ability to Implement: High
Effectiveness: Moderate

R-6 & R-7 - Dispersion of Subsurface and Surface Drainage Associated with Roads

Ditch relief and cross drainage will assure intercepted ground water and surface water is moved from road prism before it develops enough energy to undermine cut slopes or erode fill slopes.

Responsibility: Engineering Technician
Timing: During activity
Ability to Implement: High
Effectiveness: Moderate

R-18 - Maintenance of Roads

Ditches and culverts will be kept open and ruts repaired.

Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: High
Effectiveness: High

R-19 - Road Surface Treatment to Prevent Loss of Material

Watering and grading will be kept on schedule to assure surface material is not lost.

Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: High
Effectiveness: High

R-20 - Traffic Control During Wet Periods

Haul and other associated traffic will be controlled when road damage is likely to occur due to road/weather conditions and only during the time frame from July 1 - October 1.

Responsibility: Sale Administrator
Timing: During activity

Ability to Implement: High
Effectiveness: High

R-21 - Snow Removal Controls to Avoid Resource Damage
Snow removal will assure water can drain from road prism before it develops enough energy to erode road surface or fill slopes.
Responsibility: Sale Administrator
Timing: During activity
Ability to Implement: High
Effectiveness: High

R-22 - Restoration of Borrow Pits and Quarries
Borrow Pits will be stabilized such that banks are stable and access road provides necessary drainage.
Responsibility: Engineering Technician
Timing: During activity
Ability to Implement: High
Effectiveness: High

R-23 - Obliteration of temporary roads and landings
Temporary roads and landings will be obliterated at the completion of their intended use to reduce chronic sediment sources and restore productivity. Effective obliteration is generally achieved through a combination of the following measures: temporary culverts and bridges removed and natural drainage configuration reestablished, road surface ripped, sideslopes reshaped and stabilized, road effectively drained and blocked, road returned to resource production through revegetation (grass, browse, or trees).
Responsibility: Sale Administrator, with advice from hydrologist
Timing: At the completion of activity
Ability to Implement: High
Effectiveness: High

F-1 - Fire and Fuel Management Activies
Activity related fuel will be managed to assure the risk of wildfire is not increased. The timber sale contract will be utilized to ensure that LRMP standards and guidelines for down woody material are met without necessitating additional impacts due to use of machinery. Some slash should be retained on the forwarder trails to reduce the chances of erosion, to trap sediment, and to provide nutrients to the soils for productivity.
Responsibility: Fire Management Officer
Timing: During activity
Ability to Implement: High
Effectiveness: High

F-2 - Consideration of Water Quality in Formulating Prescribed Fire Prescriptions
The prescribed fire plan for natural fuels reduction will be developed to assure fire mortality does not exceed 15% of the tree canopy or remove effective ground cover from more than 15% of the burn area. Fire ignitions will not occur within RHCAs.
Responsibility: Fire Management Officer
Timing: Prior to activity
Ability to Implement: High
Effectiveness: High

F-3 - Protection of Water Quality During Prescribed Fire Operations
The prescribed fire will follow the burn plan. Adjustments will be made during firing operations if objectives are not being met.
Responsibility: Fire Management Officer
Timing: Prior to and during activity
Ability to Implement: High
Effectiveness: High

W-5 - Cumulative Watershed Effects
To ensure that the additional effects of the proposed management activities, when added to the existing conditions, do not exceed thresholds of concern or result in adverse (degraded) water quality or channel/fish habitat conditions.
Responsibility: Hydrologist
Timing: Prior to activity
Ability to Implement: High

Effectiveness: High

Appendix B

Documentation for changing the silviculture system:

Units 14, 15, 20, 23, 28, 39, 40, 46, and 48 were originally classified as Seed Tree cuts (HSST). This term was used because these units would leave between 6 and 12 trees per acre after harvest. This fits with the definition of regeneration cutting methods described in the white paper titled "Silviculture Terminology" by Dave Powell, June 1992 and describes how the stand will look after harvest. However, the silvicultural system should reflect the *objective* of the prescription, instead of its appearance after harvest. Therefore the treatment should have been classified as an Improvement Cut (HIIM). The definition of Improvement Cut is "an intermediate cutting in stands past the sapling stage to improve their composition and quality. Trees of undesirable species, form or condition are removed from the upper canopy, often in conjunction with an understory thinning." The objective is not to regenerate the units, but to manage for the existing Ponderosa pine and western larch. The units are currently overstocked with late seral grand fir and Engelmann spruce. The prescription reduces the risk of stand-replacing wildfire by eliminating trees that aren't resistant to fire. It also improves the health and vigor of the remaining trees (since the stand will not be overstocked anymore); improved vigor translates into reduced susceptibility to insect and disease problems. Four of the units (39, 40, 46, and 48) have severe root disease problems. The infection is so severe that tree species that are normally resistant to root disease are being attacked. In order to achieve the desired future condition for the analysis area, the non-resistant species need to be removed so the stand will not regenerate to the same species and perpetuate the root disease.
After harvest, all of the units will still be considered appropriately stocked stands according to the "Suggested Stocking Levels for Forest Stands in Northeastern Oregon and Southeastern Washington: An Implementation Guide for the Umatilla National Forest" by Dave Powell, April 1999.

Documentation for changing the post stand structure:

Units 20, 23, 28, 39, 40, 46, and 48 were originally classified as Stand Initiation after harvest. The definition of Stand Initiation (SI) is: "growing space is reoccupied following fire or another stand replacing disturbance, usually by seral species. A single canopy stratum of seedlings and saplings is present; grasses, forbs and shrubs coexist with the trees". This term was used in error. The correct description of post harvest conditions for these units would be Old Forest Single Stratum (OFSS). OFSS is defined as having a predominance of large trees, many age classes and a discontinuous canopy cover of at least 15%. These units will meet this definition after harvest.

Su Meredith
Certified Silviculturist 5-10-04

Appendix C
Unit Summary

Unit	Log Sys	Rx	Gross Acres	Net Acres	Prescribed Fire	Fuel Man Area	Fire Regime	Condition Class	Silv. Objective	Post Harv Structure	Current Structure
4	H	HIIM	31	18	UB		Mix	1	Stocking	YFMS	YFMS
5	F	HIIM	16	9	GR		Mix	1	Stocking	UR	UR
6	F	HIIM	11	7	GR		Mix	1	Stocking	UR	UR
7	F	HSST	33	32	UB		Mix	1	Regen	SI	UR
8	F	HSST	16	8	UB		Mix	1	Regen	OFSS	OFMS
9	F	HSST	27	20	UB		Mix	1	Regen	OFSS	OFMS
14	H	HSST	13	10	UB		Frequent	3	PP-DF	OFSS	OFMS
15	H	HSST	24	13	UB		Frequent	3	PP-DF	UR	OFMS
16	H	HITH	19	19	GR		Infrequent	1	Stocking	YFMS	YFMS
17	H	HIIM	21	17	UB	A	Frequent	3	PP	YFMS	YFMS
18	H	HIIM	44	28	UB	A	Frequent	3	PP	YFMS	YFMS
19	H	HSST	24	24	UB	C	Frequent	2	Root Rot	YFMS	YFMS
20	H	HSST	32	30	UB	A	Frequent	3	PP	OFSS	OFMS
23	H	HSST	25	25	UB	A	Frequent	3	PP	OFSS	OFMS
24	H	HSST	10	10	UB		Frequent	2	Regen	SI	YFMS
25	H	HSST	29	29	UB	C	Frequent	2	Root Rot	SI	SECC
26	F	HSST	8	8	UB		Frequent	2	Regen	SI	YFMS
27	F	HIIM	24	18	GR	A	Mix	1	PP-WL	YFMS	YFMS
28	H	HSST	40	32	UB	A	Frequent	2	PP-WL	OFSS	OFMS
29	H	HIIM	6	6	UB		Frequent	2	PP-WL	YFMS	YFMS
31	F	HIIM	24	17	Mast, UB		Frequent	2	PP-WL	YFMS	YFMS
32	F	HSSW	40	28	UB	A	Mix	1	WL	YFMS	YFMS
33	F	HIIM	25	24	GR	A	Frequent	2	PP	UR	UR
37	H	HIIM	47	40	UB	A	Frequent	2	PP-WL	UR	OFMS
39	H	HSST	13	13	UB	C	Frequent	2	Root Rot	OFSS	OFMS
40	H	HSST	16	11	UB	C	Frequent	2	Root Rot	OFSS	OFMS
41	F	HSST	40	40	GR	A	Frequent	2	Root Rot	SI	YFMS
43	F	HCPH	23	5	Mast, UB	A	Mix	2	WL	YFMS	YFMS
44	F	HCPH	8	2	UB		Frequent	2	WL	YFMS	YFMS
45	F	HCPH	34	7	UB		Frequent	2	WL	YFMS	YFMS
46	H	HSST	5	5	UB	C	Frequent	2	Root Rot	OFSS	OFMS
47	F	HIIM	18	17	GR	A	Frequent	2	PP	UR	UR
48	H	HSST	4	4	UB	C	Frequent	2	Root Rot	OFSS	OFMS
50	F	HITH	28	26	GR	A	Frequent	2	Stocking	SECC	SECC
52	F	HCPH	19	4	Mast, UB		Mix	1	PP	YFMS	YFMS
54	H	HITH	14	10	UB	C	Frequent	2	PP	UR	UR
55	F	HITH	18	11	GR	A	Frequent	2	PP-WL	YFMS	YFMS
56	H	HIIM	16	14	GR	C	Frequent	2	PP	YFMS	YFMS
59	H	HIIM	14	7	UB	C	Frequent	2	PP	UR	UR
60	H	HIIM	36	26	UB	C	Frequent	2	PP	YFMS	YFMS
61	F	HIIM	36	24	UB		Mix	1	PP-WL	OFMS	OFMS
62	H	HIIM	17	13	UB	C	Frequent	2	PP	UR	UR
65	F	HIIM	42	30	UB		Mix	1	PP-WL	OFMS	OFMS
69	F	HSST	41	40	GR		Frequent	2	Root Rot	SI	YFMS
77	F	HSSW	38	28	UB	A	Frequent	2	PP-WL	YFMS	YFMS
78	F	HIIM	30	24	Mast, UB		Frequent	2	Stocking	YFMS	YFMS
79	F	HIIM	24	16	UB		Mix	1	WL	YFMS	YFMS
80	F	HCPH	26	5	UB		Frequent	2	PP-WL	YFMS	YFMS
82	F	HIIM	106	106	UB		Frequent	3	PP	YFMS	SEOC
83	F	HIIM	169	169	UB	A	Frequent	2	PP	SEOC	SEOC
84	M	PCT	65	65	GR		Frequent	3	Fuels	SI	SI
86	F	HIIM	31	31	UB		Frequent	2	WUI, PP	YFMS	YFMS
87	F	HIIM	77	77	UB		Mix	2	WUI, WL-DF	YFMS	YFMS
88		UB	238	200	UB		Mix	2	WUI, Fuels		NA
90	F	HIIM	65	65	UB		Frequent	3	WUI, PP	YFMS	YFMS
91	M	PCT	75	75	GR		Frequent	3	WUI, Fuels	UR	UR
92	F	HIIM	62	62	Mast, UB		Frequent	2	WUI, WL	YFMS	YFMS
93	F	HIIM	49	49	UB		Mix	2	WUI, PP-WL	YFMS	YFMS
94	F	HIIM	90	90	UB		Frequent	2	PP	SEOC	SEOC
95	F	HCPH	43	10	UB		Frequent	2	WUI, PP	YFMS	YFMS
96		UB	55	55	UB	A	Frequent	2	Fuels		NA
97		UB	258	194	UB	C	Frequent	2	Fuels		NA
98	H	HIIM	103	94	UB		Frequent	2	WUI, WL	YFMS	YFMS
99	F	HIIM	37	37	Mast, UB		Frequent	2	WUI, PP	YFMS	YFMS

Appendix D
Units and Forest Plan Management Areas

Unit	Rx	Gross Acres	A3	C1	C3	C4	C5	E2
4	HIIM	31	20			11		
5	HIIM	16	16					
6	HIIM	11	11					
7	HSST	33	10			23		
8	HSST	16	12			4		
9	HSST	27	17			10		
14	HSST	13	0			13		
15	HSST	24	0			24		
16	HITH	19	16			3		
17	HIIM	21						21
18	HIIM	44						44
19	HSST	24				24		
20	HSST	32						32
23	HSST	25						25
24	HSST	10						10
25	HSST	29				29		
26	HSST	8						8
27	HIIM	24						24
28	HSST	40						40
29	HIIM	6						6
31	HIIM	24						24
32	HSSW	40						40
33	HIIM	25						25
37	HIIM	47					2	45
39	HSST	13			8	5		
40	HSST	16			14	2		
41	HSST	40						40
43	HCPH	23						23
44	HCPH	8						8
45	HCPH	34						34
46	HSST	5			5			0
47	HIIM	18						18
48	HSST	4			4			
50	HITH	28						28
52	HCPH	19						19
54	HITH	14			14			
55	HITH	18						18
56	HIIM	16			16			
59	HIIM	14			14			
60	HIIM	36			36			
61	HIIM	36						36
62	HIIM	17			17			
65	HIIM	42						42
69	HSST	41						41
77	HSSW	38						38
78	HIIM	30						30
79	HIIM	24						24
80	HCPH	26						26
82	HIIM	106						106
83	HIIM	169		10				159
84	PCT	65						65
86	HIIM	31						31
87	HIIM	77						77
88	UB	238				20		218
90	HIIM	65						65
91	PCT	75						75
92	HIIM	62						62
93	HIIM	49						49
94	HIIM	90						90
95	HCPH	43						43
96	UB	55						55
97	UB	258			251	3	4	
98	HIIM	103					6	97
99	HIIM	37						37
		2672	102	10	379	171	12	1998

Appendix E

Use of Meadows, ridgetops, and roads for effective fire control

Individually or in combination: meadows, ridge top roads and previous harvest units do not necessarily provide a fuel break or defensible space. Under wildfire conditions meadows made up of cured herbaceous material can contribute to the rapid acceleration of fire spread. Burning conditions, fuels, slope, wind and spotting distance need to be considered when taking suppression action on a ridge top.

The Effect of Grass Meadows on Fire Spread

Cured grass meadows burn rapidly during a wildfire. There is usually very little ecosystem damage from a grass fire using burn severity as a measure of damage because of the rapid passage of the flaming front. However this rapid passage can deliver fire to heavier fuels along the meadow edge setting the stage for a mass ignition of adjacent timber stringers that other wise would burn much slower than the grass (Table 1). Mass or multiple ignitions in heavy timber greatly increases the likelihood of crown fire. Fire in light fuel, such as grass, is one of the common denominators in fire entrapments.

Table 1- Comparing Flame Length and Rate of Spread Between Grass and Heavy Timber Fuel Types for a Single Point Ignition.

	1 Hour Fuel Moisture	Wind Speed	Slope	Flame Length	Rate of Spread
Grass	6%	2 mph	45%	3.5 Ft.	58 Ft/Min
Heavy Timber	6%	2 mph	45%	4.2 Ft.	7 Ft/Min

Using Ridge Top Roads in Fire Suppression Actions

Extreme caution needs to be used when approaching a fire or taking suppression action from a ridge top road. Many firefighters have been trapped on ridge tops by fires. Expect the fire to spread rapidly from below, moving uphill toward the road. Slope, wind and fuels can easily cause short and long distance spotting over a ridge top road. From a ridge top road the fire fighter is attempting a frontal assault with unburned fuels between the action point, the ridge top road and the head of the fire, which is below the road. This circumstance is addressed in Watchout Situations 10 and 11.

When evaluating a ridge top road for use in a suppression action consider the condition of the road, fuels, slope and wind. Unpaved roads may have flammable vegetation in the strip between the tire tracks that would contribute to a fire crossing the road under light wind conditions. (This is the case on the four wheel drive roads on Middle Ridge) Fuels on the fire side of the road may provide a source for embers, while fuels on the unburned side may provide a receptive fuel bed for spots. Slope and wind combine to increase the rate of spread in all fuel types by hastening the effects of convection, radiant heat and spotting.

Ridge top roads on steep ground can be used as access points and anchors for fire suppression actions. Direct attack on fires can be made from roads under favorable conditions of slow fire spread, low flame lengths and limited spotting. Under the right conditions ridge top roads can be used to anchor backfires. When successfully fired the road becomes a direct control line.

While the road may provide access to the ridge top the best location to stop a fire through direct line is the lee side of the ridge just below the ridge where the wind currents eddy into the slope. This wind pattern slows the spread of the fire on the lee side of ridges.

Previous Harvest Units Effect on Fire Spread

Most sites where previous harvest activities have occurred are in need of additional treatment. This is primarily due to the succession of plants and accumulation of fuels over the interim since the harvest

treatments occurred. In wildfire conditions expect the accumulated surface fuels and young understorey plants to contribute to crown fire. Additional biomass removal and prescribed burning will return these sites to Condition Class 1, which reduces the risk for uncharacteristic ecosystem damage and is inherently safer for firefighters.

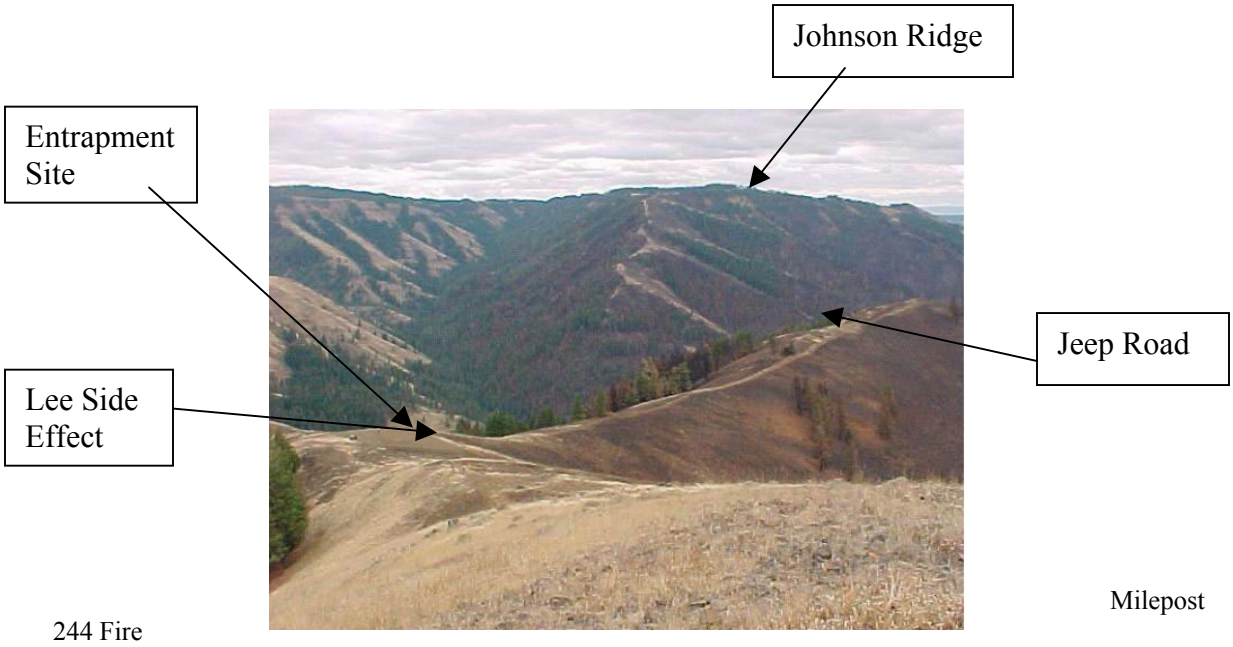
Fuel Break

The term fuel break implies an absence of fuels. The succession of plants in disturbed and undisturbed sites assures the presence of a variety of changing fuel conditions both spatially and temporarily.

Case Study

On August 15, 2000 the Milepost 244 Fire started in the Meacham Canyon area of the Walla Walla Ranger District. The fire started at midday and burned actively for the next three days. Fire activity peaked late on the afternoon of the first day. The fire burned over 4,000 acres and caused the entrapment of three firefighters and a bulldozer attempting to use a ridgetop road to contain the fire.

Moderate surface winds and slope initially carried the fire rapidly uphill to the top of the canyon and brought fire to the edges of numerous timber stringers. A bulldozer crew was working their way up a ridge four miles from the fire. Several timber stringers became involved in active crown fires. The fire grew from 600 acres to over 2000 acres in a short amount of time due primarily to profuse spotting and wind driven flaming fronts. The bulldozer crew was entrapped by the unexpected fire spread. The ridge top road and meadows did not function as a fuel break or defensible space. Observed spotting distances exceeded 0.5 miles. Rates of spread for all fuel types involved met or exceeded maximum predicted values.



Milepost 244 Fire

When the fire reached the jeep road it had burned nearly 2000 acres and already spotted onto the lower slopes of Johnson Ridge. The fire burned around the entrapment site. The fire held on the ridge above the entrapment site because of the lee side effect and sparse fuels. By the time the fire burned to Johnson Ridge it had covered over 4,000 acres.