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Grave Creek Watershed Analysis

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Interdisciplinary Team Members:

Loren Wittenberg
David Eichamer
Marylou Schnoes
Doug Stewart
Steve Timmons
Bob Bessey
Roger Schnoes

Grave Creek
Watershed Analysis
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Summary - Grave Creek Watershed Analysis

MORPHOLOGY

Geographic Province	Klamath mountains
Watershed size	104,371 acres; BLM 50,273 (48%)
Elevation range	690 ft (mouth of Grave Creek) to 5,265 ft (King Mountain)
Drainage pattern	dendritic
Total streams	1,096 miles; BLM 477 (43%)
Drainage density	6.7 mi/mi^2
Transient Snow Zone (land above 2,500 ft)	38,731 acres (37 percent of the watershed)
Sixth-field watersheds	Upper Grave 19,890 acres
	Placer 12,786 acres
	Sunny Valley 19,563 acres
	Upper Wolf 11,163 acres
	Coyote 9,843 acres
	Lower Wolf 7,325 acres
	Lower Grave 23,802 acres

METEOROLOGY

Annual precipitation	45-60 inches; highest amounts around King Mountain
Precipitation Timing	80% occurring October thru May
Temperature range	0-100 degrees F

SURFACE WATER

Minimum flow (Grave Cr near Placer)	1.0 cfs during several summers. Many stream segments are dry during summer months.
Maximum peak flow (Grave Cr near Placer)	8,000 cfs October 29, 1950
Reservoirs	Numerous small private ponds 2 BLM ponds: Burma Pond and Dutch Herman
Water quality limited streams	81.3 miles; BLM 27.5 miles (34%) (listed for temperature above 64 degrees)

GEOLOGY

Formation	Galice (formed of metamorphic sedimentary and ultra-mafic rock
Soils	Shallow depth, many different series and complexes. Generally very low water holding capacity, relatively infertile.

VEGETATION Primarily mixed evergreen; conifers and hardwoods. Vegetative communities differ by slope, aspect, elevation and soils.

BIOLOGICAL

Total fish streams	122 miles; 37 miles on BLM lands (30%)	
Candidate, threatened, or endangered species	Spotted owl: 18 active sites Marbled murrelet: west half of watershed within 50 miles of coast (none found) Southern Oregon/Northern California coho salmon - Threatened Klamath Province Steelhead Trout - Candidate Southern Oregon/Coastal California Chinook Salmon - Candidate Oregon Coast Sea-run Cutthroat Trout - Under status review	
Survey and Manage species	Del Norte salamanders mollusks red tree voles peregrine falcons bald eagles	fungi bryophytes lichens
Special Status Plants	Numerous species and locations	

HUMAN INFLUENCE

Counties	Josephine Jackson Douglas (small portion)
Roads	808 miles
Roads within one tree length of streams	314 miles; BLM 121 (38%)
Roads within one tree length of fish streams	57 miles; BLM 16 (28%)
Road density	5.0 mi/mi^2
Timber production	Generally large, mature and old growth trees 23,750 acres of BLM lands (47%) available for intensive timber harvest (General Forest Management Area and Connectivity Blocks)
Mining	Placer claims on most tributaries and Grave Creek. Several hard rock mines.
Utility corridors	Natural gas line, fiber optics line, electric power line, railroad.
Communication sites	King Mountain Sexton Mountain Northwest of I-5 on Stage Hill
Communities	Wolf Creek, Sunny Valley, numerous residents in valleys

PUBLIC LANDS

BLM lands 50,273 acres (48 percent of the watershed)

Land use allocations

Land Use Allocation	Acres	Percent of federal land
Late-successional Reserves	1,798	4
Area of Critical Environmental Concern/ Recreation Areas	227	0
Connectivity/Diversity Blocks	3,850	8
Northern General Forest Management Area	43,131	86
Southern General Forest Management Area	1,208	2
Total:	50,214	100

I. Introduction

The area covered under this watershed analysis was first analyzed in preliminary watershed analysis documents completed for the Grave Creek East and Grave Creek West Watershed Analysis Areas in October, 1994. The current analysis is designed to update information and analyses and conform with the recent interagency guidance for ecosystem analysis.

This Watershed Analysis is designed to characterize the physical and biological elements, processes, and interactions within the watershed. It is not a decision- making document, but serves to set the stage for future decisions by providing a context in which plans and projects can be developed while considering all important issues within the watershed.

The format for the Watershed Analysis follows the format in Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis; August 1995. The process for conducting ecosystem analysis at the watershed scale has six steps:

1. Characterization of the Watershed, in which the physical setting and the land allocations and designations are described;
2. Identification of Issues and Key Questions, which define the scope and level of detail of the analysis;
3. Description of Current Conditions within the watershed;
4. Description of Reference Conditions, or historic conditions and trends;
5. Synthesis and Interpretation of Information; and
6. Recommendations.

This analysis is basically organized around this format, with a few modifications. The Current Conditions and Reference Conditions are combined into one chapter. The Key Issues and Key Questions are listed in Appendix A. The chapters are based on the Key Issues identified; however, overlapping does occur among some sections.

The first part of this analysis will address the physical, biological, and human processes or features of the watershed which affect ecosystem functions or conditions. Secondly, the Current and Reference Conditions of these important functions are described; followed by Synthesis and Interpretation, which is the comparison of these conditions and their significant differences, similarities, or trends and their causes. Finally, recommendations are made to guide the management of the watershed toward the desired future condition.

An interdisciplinary team developed the analysis utilizing direction in the Northwest Forest Plan (NFP) dated April 13, 1994 and the Medford District Resource Management Plan (RMP) dated April 14, 1994. Resource-specific objectives and constraints common to all lands were used in planning management actions within this watershed.

There were five Key Issues identified for this watershed:

Water Quality/Aquatic Habitat/Fish
Commodity Production
Late-successional Habitat/Species
Social
Ownership Patterns

II. Characterization

The Grave Creek watershed is a fifth-field watershed in the Klamath Mountains province, located in southwest Oregon, approximately 20 miles north of Grants Pass (Map 1). The watershed contains about 104,371 acres; BLM administers about 50,273 acres (48 percent). The towns of Wolf Creek and Sunny Valley are the major communities in the watershed. There are residential areas located along Grave Creek, Coyote Creek and Wolf Creek.

Major tributaries include Reuben Creek, Poorman Creek, Wolf Creek, and Rock Creek. The unit has been divided into seven sixth-field watersheds (Map 2) and 90 seventh-field watersheds ranging from about 450 acres to about 6,000 acres. These include a series of small creeks which drain directly into Grave Creek and are lumped together as frontal creeks. Annual precipitation in the watershed averages about 45 inches. Extended summer drought is common. Most of the area, with the exception of primarily north facing slopes along Wolf Creek and Grave Creek, has southerly aspects.

Soils in the unit are derived from metasedimentary and metavolcanic rock types. Soils associated with metasedimentary rocks tend to be deeper and have more nutrients available. Soils developed from metavolcanic rock types tend to be shallow and have less nutrients and soil development than the sedimentary. Organic matter plays an important role in the productivity of the metavolcanic soils. Some of the unit is dominated by serpentine-derived soils which are low in calcium and high in magnesium and other minerals. The resulting vegetative communities are unique, since many plant species which are adapted to calcium-based soils (including Douglas-fir) are unable to grow in such soils.

The entire watershed has federal lands intermingled with non-federal lands in a "checkerboard" pattern characteristic of much of the Oregon and California (O&C) railroad lands of western Oregon (Map 3, Tables1 and 2, and Figure 1).

Most streams have a history of placer gold mining, which is still ongoing. Placer mining involves washing stream gravels for gold. Riparian vegetation in some areas has been destroyed as a result of mining and past logging practices. The channels are unstable at this point and will probably continue to be unstable until riparian vegetation is reestablished and the uplands become vegetated.

Table 1. Land Ownership - Grave Creek Watershed

Ownership/Land Use	Acres	Percent of Grave Creek Watershed
Medford BLM	50,273	48
Oregon State	2,828	3
Josephine County	7,001	7
Private Timber Industry	22,227	21
Private Forest: Non-industry	16,628	16
Agricultural/Residential	5,414	5
Total	104,371	100

The Medford District Resource Management Plan (RMP) designated several land use allocations for federal lands within the watershed (Map 4, Figure 2 and Table 3). These allocations provide overall management direction and varying levels of resource protection.

Figure 1. Federal Land Use Allocations

Grave Creek Watershed

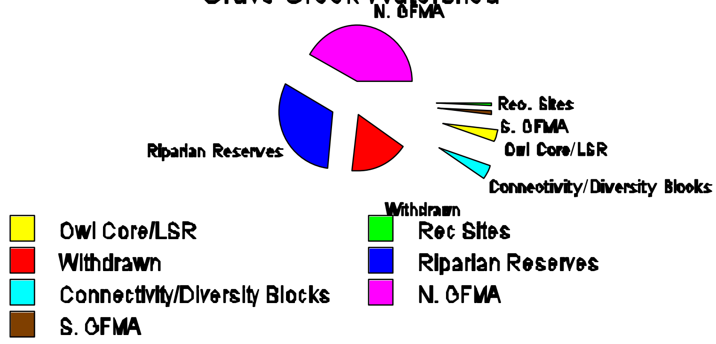


Table 2. Acres of BLM Ownership by sixth-field watersheds.

Drainage	Total	BLM	Percent
GV01 Upper Grave	19,890	10,553	53
GV02 Placer	12,786	6,183	48
GV03 Sunny Valley	19,563	6,038	31
GV04 Upper Wolf	11,163	5,588	50
GV05 Coyote	9,843	5,097	52
GV06 Lower Wolf	7,325	2,806	38
GV07 Lower Grave	23,802	14,005	59

Table 3. Federal Land Use Allocations within the Grave Creek Watershed.

Land Use Allocation	Acres	Percent of federal land
Late-successional Reserves/1	1,798	4
Area of Critical Environmental Concern/ Recreation Areas	227	0
Connectivity/Diversity Blocks	3,850	8
Northern General Forest Management Area/2	43,131	86
Southern General Forest Management Area/2	1,208	2
Total	50,214	100

/1Late-successional reserves include portions of large LSR and 100-acre spotted owl core areas
/2 General Forest Management Area includes Riparian Reserves

Late-successional reserves are areas designated in the RMP where the major management objective is to maintain or promote late-successional (and mature old growth) habitat. In this watershed there is only a small part of a large LSR which is located to the west, 15 spotted owl core areas of about 100-acres each and numerous Managed Late-successional Areas occupied by Del Norte salamanders.

Connectivity/Diversity blocks are generally square-mile sections in which at least 25-30 percent of each block will be maintained in late-successional conditions. They are designed to promote movement of species associated with late-successional habitat across the landscape and add richness and diversity to the land outside the LSRs. There are portions of nine of these Connectivity/Diversity blocks in the watershed.

The General Forest Management Area (GFMA) is the allocation where timber harvest is a primary objective. Most of the Grave Creek watershed falls into the northern GFMA, where the RMP calls for retaining at least 6-8 large trees per acre in regeneration harvests. There is a small part of the watershed which has been designated as southern GFMA. A higher level of green tree retention is called for under this regime.

Within the General Forest Management Area lands there are 8,700 acres which have been withdrawn from intensive timber harvest. The majority of these acres were withdrawn due to rocky soils which preclude successful replanting. In addition to these land allocations, there are also several other important designations that occur within the watershed.

A portion of the headwaters of Grave Creek were designated as "Deferred Watersheds" in the RMP (Map 9). This means that programmed timber harvest is not allowed for the first decade of the plan (i.e., until 2004).

There are 20,247 acres within the watershed which have been designated as critical habitat for the northern spotted owl, a federally-listed threatened species. The primary purpose of the critical habitat unit (CHU) is to help provide east-west dispersal of owls between the Klamath and Coast Range provinces and the Cascade Mountain province.

Potential natural vegetation was mapped on three levels (Appendix B). The series is determined by the most abundant reproducing tree in the understory of late-successional stands. Often, this is the most shade-tolerant species present. Plant associations are fine scale divisions based on the indicator species present in late-successional stands. These associations are further aggregated into plant association groups, to ease interpretation. The plant associations used are described by Atzet et al. (1996), who gives more detailed information on species composition.

III. Current Conditions and Reference Conditions

Water Quality/Aquatic Habitat/Fish

Water Quality

The Oregon Department of Environmental Quality (DEQ) designates beneficial uses of all tributaries of the Rogue River Basin, including the Grave Creek watershed. Grave Creek is a tributary to the Rogue River.

The following is a list of the designated beneficial uses for the Rogue River:

- Private Domestic Water Supply
- Public Domestic Water Supply
- Industrial Water Supply
- Irrigation, Livestock Watering
- Anadromous Fish Passage
- Anadromous Fish Rearing
- Anadromous Fish Spawning
- Resident Fish and Aquatic Life
- Wildlife and Hunting
- Fishing
- Boating
- Water Contact Recreation
- Hydro Power (Oregon Administrative Rules Chapter 340, Division 41).

In this analysis these beneficial uses apply to the Grave Creek Watershed.

The Clean Water Act of 1977, as amended by the Water Quality Act of 1987 provide direction for designation of beneficial uses and limits of pollutants (section 303d). DEQ is responsible for designating streams which fail to meet established water quality criteria for one or more beneficial uses. These designated streams are often referred to as the 303d list. Water Quality monitoring by several agencies throughout Grave Creek has resulted in 303d listings for 81.3 miles of streams which have failed to meet established criteria for one or more beneficial uses (Map 5 and Tables 4 and 5).

Table 4. Water quality limited streams in the Grave Creek watershed.

Stream	Water Quality Parameter	Approximate Miles
Boulder Creek	Temperature	1.9
Big Boulder Creek	Temperature	4
Slate Creek	Temperature	3.5
Clark Creek	Temperature	3.5
Coyote Creek	Temperature	7.3
Wolf Creek	Temperature	15.3
Grave Creek	Temperature	34.4
Poorman Creek	Temperature	4.5
Reuben Creek	Temperature	6.9
Note: The above streams were listed from the mouth to the headwaters		

The streams listed in Table 4 do not meet the criteria for temperature because they exceed the Department of Environmental Quality (DEQ) standard of 64 degrees F, which is considered the maximum for anadromous fish rearing. This also applies to resident fish and other aquatic life, particularly resident cutthroat trout, which are present in these streams.

There are many factors which contribute to listing these streams as water quality limited. In many cases there is more than one factor operating on an individual stream. The most important factors are:

-Several of the tributary streams have segments that have no surface flow during summer periods,
-Low summer discharge (less than 1.0 cfs from records),
-Riparian cover is absent,
-Agricultural practices are adjacent to streams,
-Past salvage logging has occurred within riparian zones,
-Logging has removed shade over streams,
-Wide streams and stream orientation allow for direct solar heating,
-Wide, shallow gravel bedrock channel,
-Relatively low gradient channels result in longer water retention time,
-High percentage of roads in or adjacent to riparian zones, and
-High ambient air temperatures during summer months.

Some other, less important factors contributing to water quality limitations in this watershed include:

-Many of the larger tributaries to Grave Creek are on non-federal land,
(State regulations do not adequately maintain water temperatures on non-federal lands),
-Septic tanks and Cess Pools,
-Diversions for irrigation and pumping,
-Gravel operations,
-Stream channelization,
-Placer mining.

Maximum summer water temperatures in Grave Creek downstream of Salmon Creek have probably always exceeded the current DEQ standard because its width, low gradient, and east-west orientation create a condition that allows for maximum absorption of solar radiation throughout the day. Much of the watershed has shallow soils which have low water holding capacity. In addition bedrock, which is a major component of the substrate, absorbs heat during the day and radiates it to the stream at night. But natural factors by themselves do not appear to be significantly limiting stream productivity. Rather, habitat problems are the direct result of human activities.

Stream channel widths on Grave Creek above Salmon Creek and on all Grave Creek tributaries are narrow enough for stream-side vegetation to provide adequate shade. However, canopy closure over many fish-bearing streams is inadequate to maintain water temperatures below 64°F. Naturally low summer flows quickly result in elevated water temperatures when streams are subjected to timber harvest, land clearing and water diversion. Water diversion in Grave Creek and nearly all of its tributaries limits the amount of habitat available for fish and other aquatic species.

Stream temperatures have been monitored since 1993; the program will continue in coordination with Oregon Department of Environmental Quality under the 303(d) Program. The BLM monitored several listed streams in summer 1998 to determine which portion of the streams are water quality limited (Appendix F). It will take several years of monitoring to determine the extent of water quality limits on those streams.

BLM manages approximately 48 percent of the watershed, but only 34 percent of the water quality limited stream miles within this watershed occur on BLM. Temperature is listed as being the limiting factor for the beneficial use of waters of Grave Creek. There are several conditions within the watershed that would explain the higher percentage of water quality limited miles on non-federal lands. BLM lands are higher in elevation, and contain many of the 1^{st} through 3^{rd} order streams. These streams are steep and narrow and are fed by ground water sources which are naturally cool. Due to the small width of most of these channels, overhanging brush and smaller trees provide adequate shading. Lower elevation 4^{th} through 6^{th} order streams have lower gradients and are wider. These streams are primarily on non-federal land. Larger trees are required to adequately shade these streams, but due to logging practices and agricultural practices such as grazing, most of the riparian vegetation and width of riparian zones do not provide the shading. The east/west orientation of the streams also expose the waters to greater solar heating during the day.

The geology and soils of this basin do not allow for a great degree of water storage. Uplands are steep and soils profiles are relatively shallow. Recharge of streams by ground water is very limited during summer months.

King Mountain's position within the watershed has significance for water flows and availability. Because of its elevation, it receives almost twice the annual precipitation as does Sunny Valley or Wolf Creek. Drainage from King Mountain undoubtedly contributes surface water and probably some ground water to the valleys. Since the soils do not have a great deal of water holding capacity and there are no dams in the basin, the water from the highlands is important and is probably the only source of domestic water.

Table 5. Water quality limited stream mileage by ownership category; Grave Creek watershed.

Ownership	Miles	Percent	Trends in Quality
BLM	27.5	34	Improving in upper reaches
Local Government	3	4	Unknown
Private Timber Industry	18.5	22	Declining or stable
Private - Non-industry	32	40	Declining
Total	81	100	

Sedimentation

Sedimentation is also known to be a major problem for streams in this watershed. However, no standards are set for this parameter, and there is no consensus on how to measure stream sediment levels, so it is not included in these listings. Some sediment data were collected during the stream surveys. However, these were qualitative ratings, so the value of the data is severely limited. The health of aquatic macroinvertebrate communities may be a better indicator of the extent of sedimentation (Appendix G).

Other erosional processes which could adversely affect fish habitat in this watershed include:

- road building,
- logging activities which create soil disturbance,
- dry ravel from adjacent slopes which fill intermittent channels,
- translational and rotational land slides blocking channels,
- floods, and
- normal road maintenance activities.

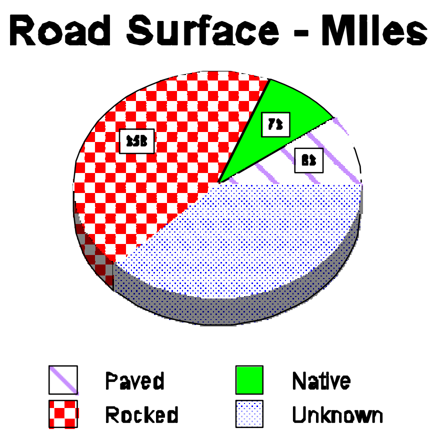
Roads are a chronic sediment source to streams in this watershed. There are 808 miles of roads in the watershed (Table 6, Map 6), representing approximately 4,848 acres in roads. There is an average road density of 5.0 miles of road per square mile. The surface classification of 309 miles of roads (38 percent) is currently unknown. Most of these roads are on private timber industry lands and the vast majority are probably native surface. If so, the native surface roads could total as much as 382 miles (47 percent). The native surface roads are generally the largest sediment sources, especially if these roads are open to public motor vehicle use. Map 7 indicates the closure status of the roads in the watershed. It is unlikely that private timber industry will be building extensive new road systems in the near future; most of the non-federal lands have already been well roaded.

In recent years as timber sales have declined and budgets have been reduced, road maintenance on federal lands has been greatly reduced. Plugged culverts and ditch lines have resulted in several washed out roads and numerous mass failures. These are somewhat episodic but contribute large amounts of sediment to streams.

Table 6. Road surface types and road densities in Grave Creek watershed.

Sixth-field Watershed	Acres	Native Surface (miles)	Rock Surface (miles)	Paved Surface (miles)	Unclassified Surface (miles)	All Roads (miles)	Road Density (mi/mi^2)
Upper Grave Creek	19,890	18	79	11	45	153	4.9
Eastman Gulch	12,786	17	36	7	46	106	5.3
Salmon Creek	19,564	13	65	25	69	172	5.6
Upper Wolf Creek	11,162	3	33	15	30	81	4.7
Coyote Creek	9,844	1	39	10	24	74	4.8
Lower Wolf Creek	7,325	4	7	7	22	40	3.5
Lower Grave Creek	23,802	17	83	8	73	181	4.9
Totals:	104,373	73	342	83	309	808	4.8

Figure 2. Road surface categories, Grave Creek Watershed



Another important factor in determining sediment production is the proximity of roads to streams; a ridge top road usually contributes much less sediment to streams than a road running right next to a stream for a long distance. In this watershed, there are 252 miles of streams which have a road within 166 feet, (23 percent of all streams) the approximate height of one site-potential tree. The situation is more dramatic with regard to fish streams. Approximately 91 miles out of the 122 miles of fish streams (75 percent) have a road within the Riparian Reserve (i.e. within 335 feet of a road). These roads have a high potential for providing sediment directly into the streams, as well as disrupting riparian habitat and connectivity along streams.

Table 7. Proximity of roads to streams; Grave Creek watershed.

Sixth-field Watershed	Approx Miles of Road	Approx Miles of Streams	Approx Miles of Fish Streams	Approx Miles of Streams Within 166' of roads	Approx Miles of Fish Streams Within 335' of roads	Approx Miles of Fish Streams Within 166' of roads
Upper Grave	153	222	27	72	23	16
Eastman Gulch	106	107	13	31	11	5.5
Salmon Creek	172	187	23	58	16	8
Upper Wolf Creek	81	105	12	30	9	6
Coyote Creek	74	116	11	36	10	7.5
Lower Wolf Creek	40	86	9	18	5	2.5
Lower Grave Creek	181	273	27	69	17	11.5
Totals	808	1,096	122	314	91	57

Table 8. Proximity of roads to streams; Grave Creek watershed, by ownership.

Ownership	Approx Miles of Road	Approx Miles of Streams	Approx Miles of Fish Streams	Approx Miles of Streams Within 166' of roads	Approx Miles of Fish Streams Within 335' of roads	Approx Miles of Fish Streams Within 166' of roads
BLM	371	477	37	121	26	16
Non-BLM	437	619	85	193	65	41
Total	808	1,096	122	314	91	57

Aquatic Conservation Strategy

All the sub-watersheds have high road densities and all are above the two miles per square mile target established by the National Marine Fisheries Service (NMFS) for proper functioning condition. Above 3 miles per square mile is considered not functioning properly by NMFS. Road densities are important in that roads result in more rapid runoff and increase ground water interception. In essence, each mile of ditched road becomes a first order intermittent stream.

The Northwest Forest Plan has greatly contributed to reducing impacts on the aquatic system on federal lands. These include, but are not limited to, wide riparian buffers on all streams, including intermittent stream channels; green tree retention on harvest units; restrictions on new road construction and requirements for 100 year flood capacity for road crossing structures. Best management practices that were designed for implementation under the Northwest Forest Plan and the RMP, will help to reduce impacts and in some cases actually restore conditions to "Properly Functioning" from the standpoint of riparian function and hydrology.

Flood plains

The flood plain in the Grave Creek watershed has developed upstream of constricted rocky canyons. The flat areas of deposition are currently the places where small communities exist (Wolf Creek and Sunny Valley). Most of the residences and lands surrounding these communities are situated on or adjacent to the flood plain. Most activities on these lands are agricultural, generally grazing. Much of the flood plains have been altered from their original state by hydraulic mining. The road network and mining have changed the channel configuration from meander to straight with little or no channel complexity. The absence of beaver and continued disturbance by mining, cattle grazing and other human activities will restrict the input of large wood and natural channel migration. Ground water recharge will likely remain below potential as a result of this since flood waters will seldom spread out and store within the flood plain. The highest recorded peak flow discharge for Grave Creek near Placer was 8,000 cubic feet per second (cfs) on October 29, 1950. A more normal peak flow for this stream is 3,000 - 4,000 cfs.

Potential Sources of Sedimentation

Map 8 shows areas that are high potential sources for stream sedimentation resulting from erosion. The upper basins of Grave Creek basin are situated in an area of decomposing ultramafic rock. Surface disturbance by road building and tractor logging as well as natural processes such as landslides and mantle creep pose a potential for to stream sedimentation. Another area, Poorman Creek, has potential sources of sedimentation due to the nature of the soils and logging activities within this drainage. The majority of the non-federal lands were tractor logged on steep ground, resulting in exposed soil and compaction. This results in reduced infiltration, more runoff, and subsequent erosion.

Current management direction for Riparian Reserves, road building, and road maintenance on Federal land, serve to enhance the protection of the riparian zones as well as unstable areas that could result in sedimentation of fish streams.

Three natural factors may limit stream productivity to a minor extent: pockets of serpentine soils, high water temperatures and low summer flow in tributaries. Serpentine soils, which are less productive than many other soil types, border portions of Upper Grave, Boulder, Clark, and Upper Poorman Creeks and may limit the amount of shade, tree diameter and density and therefore size and amount of wood that enters streams. It is assumed that roads and sources of sediment on non-federal lands will continue to be problematic. While not occurring all the time everywhere, pulses of sediment (episodic) will occur through new disturbance of lands and the occasional large storms and natural disturbance events such as mass failure. Current RMP directives are thought to produce properly functioning riparian zones on federal lands in the long term and contribute to better water quality and less sedimentation. But there are already many miles of roads within Riparian Reserves, which will continue to contribute sediment into streams unless they are decommissioned.

Non-federal lands, on the other hand, have a very high potential for continuing to contribute sediment to streams. The Oregon Forest Practices Act, which applies to non-federal lands, does not protect streams from temperature and sediment increase as well as the requirements on federal lands. Division 640 of the Act allows for leaving only 30-40 conifers, 8-11" dbh, for every 1,000 feet of fisheries stream, within 20 feet of the stream; non-fisheries streams receive even less protection and shading. The buffer width could be variable, however, there does not appear to be enough of a filter zone to adequately reduce sediment loading. Although protection of soils and other language exists in Division 630 of the Act, field observations within this watershed indicate that skid trails and yarding corridors often result in damaged stream banks and stream sedimentation.

Grazing within riparian zones also has a high potential to contribute sediments. Soil compaction and loss due to erosion, reduced soil percolation and loss of riparian vegetation all contribute to reductions in summer stream flows, increases in winter runoff and sedimentation in to the stream throughout the year.

Poorly designed waterbars that dam water, rather than divert it off the road surface, are a source of sedimentation and erosion occurring in the basin. Unmaintained roads and skid trails are a continual source of erosion leading to sedimentation of salmonid habitat. This applies to all lands in the watershed, regardless of ownership.

Riparian

First and second order streams and associated riparian habitat which comprise the vast majority of all stream miles in the watershed, are often in better condition than larger fish-bearing streams since their watersheds are considerably smaller and their integrity is influenced by activities on fewer ownerships. Stream and riparian habitats in natural (unmanaged) condition are relatively common but limited to unroaded and unharvested first and second order watersheds that are often separated from similar habitats by areas that have been extensively disturbed by logging and road building.

Riparian habitat in older forests, which occurs almost exclusively on public lands, provides the greatest structural diversity of all seral stages and potentially supports a great variety of plant and wildlife species and has an important influence on the quality of stream habitat. Virtually all known riparian habitat is associated with streams. Over 80 percent of the wildlife species believed to occur in the watershed are dependent upon riparian habitat to varying degrees.

Riparian zones along Board Tree Creek are the best examples of contiguous riparian forest in the watershed still in a natural condition. Oregon Department of Fish and Wildlife (ODFW) stream survey data indicate that the abundance of large woody debris (LWD) in mainstem Board Tree Creek is less than expected for streams with intact riparian habitat. Much of the forest near this stream is the result of a stand-replacement fire 80-120 years ago. Some of the standards for LWD established by ODFW may not necessarily apply to southwest Oregon in the Klamath Province, since most of the data that was used to develop those standards were gathered from coastal and Willamette Valley sites.

There are approximately 19,893 acres of Riparian Reserves in the Grave Creek watershed which constitutes about 40 percent of federal lands. Currently about 12,550 acres of these Riparian Reserves on federal lands are greater than 80 years of age, or 63 percent of the Riparian Reserves (Table 9). Within the next 50 years, approximately 15,870 acres will grow to be older than 80 years old, barring fire or other major disturbances. The stream miles for each sixth-field watershed are displayed in Table 11.

There are about 3,013 acres of Riparian Reserves along <u>fish</u> streams on BLM administered lands. Table 10 indicates that about 62 percent or 1,864 acres of riparian zones are greater than 80 years of age. Based on the information in the table it is projected that within 40 years about 72 percent of the Riparian Reserve acres along fish streams will be in age classes greater than 80 years of age.

Table 9. Acres of Riparian Reserves by seral stage, Grave Creek Drainages.

	Grave Creek Total	Sixth-field watersheds						
		Upper Grave GV01	Placer GV02	Sunny Valley GV03	Upper Wolf GV04	Coyote GV05	Lower Wolf GV06	Lower Grave GV07
Non Forest	382	75	27	46	98	43	75	17
0-10 years	1,483	294	105	264	4	156	54	607
11-20 "	1,358	481	81	162	252	144	8	229
21-30 "	796	264	62	99	112	101	44	114
31-40 "	1,449	710	179	134	127	122	6	171
41-50 "	1,015	441	60	4	234	60	69	147
51-60 "	203	35	13	6	26	46	1	76
61-70 "	306	61	13	28	50	6	113	35
71-80 "	350	63	16	8	89	40	66	67
81-200 yrs.	7,946	952	1,028	1,044	655	912	285	3,070
201+ "	3,200	894	179	30	359	258	324	1,157
81+ Modified	1,405	243	153	210	194	96	44	464
Total	19,893	4,513	1,916	2,035	2,200	1,984	1,089	6,154

Table 10. Riparian Reserve seral stages along fish streams on BLM.

Vegetation Class (Age)	Approximate Acres
Non-Forest	24
0-20 years	238
21-40 years	332
41-80 years	305
81-200 years	1,409
200+ years	456
Modified 80+ years	242
Total	3,006

Table 11. Miles of Stream by Drainage.

Drainage	Miles
GV01 Upper Grave	222
GV02 Placer	107
GV03 Sunny Valley	187
GV04 Upper Wolf	105
GV05 Coyote	116
GV06 Lower Wolf	86
GV07 Lower Grave	272
Grave Creek (fifth-field)	1,097

Fish Habitat Condition

Fish habitat on BLM and non-federal lands is in poor condition (not properly functioning) because human activities over the last 150 years have had long term adverse consequences on the resource. BLM land management practices have been more sensitive to stream protection since the mid-1970s. But actions on non-federal lands, are maintaining stream habitat in a degraded condition, even on BLM lands downstream of non-federal ownership.

Analysis of stream survey data using the National Marine Fisheries Service Matrix of Factors and Indicators (Appendix C and D) has shown that fish habitat quality is poor throughout the watershed. Numerous stream habitat and watershed factors were consistently rated fair or poor: sedimentation, summer water temperatures, large down wood in the channel, pool quality, road density and location and integrity of riparian reserves.

Native Americans probably burned broad valley bottoms (e.g. Sunny Valley) on a regular basis to maintain them in an open condition for hunting and food gathering (Boyd 1986, Pullen 1995). Frequent burning maintained vegetation in a pine/oak/grass community and, as a result, streams probably had far less large wood than streams in narrow canyons and at higher elevation. Beaver dams in low gradient streams probably provided optimum coho rearing habitat. Beavers, which play an important role in coho salmon production, were decimated as trappers worked the watershed beginning in the late 1820s. The species is often trapped because of its tendency to plug culverts and interfere with water diversion. Much of the land adjacent to the 7.5 miles of Grave Creek between Brushy Gulch and Quartz Mill Gulch (middle Grave Creek) is now farmland with only a narrow band of alder or young conifers bordering most of the stream. The same is true of Wolf Creek between Coyote Creek and Hole-In-The-Ground Creek and lower Coyote Creek.

Mature and late successional forests supply optimum amounts of large wood to streams. Yet only about 54 percent of riparian forests across all ownerships are in this successional stage and virtually all of it is on public land.

The widespread absence of large wood in streams, which directly affects habitat factors such as pool frequency, depth and complexity, appears to be due to an extensive road network and logging in valley bottoms. Pools, which are often created by large wood, provide resting and hiding cover for fish and refuge from high water velocity. They are especially important for survival of cutthroat trout, juvenile coho salmon and to a lesser extent, juvenile steelhead. Juvenile coho and steelhead remain in small tributaries 1-3 years before emigrating to the ocean as smolts and during this critical time, are susceptible to impacts from land management activities. Resident trout never leave freshwater environments. Large wood also dissipates stream energy, creates complex pool habitat, creates spawning areas by trapping gravel and sifts small organic debris from the stream flow. About 47 percent of all stream miles that provide habitat for fish are within one site potential tree height (roughly 166 feet) of a road (Tables 7 and 8). In addition to roads, railroad grades follow substantial portions of lower Wolf Creek and lower Grave Creek within one site potential tree height. Transportation routes and timber harvest close to streams removes potential sources of large wood for streams and also facilitates salvage of logs from streams. In addition stream cleaning operations have occasionally removed large accumulations of logs to correct perceived fish passage problems. In retrospect some projects were appropriate, while others were not.

Historic, as well as some contemporary placer mining activity, has removed large conifers from riparian areas, added large quantities of sediment to streams and has simplified stream habitat. Most of mainstem Grave Creek through Sunny Valley, as well as middle Wolf Creek and lower Coyote Creek have been channelized during placer mining or to protect agricultural lands. Extensive tailings piles from placer mining in many riparian areas throughout the watershed have significantly reduced the potential for the land to ever grow conifers large enough to effectively provide quality riparian habitat and large down wood for stream channels.

Aquatic macroinvertebrates are sensitive indicators of habitat and water quality changes in forested watersheds and are a major food source for most native fish. Information on species diversity and abundance (Appendix G) indicates that functioning of most fish-bearing streams in the watershed is impaired because of excessive sediment in rock crevices, lack of large wood in the channel, poor riparian condition and elevated water temperatures. There are a moderate number of sediment-tolerant species in most streams, indicating that sedimentation limits aquatic productivity. Cool-water species are not uncommon but they are less abundant than would be expected in streams with consistently cold water (i.e. <60EF). All streams sampled to date in the watershed have low to moderate habitat quality for aquatic insects. This undoubtedly has implications for fish and other aquatic species.

Hydrologic Cumulative Effects

Analysis of the hydrologic functions in the Grave Creek basin was updated based on 1996 aerial photography, including equivalent clearcut acreage (ECA) transient snow zone openings (TSZ) compaction, and road density values (Appendix Q).

Two small drainages in upper Grave Creek were deferred from harvest activity during the last planning process under the RMP (RMP ROD Map #5 and Page 43). These two areas include Upper Grave Creek and Boulder Creek and total 2,924 acres. Recovery of these two drainages from an ECA perspective is expected to take at least 10 years but probably longer. Both drainages are in the Transient Snow Zone (Map 9). It may take up to 30 years for the canopies to develop and function more like mature forest stands in terms of capture of snow and subsequent sublimation.

By far, the major hydrologic elements that are of the greatest concern in this watershed are the high road densities, and the amount of compaction. Both of these elements contribute to increased runoff and affect the timing of peak flows during a storm. Placer mining along most of the major tributaries has widened and displaced the channel. This being the case, the channels are considered wide enough now to handle the increased runoff. Historically, beaver dams and undisturbed flood plains would have slowed and reduced peak flows.

There are four hydrologic parameters which are commonly used to describe the functioning and health of a watershed:

> Equivalent Clearcut Area (ECA) is a computed value which is time-weighted from the time of disturbance and decreases annually as the vegetation grows back. Hydrologic conditions return to pre-disturbance level in approximately 20 to 27 years. The relative indicator is 25 percent of the watershed in equivalent clear-cut area openings at any one time. (Values nearing the indicator value for any given HUC 7 are scrutinized according to the soils and stability of the watershed.) The relative indicator for some watersheds may be lower than 25 percent due to conditions in that particular watershed.
>
> Transient Snow Zone (TSZ) openings percentages are used to evaluate the risk of rain-on-snow events which potentially can destabilize stream channels. Acreage of the TSZ in open condition that exceed 25 percent of the entire basin have the potential for channel alteration through higher peak flows. Stream channel stability and other factors within the watershed are then analyzed to further assess the risk.
>
> Soil Compaction can cause increased runoff during rainfall events where percolation has been reduced. Erosion from compacted areas and resulting sedimentation of streams are partially responsible for reducing the quality of spawning and rearing habitat for aquatic species. Compaction values above 5 percent of the watershed are considered problematic.
>
> Road Density is a measure of the miles of road per square mile. Roads cause changes in hydrologic function and result in an increase in the effective mileage of intermittent stream channels. The ditches on these roads act as streams during runoff events. Roads also intercept subsurface water thereby altering the natural hydrologic regime. Road densities above 5 miles per square mile are cause for concern from a hydrologic perspective.

Hydrologic studies have demonstrated that clearcutting increases the availability of soil moisture on the site (Harr, 1989, Hicks, et. al 1991, Adams, et. al. 1991). This occurs since evapotranspiration is not occurring at the rate it was before the timber harvest. As the clearcut area revegetates in 5 to 15 years, the site may demand more water than the unharvested site depending on the amount of vegetation cover. This occurs when more vegetation (in terms of stems per acre) is present on the site than was previously there. More evapotranspiration is occurring during this phase mainly due to shrubby and herbaceous vegetation presence which was not present in the mature forest stage.

Ground water availability is affected by several factors, some of which can be predicted, such as permeability of parent material (bedrock), depth of soil (water retention), structure of soil (clay versus sand), proximity to wells, degree of slope of land and geography (annual rainfall). What cannot be predicted are factors that deal with climate change (short term and long term, water use (withdrawal) and shifts in water bearing zones resulting from fault failure either by gravity or earthquake activity.

Data from ODFW stream surveys indicate that most stream banks in the watershed are fairly stable with some instability in streams which were placer-mined or disturbed by other activities, especially tractor logging. Based on these data, the stability of stream channels within the watershed appears to be within the range of natural variability since the present channels are wide enough to accommodate peak flows without unexpected channel modification during medium floods. Channelization along Wolf and Grave Creeks has altered the sinuosity that would be expected in the flood plain, which could increase stream bank stability in those stream reaches. Beavers historically increased stream sinuosity, reduced stream velocity and added water storage areas. But they have been largely absent from the watershed for decades. Road density within the watershed may have altered the timing and frequency of 5 to 10 year flood events, but is unlikely to have affected peak size or timing of 25 to 100 year events

Stream low flows can be affected when 25 percent of the basin is in a clearcut condition as demonstrated by several studies (Doyle 1991, Harr 1989). The degree of impact to stream flow can vary from stream to stream depending on whether a flood plain exists. Hardwoods that invade a flood plain in the absence of a conifer stand account for much ground water loss through evapotranspiration thus reducing stream recharge. This concept can be observed in the fall as hardwoods go dormant. Without appreciable precipitation stream flows increase with decreasing evapotranspiration by deciduous species. Likewise if riparian buffers are maintained in narrow, steep, mountain streams the degree of impact to low flows is less. The water deficit in soils and low flow could exist for up to 30 years in southwest Oregon.

There are 38,731 acres of transient snow zone (land above 2,500' elevation) in the watershed. This represents 37 percent of the watershed. Most of this higher elevation land is in the eastern portion of the watershed, in upper Grave Creek (Map 9). The snow zone openings for sub-watersheds are presented in Appendix Q.

Fish Resources

Distribution and Status

The Grave Creek Watershed contains approximately 122 miles of stream habitat for winter and summer steelhead, coho and fall chinook salmon, as well as resident cutthroat and rainbow trout (Table 12, Map 10). BLM manages only 30 percent of the habitat for all fish habitat stream miles. The watershed's fish production will continue to be determined by actions on non-federal lands, rather than by BLM land management practices.

The number of adult salmon and steelhead that have historically returned each year to spawning streams is unknown. Anecdotal information from long-time residents suggests that anadromous fish runs to the Grave Creek basin are currently only a fraction of their historic levels. Activities and environmental conditions outside the watershed such as ocean productivity, sport angling, and commercial harvest of coho salmon downstream of the watershed, as well as activities in the watershed, influence the number of adult fish returning to spawn.

The National Marine Fisheries Service has been reviewing the population status of fish species throughout Western Oregon to determine whether individual stocks warrant listing as threatened or endangered under the Endangered Species Act. Current species status in the Grave Creek watershed is as follows:

Southern Oregon/Northern California coho salmon	- Threatened
Klamath Province Steelhead Trout	- Candidate
Southern Oregon/Coastal California Chinook Salmon	-Candidate
Oregon Coast Sea-run Cutthroat Trout	- Under status review

No streams in the watershed are stocked with hatchery trout. Recent concerns about the health of anadromous salmonid populations has prompted the Oregon Department of Fish and Wildlife to close all streams in the watershed to fishing to prevent mortality of juvenile salmon and steelhead.

Non-game species such as speckled dace, redside shiner, Pacific lamprey and sculpin also inhabit streams in the watershed.

Historically, the most productive fish habitat in the watershed was probably concentrated in three stream reaches: Grave Creek, roughly from the Brushy Gulch confluence upstream to Quartz Mill Gulch; middle Wolf Creek from Coyote Creek to approximately Hole-In-The-Wall; and lower Coyote Creek. These streams are located in broad valley floors and have very low gradient (i.e. < 2 percent). Historically they probably meandered across the valley floors, had numerous side channels and were connected with their flood plains. Unfortunately, placer mining, timber harvest, agricultural land clearing and water diversion have extensively modified these once important habitats since the mid-1850s to the point where they are currently among the poorest quality of all streams in the watershed. These three stream reaches are in non-federal ownership.

Fish habitat on BLM in this watershed typically is not in broad valley floors, but rather in narrow canyons and on moderate to high gradient tributaries, a condition that does not lend itself to stream meander, side channels or a broad flood plain. But because human activities have generally degraded streams less on BLM than on non-federal lands, streams on BLM will remain the key to maintaining viable fish populations in the watershed.

There are no known natural barriers that block or restrict upstream movement of fish in the watershed. If any are found, it is important that these waterfalls not be modified to provide fish passage so that populations of cutthroat trout or amphibians above the barriers are not exposed to levels of competition and predation beyond which they have presumably adapted to over millennia. Road construction and, to a lesser extent water diversion dams, have created numerous barriers to aquatic species. Man-made barriers, primarily culverts (Appendix E), may be preventing genetic interchange and some species from accessing habitats that are necessary for meeting life history requirements. They will also prevent recolonization of areas if subpopulations are extirpated through human-caused or natural events.

Because 70 percent of all fish habitat is on non-federal lands, significant improvement in the quality of stream habitat is unlikely until logging practices and riparian and road management on non-federal lands are implemented in a manner that meets Aquatic Conservation Strategy objectives.

Table 12. Approximate Miles of Fish Habitat in the Grave Creek Watershed.

STREAM NAME	COHO	CHINOOK	STEELHEAD	RESIDENT TROUT
Grave	22.9	22.9	37.3	38.5
Reuben	1.7		2.0	5.1
Rock			0.5	2.2
McKnabe				2.0
Poorman	1.2		2.7	4.9
Butte	0.6		0.7	2.5
Tom East (Sec 1)	0.5		1.0	1.0
Brimstone	0.4		0.7	3.2
Flume			0.9	2.5
Dog				2.9
Mill				1.2
Mackin				0.6
Rat			1.4	1.4
Maple			0.6	0.8
Salmon				0.5
Burgess				0.9
Shanks			1.8	1.8
Benjamin				0.3
Slagle				0.5
Tom East (Sec 8)	0.2		2.2	2.3
Clark			1.1	3.2
Boulder			2.6	3.4
Unnamed trib (Sec 6)				0.9
Baker				1.7
Slate				1.6
Lick (Sec 22)				0.5
Big Boulder			0.5	1.6

STREAM NAME	COHO	CHINOOK	STEELHEAD	RESIDENT TROUT
Last Chance			1.7	2.0
Panther (Sec 11)				0.3
Wolf	10.4		14.5	15.1
Hughes				0.4
Bear			0.4	0.4
Water Tank				0.2
Coon			0.4	0.5
Farmer			0.2	
Stage Road			0.2	
Sourdough			0.1	
Board Tree			1.0	
Hole-In-The-Ground			0.5	
Bummer			0.6	
Seccesh				1.6
Coyote	2.7		7.1	8.1
Dunbar			0.2	0.2
Kennedy			0.8	0.8
Colby				0.2
Miller				1.2
Bear			0.4	0.5
Scholey				0.3
Post				0.1

Current Monitoring Efforts

Monitoring sites using aquatic macroinvertebrates as indicators of habitat quality have been established on nearly all fish-bearing streams in the watershed that flow through public land. Sampling to establish baseline information has been conducted since 1992. The intent is to collect additional samples at the same sites at 3-5 year intervals to track watershed condition and trend.

Temperatures on many fish-bearing streams have been monitored since 1993. The program will continue in coordination with the Oregon Department of Environmental Quality under the 303d Program.

Stream habitat surveys on Grave Creek and its tributaries (ODFW 1998) are being performed to document existing conditions and to be used as a tool for watershed analysis and habitat improvement. The data represent baseline conditions and provide a reference for future surveys to determine habitat trend. The Oregon Department of Fish and Wildlife began collecting data in 1994. Surveys on all fish-bearing streams should be completed within the next couple of years, depending on funding. All streams will be re-surveyed at approximately ten year intervals.

Habitat Trend

Although there is no historic data for streams in the watershed, it is believed that the trend in habitat condition for fish-bearing streams has been downward since the mid-1800s when European settlers began moving into the watershed; it is currently stable at a low level of productivity. This conclusion is based on field observations, as well as on current data for stream habitat in Resource Area files and Appendix D, and summer water temperature data.

Although stream and riparian conditions are better on federal lands than on non-federal, the overall condition of virtually all fish-bearing streams is poor because of checkerboard ownership. A checkerboard ownership pattern in much of the watershed and concentrated non-federal ownership in many valley bottoms will continue to prevent streams and associated riparian habitat from attaining proper functioning condition (and potential fish production) because rules governing activities on non-federal lands are far less restrictive than what is required on federal land. Trend in riparian condition on non-federal commercial forest lands continuously fluctuates as private industry harvests its land on an approximate 40 year rotation. BLM, and to a lesser extent, State of Oregon- controlled streams will see an upward trend in riparian condition due to better management of riparian zones through implementation of the Aquatic Conservation Strategy (federal) and the Oregon Coastal Salmon Restoration Initiative.

Water quality trends for the recent past and for the near future is probably stable in a degraded condition on Grave Creek and major tributaries because most of the watershed is in non-federal ownership (52 percent) with no concerted effort to reduce sedimentation from roads or to maintain or restore riparian habitat to proper functioning condition. Conversely, the trend is probably upward for small headwater streams (order 1, 2 and 3) that originate on BLM and that are largely unaffected by activities on other ownerships, as BLM implements ACS objectives on its lands. It is doubtful if improvement of water quality as a result of BLM management will be measurable in Grave Creek or at the mouth of major tributaries as long as the ACS does not apply to all ownerships.

The Sunny Wolf Community Response Team has developed a Strategic Plan for Community Development updated in January, 1999. It includes a strategy to educate the community about healthy waterways to maintain water quality and aquatic habitat.

A cooperative agreement with Rogue Valley Council of Governments will result in a watershed management plan being developed in 1999.

Commodity Production

Timber Products

The primary forest product available in this watershed is merchantable timber from unmanaged or previously partial-cut stands. The majority is large, older trees. Smaller timber, is also available from commercial thinning, but to a lesser extent.

Almost all of the old-growth timber on non-federal land has been cut. Recent harvest on private land has consisted of smaller trees left in previously logged lands, and of second or third growth stands. State of Oregon lands and Josephine County lands have also had most of their larger trees harvested, but there are still remnants of older stands remaining.

On BLM lands, timber productivity and management is closely tied to natural plant series (see discussion in the Characterization section) and site productivity. The Grave Creek watershed is an area of typically low site productivity. Nearly 90 percent of all BLM land in the Grave Creek watershed is Site Class 4 or 5. These lands have relatively low productivity; site class 6 is virtually non-forested, site class 1 and 2 are the most productive lands.

The General Forest Management Area (GFMA) lands are available for intensive timber management. There are 44,339 acres of GFMA lands in the watershed. Under the RMP, regeneration harvest would not be planned for stands less than 100 years old and would generally not occur in stands less than 120 years old in the first decade of the plan; before 2005 (RMP p. 189). Also in the RMP, regeneration harvests on northern GFMA lands are mandated to leave a minimum of 6 to 8 standing green trees per acre, as well as snags and coarse woody debris for wildlife, fish and soil purposes. This could amount to 5,000 board feet per acre or more being left. Historically, a portion of this material would have been harvested and removed. Therefore, any discussion about timber commodity harvest must recognize that a portion of the potential timber commodity is purposely left on every acre.

Some BLM lands have been administratively withdrawn from timber harvest through the Timber Productivity and Capability Classification (TPCC) based on rocky soils, fragile slopes, high water tables and other factors. There are 8,710 acres of TPCC withdrawn lands included within the General Forest Management Area (GFMA) land allocation; these also overlap Riparian Reserves. Reserves for Owl Core areas (1,799 acres) and Recreation sites (227 acres) have also been withdrawn from timber management. Riparian Reserves outside of these land allocations are approximately 15,754 acres. After these reductions are made, there remains approximately 21,478 acres or 43 percent of GFMA lands that are still available for intensive forest management in the watershed.

Connectivity/Diversity Blocks (2,011 acres) are also available for intensive timber management; together with the GFMA, they make up the Matrix lands in the NFP. Connectivity blocks may have some timber removed from them but are partially constrained compared with the GFMA lands.

Timber Projections

In recent years, much discussion has occurred regarding the "sustainability" of various commodities on federal lands, particularly the timber resource. What level of "sustainable harvest" can occur on a regular interval that will not adversely affect watershed, riparian, soil, wildlife , or other resources, and still provide wood products as the NFP instructs BLM managers to do?

An examination of how the BLM currently determines its Allowable Sale Quantity (ASQ) and how it affects the Grave Creek watershed should be made here. The ASQ is the amount of the timber resource including salvage, that the BLM calculates can be removed from its timberland each year without adverse effects. These calculations include increases in growth over the life of the timber stand as a result of intensive forest management practices such as planting, brushing, and thinning. The area where these calculations occur is done by Master Unit. All of the Grave Creek HUC 5 WA is included in the Josephine Master Unit, which comprises roughly half the Medford District's land base. These calculations are based on many permanent inventory and growth plots occurring throughout each Master Unit. Therefore, the BLM does not generate its inventory and its projections of the Allowable Sale Quantity by HUC 5 or HUC 6 watersheds analyses. Acres actually cut in a given year may be chosen from anywhere within the Master Unit and not necessarily proportionately from any HUC 5 or HUC 6 watershed within it. Also, there is no requirement to harvest a given amount of acres or volume each year from the Grave Creek watershed area. As it is spread over the entire Master Unit, there may actually be large variations of harvest in the Grave Creek watershed in a decade. It is up to the BLM managers to determine an appropriate amount to be taken each year from lands available for harvest and to do it in accordance with the RMP. Currently, there is an ASQ of about 13 million board feet from the entire Glendale Resource Area. The Grave Creek watershed comprises about one quarter of the Glendale Resource Area.

What might a "sustainable harvest " of timber commodities on General Forest Management Area lands outside reserves in the Grave Creek WA look like? It does not include lands reserved in Riparian Reserves, spotted owl core areas, Late-successional Reserves, TPCC-withdrawn areas, or recreation sites. Harvest can occur on "what's left" outside of designated reserves on BLM lands, about 21,478 acres in the Grave Creek watershed.

The exception of Connectivity Blocks in the Grave Creek watershed should be noted here. There are 2,011 acres of this land allocation in this watershed. Connectivity Blocks, along with the GFMA, comprise the Matrix lands in the NFP. Timber harvest is permitted, although special considerations are made to retain late successional characteristics. Connectivity blocks provide blocks of land between Late-successional Reserves, that still have late-successional characteristics. Potential harvest amounts, therefore, are less than from other GFMA lands. This is due to the restriction of having to leave 12 to 18 green trees per acre in these blocks. For much of the low site lands in this watershed, there often is only slightly more than 18 green trees per acre to begin with. This combination of factors severely restrict the potential harvest here, and for that reason, any harvest that may be made here in the future won't be figured into any projected "sustainable" commodities.

Assuming a 100-year rotation age, with 21,478 acres of General Forest Management Area lands outside reserves (Table 13) an evenly distributed harvest on BLM lands in the watershed can be projected to result in approximately 2,200 acres of regeneration harvest per decade. This is a greatly simplified analysis, since productivity varies greatly between locations, but it is a useful aid in assessing relative timber availability and future projections of impacts.

Another method to project future harvests is to use Table 13 as a tool. The year 2000 on this table shows the most recent BLM record of ages according to our data files.

This table shows that for GFMA lands outside of reserves 4,183 acres occur in the 0-20 and 2,477 acres in the 21-40 year age groups, when the primary disturbance agent to create these age groups in the last forty years has been timber harvest. It shows how harvest acres are increasing in recent decades. However, harvests are still reasonably close to the 2000 acre per decade number for " sustainability " that has been estimated. This, also, is very close to the approximation mentioned above of 2,200 acres per decade as reasonable for "sustainability".

The balance of the table shows how harvests in the future would affect the seral stages of intensely managed stands. It should be noted that the ages and seral stages of all other reserve lands in the Grave Creek watershed will continue to age and develop under this scenario.

Table 13 uses the current seral stage acres as a starting point and an exercise to project what amounts might be harvested in the next one hundred years.
There are a few assumptions in this table:

- Newly harvested land will be primarily from the oldest age groups and from areas previously entered for partial cut harvest
- No more than 4,000 acres will have regeneration cut in any 20 year period (i.e. 2,000 acres per decade) .

Table 13. Projected seral stage acres on GFMA lands in the Grave Creek watershed, outside reserves, assuming an average of 2,000 acres is cut per decade.

Stand Age	2000	2020	2040	2060	2080	2100
0-20 yr	4,183	4,000	4,000	4,000	4,000	4,000
21-40 yr	2,477	4,183	4,000	4,000	4,000	4,000
41-60 yr	1,331	2,477	4,183	4,000	4,000	4,000
61-80 yr	1,332	1,331	2,477	4,183	4,000	4,000
81-100 yr	1,293	1,332	1,331	2,477	4,183	4,000
101-200 yr	6,463	5,463	4,298	1,769	1,295	1,478
200+ yr	2,804	2,097	1,189	1,049	0	0
81-200 yr Modified	1,595	595	0	0	0	0
TOTALS	21,478	21,478	21,478	21,478	21,478	21,478

Some conclusions from the data in Table 13 include:

- By the year 2040, all modified (partially harvested acres) have been harvested.
- Stands in all the older classes have been reduced to slightly less than half of Year 2000 levels.
- By 2080, 15 percent of older classes still remain.
- By 2100, an even seral stage distribution will be achieved, with seral stages of 0 - 100 years.

It appears possible from this projection that the BLM could sustain a harvest on an average of 2,000 acres per decade in this watershed while maintaining standards and guidelines as stated in the Medford District RMP, while retaining older aged stands and seral stages in the Grave Creek watershed in designated reserves.

If a range of 10,000-20,000 board feet/acre of timber is removed each decade, then a range of harvests might be projected to be 20 million to 40 million board feet per decade of timber in the Grave Creek watershed. Volumes per vary greatly within the watershed which greatly reduces the accuracy of future projections.

It should be noted that of the 50,271 acres in the Grave Creek WA, this table only implies having harvest activity on 21,478 acres (the 1,138 non-forest acres have been removed form this table). This is approximately 43 percent of all federal land in the Grave Creek watershed that will be available for harvest.

Table 14. Projection of seral stage acres on federal and non-federal lands in the Grave Creek watershed.

YEAR 2000 SERAL STAGE	BLM		NON-FEDERAL LANDS*	TOTALS	YEAR 2100 SERAL STAGE	BLM		NON-FEDERAL LANDS*	TOTALS
	GFMA IN BASE OUTSIDE RESERVE	OTHER BLM LANDS				GFMA IN BASE OUTSIDE RESERVE	OTHER BLM LANDS		
0-20 yr	4,183	3,024	15,668	22,875	0-20 yr	4,000	1,000	15,668	20,668
21-40 yr	2,477	2,633	14,751	19,861	21-40 yr	4,000	1,000	14,751	19,751
41-60 yr	1,331	1,108	10,378	12,817	41-60 yr	4,000	1,000	10,378	15,378
61-80 yr	1,332	1,107	10,378	12,817	61-80 yr	4,000	1,000	10,378	15,378
81-100 yr	1,293	2,004	304	3,601	81-100 yr	4,000	1,000	304	5,304
101-200 yr	6,463	10,019	1,522	18,004	101-200 yr	1,478	7,600	1,522	10,600
200+ yr	2,804	6,149	841	9,794	200+ yr	0	15,438	841	16,279
81-200 yr (MOD)	1,595	1,994		3,589	81-200 yr (MOD)	0			0
NON		1,105		1,105	NON		1,105		1,105
TOTALS	21,478	29,143	53,842	104,463	TOTALS	21,478	29,143	53,842	104,463

*The following timber harvest rotation age assumptions were made for non-federal lands:
- -Industrial timber companies - 60 year rotation
- -State lands - 60 year rotation
- - small private land owners -100 year rotation

Table 14 projects seral stages on both non-federal and public land age classes in the watershed. It was assumed that BLM would harvest an average of 2,000 acres per decade, with a 100-year rotation, and that private land owners would harvest on a shorter rotation length (i.e., private industry 60 years; Oregon state 80 years, small private land owners 100 years). An allowance was made in this projection for disturbance (e.g. fire) in the reserve areas of 500 acres each decade. By the year 2100 there are still 1,478 acres of GFMA lands outside of reserves older than 100 years. Also, 29,143 acres of older stands occur in reserves. The projection shows a significant shift to seral stages older than 100 and 200 years for the watershed as a whole, as BLM reserves recover from past logging. This is a feature of the Northwest Forest Plan that calls for Riparian Reserves and other reserves to remain uncut for this period. This shift would occur exclusively on BLM lands and makes no allowance for a shift on non-federal lands.

Constraints on timber availability

The NFP places numerous limitations on which lands the BLM may offer timber for sale which are not taken into account in these projections and may not be accounted for in the TRIM-plus growth and yield modeling used in setting the Allowable Sale Quantity (ASQ) in the RMP. The model assumed approximately 50 percent of the potential GFMA would be taken up in Riparian Reserves. The actual, estimated percentage of Riparian Reserves in this watershed is 48 percent. However, deductions for Survey and Manage species protection measures were not factored into the modeling at the time. Recent experience in surveying for these species in recent timber sales indicates an additional reduction will occur in future sales (Table 15).

Table 15. Potential future restrictions on timber availability on GFMA lands in the Grave Creek watershed.

Type of restriction on timber availability	Relative level of impact on timber availability on GFMA lands outside reserves*
Del Norte Salamander - retain 40 percent canopy around talus	Medium
Mollusks - Very Uncertain	High
Uneconomical/Unfeasible (UE/UF)	Low
Red Tree Voles	Low-Medium
New owl sites/CHU	None
Raptors and other Special Status Species	Low
Watershed parameters (compaction, transient snow zone, ECA, etc.)	Low
Recreation/Wildlife/Late-successional retention	None
Potential fish listing as T/E	None

* High = constrains virtually all proposed timber harvest units
Medium = constrains some proposed harvest units
Low = rarely constrains proposed harvest units
None = no effect anticipated in future harvest units

If these projections are accurate, it may indicate that the actual levels of timber harvest available in this watershed may be considerably less than those projected in the ASQ modeling and the projections above. In the long term a reduction in the ASQ may be called for. This will be continually evaluated as part of the adaptive management aspect of the RMP.

Special Forest Products

The Grave Creek watershed has a diverse array of special forest products (SFPs). The potential for commercial use is relatively high because of the ready access to Interstate 5 and the close proximity to several population centers. Some of the more important special forest products found in the watershed include:

Firewood:
Residents of the Grave Creek drainage have always used wood as a heat source and will continue to do so into the future. In the Grave Creek watershed, this is by far the special forest product most in demand, for both personal and commercial purposes. The species most asked for are pacific madrone and oak, although any species in slash piles and near rocked roads is used. Madrone has the multiple advantages of high heat output, little ash and ease of splitting. Demand has been met in the past through selling slash piles left over from timber sales and from cutting roads. Recently, however, fewer timber sales, less slash production, riparian area protection, less road building and closing of roads have combined to reduce the traditional supply of firewood. Alternatives for supplies such as thinnings and light forms of logging that leave slash for firewood are being explored. If such alternative projects can be offered, then greater supplies will be available. Since such supplies would be ongoing with new growth, these supplies should be sustainable. Maintaining supply of firewood is important here as poaching of wildlife trees in lieu of purchasing permits in designated areas has increased in recent years.

Other Wood Products:
Numerous possibilities exist within the watershed for products such as decorative wood, burls, furniture, toys, and other specialty products. Primary demand is for hardwoods: Pacific madrone, tanoak, golden chinquapin, California black oak as well as bigleaf maple, manzanita spp., and Pacific yew. All these species, with the exception of pacific yew, occur in the watershed in large numbers. The amounts of material sold for these purposes are small, so viability of a species and sustainability should not be in question. Care must be taken on the small scale, however, not to remove a given large hardwood tree where no others exist or the last burl from several acres, to maintain the diversity of these features.

Other products coming from conifers have been sold, such as posts and poles. Inventory for these types of material, also referred to as "small wood" is great in the Resource Area and in the Grave Creek watershed in particular. Overstocked stands or overtopped trees less than eight inches dbh, and in danger of mortality through lack of light and nutrients, are candidates for this type of harvest. Removal of this type of tree is economically difficult, however. Alternative harvest methods and innovative contracting will be needed to remove this surplus material. Benefits could include increased forest health and fire hazard reduction.

Decorative tree boughs:
There are several species of woody trees and shrubs sought for use both for seasonal demand near Christmas and throughout the year. By far, the species most in demand from the Grave Creek watershed is Incense Cedar. It is prevalent throughout the Grave Creek watershed in many different plant associations. Since only the outer branches are allowed to be cut, the trees are rarely destroyed and a new crop on a given tree will occur with sprouting every five years. This species is easily sustainable. Various pine species and true fir are in lesser demand than incense cedar. Supply of these species throughout the watershed is great relative to demand and sustainability is not seen as a problem. Demand is slowly increasing for manzanita species and sales have increased. They are being sought in recent years to have branches removed for wreath making. Once again, throughout the watershed, supply far outnumbers demand and cutting pressure has not yet been noticed. In fact, reduction of fuel amounts in manzanita fields may lead to a lessening of fire hazard. Other species in recent years that been sold in token numbers are ocean spray, pacific yew, and red alder. All of these species are numerous in the Grave Creek watershed and none of these species or others have been harvested in noticeable amounts.

Christmas trees:
Historically, there has not been a large demand for either commercial or personal use of Christmas trees in this watershed. The only notable exception that has to be watched is the amount of Noble Fir or Shasta Red Fir present on King Mountain on the edge of the watershed. King Mountain is the only niche these species occur on in the entire Resource Area. While cutting pressure here for Christmas trees occurs each year, most of it is done illegally. Nevertheless, monitoring of this area should occur to see the extent of harvest in recent years. Agreements and leases with commercial cutters may have some validity in plantation sites.

Bear grass:
This member of the lily family is used for decorative purposes in floral arrangements. Rarely is the entire plant removed as there is no demand for the root. When harvested, bunches of leaves are removed with the root ball left slightly damaged but intact. After three or four years, new leaves have replaced those taken and harvest is possible again. There has been consistent demand and sales of this product for the last ten years in the Glendale Resource Area. Other drainages in the area, besides Grave Creek, contain higher numbers and frequency of this plant. The highest frequencies of this plant in the Grave Creek watershed occur in the rockier, serpentine plant associations on the lower slopes of King Mountain, across several thousand acres. Monitoring should be formally done on these sites to insure the presence and harvestabilty of the species. At this time, cutting pressure does not appear to be damaging to the plant in the Grave Creek watershed and continued harvest seems sustainable.

Mushrooms:
The watershed is within the ranges for all of the wild mushrooms deemed commercially valuable: chanterelle, morel, matsutake, bolete, and hedgehog. The presence and supply of fruiting bodies of mushrooms are difficult to predict, at best in any given year.

Personal use harvest is allowed in the Medford District of the BLM for any species for the amount of five gallons per person per year without a permit. The commercial mushroom picking industry is a volatile one, with supplies and prices to harvesters fluctuating wildly. In order to maximize profits, secrecy and illegal harvest has been common. Historical uses from legal commercial harvesters is near non-existent in the Glendale Resource Area. The last season that had high numbers of mushrooms (winter 1997-98) showed evidence of mushroom picking in the Resource Area, yet few permits were sold. It is difficult, therefore, to know the true supply available and just as hard to know the amount harvested, legally or illegally. While we might know that mushrooms are being harvested, control of the harvest by BLM will have to include the presence and vigilance of BLM personnel and law enforcement. While it is not thought that any mushroom species is in danger of significant losses, there is little data to make predictions.

Pacific Yew:
This tree occurs throughout the watershed, but in small numbers. Demand isn’t high. It typically occurs in riparian areas in this watershed and as such would be off limits to harvest. In the early 1990s, its bark was notable as a source for a chemical used in cancer research. It is no longer harvested for that purpose on BLM lands in Oregon.

Other products:
Evergreen huckleberry, salal and dwarf Oregon grape are all evergreen broadleaf species used in floral arrangements. Demand has been spotty in the Resource Area, as other lands nearer to the coast have larger individuals and amounts. They all occur in the Grave Creek drainage and there have been sales for all these species. At the numbers that have been historically sold, and should demand increase by small increments, there appears no danger of over harvest.

In the future, there will likely be demand for prince's pine, vine maple, herbs, ferns, Pacific rhododendron, and mosses, all of which occur in the Grave Creek watershed. While all these species occur in the Grave Creek watershed, their inventory is very spotty. Should demand increase, careful inventory and monitoring will be needed to avoid over-cutting and riparian damage.

Mining

Minerals

An inventory, utilizing the August, 21 1998, mining claim microfiche prepared by the BLM Oregon State Office, revealed that there are 54 placer claims, 51 lode claims and one tunnel site currently existing within the watershed. Out of these 106 claims, 21 have notices on file and 10 of theses have occupancies. In the past there were several hundred mining claims in the watershed, but many claimants dropped their claims from the mid 1980's to 1990's. Appendix M shows the township, range and section for the 106 current mining claims.

There is no inventory of existing and abandoned mine adits (a opening in a hill side) or shafts (a hole in the ground, can connect to adits).

Claimants' Rights

The rights of a mining claimant/operator goes back to 1872, one of the oldest laws still on the books. A mining claimant/operator has the right to prospect and develop the mining claim as authorized through the General Mining Laws and amendments. There are two types of mining claims: placer and lode. A placer deposit is defined as a mass of gravel or sand resulting from the erosion of solid rock that contains particles or nuggets of gold, platinum, or other valuable minerals- often found in a stream bed within this area. A lode deposit is a vein with precious metals within it, that is located in the bedrock, typically at a shear or fault zone. People can also locate mill sites and tunnel sites.

Acceptable activities that normally occur on mining claims include the development of the mineral resources by extracting the mineralized or gold bearing gravel, or ore, from the claim and manufacturing of the mineral materials utilizing a trommel and sluice box system (for placer), or a mill site of some sort (for lode). After the gold and minerals are extracted the tailings (waste material) are stockpiled to either be utilized in the reclamation of the site or removed to an appropriate location. Timber on site may be used, in some situations, if outlined in a mining notice or plan of operations. The timber can only be used in conjunction with the mining operation.

The operator, or claimant, will be allowed to build structures and occupy the site where such uses are incidental to mining and approved in writing by the appropriate BLM authorized officer. The use and occupancy of a mining claim will be reviewed on a case-by-case basis to determine if such uses are incidental. A letter of concurrence will be issued only where the operator shows that the use or occupancy is incidental to mining; where substantially regular mining activity is occurring; and will be subject to the operator complying with all state, federal, and local governmental codes and regulations. This means that in addition to meeting the requirements to mine on a regular basis the claimant will need to meet the standards of the Oregon Uniform Building Codes and all state sanitation requirements.

Surface Uses of a Mining Claim

The filing of mining claims gives the claimant the rights and ownership of the minerals beneath the surface of the lands encumbered by the mining claims. In most cases, management of the surface of the claims rests with the appropriate federal agency with jurisdiction.

The claimants/operators have the right to use that portion of the surface necessary in the development of the claim. In the cases where the surface of the claims are administered by the BLM or U.S. Forest Service the claimant/operator may, for safety or security reasons, limit the public access at the location of operations. Where there are no safety or security concerns the surface of the mining claims are open to the public.

In some instances the surface of the mining claim is managed by the claimant. These are claims that were filed before July 1955 and determined valid at that time on Public Domain (PD) Lands. The same would not apply to O & C Lands because the O & C Act of 1937 reserved all timber to BLM. Though this has never been court tested for claims filed before 1955 on O & C Lands. In addition to the owners' rights already discussed, claimants of these claims also have the right to eliminate public access across that area where they have surface rights. It does not mean that the claimant can cut the timber for his gain. There is one instance within the watershed where the claimants have surface rights, the Daisy claim T. 34 S., R. 5 W., section 14.

There are ten occupancies within the watershed, all of them have filed a notice. The new regulations state that the BLM needs to approve or disapprove of all existing and future occupancies. Refer to Appendix N and Map 11 for locations of mining notices and legal occupancies.

There are two parcels of private land within the watershed where mineral patents were issued with BLM retention of rights to cut timber. Those are described below with the extent of the BLM timber management rights outlined:

> T. 35 S., R. 5 W., section 1, S1/2NE1/4NW1/4. This is a 20 acre parcel. Patent number 36-81-0001. There is a reservation to the United States for "the timber now or hereafter growing on said land, togther with the right to manage and dispose of the timber as provided by law, in accordance with subject to the provisions of the Act of April 8, 1948 (62 Stat 162)". The Act of 1948 in general opens Revested O&C Railroad lands to mineral entry.
>
> T. 33 S., R. 4 W., section 17, MS 899. This is a 55.974 acre parcel. Patent number 1154357. The same timber reservation as above pertains to this parcel.

At the town meeting to discuss this area on Nov. 12, 1998 it was brought up that some of the occupancies were unsightly- with trash and junk spread about the area.

Levels of Operation

On the lands administered by the BLM there are three levels of operations that may occur. These are casual use, notice and plan of operations.

Casual Use

The lowest level of operations is considered casual use. It includes those operations that usually result in only negligible disturbance. These types of operations usually involve no use of mechanized earthmoving equipment or explosives, and do not include residential occupancy. No administrative review of these types of operations is required. The number of casual users in this category is not known.

Notice

A notice is the most common level of operations. It involves activities more disturbing than casual use and less than a disturbance level of five acres. This level of operations requires the operator to file a mining notice pursuant to the BLM Surface Management Regulations. The mining notice informs the authorized officer of the level of operations that will occur, the type of existing disturbance at the location of the operations, the type of equipment to be used in the mining operations, and the reclamation plans following the completion of the mining activities.

Mining notices involve an administrative review of access routes used in the mining operations and a review to determine if unnecessary or undue degradation may occur as a result of the mining operations. Within the Grave Creek watershed twenty mining notices have been submitted for operations proposed to occur on the BLM-administered lands. BLM has 15 days to review a mining notice.

Plan of Operations

A plan of operations may be required for mining operations that meet any of the following criteria:

a. Proposed operations that may exceed the disturbance level of five acres;

b. Activities above casual use in specially designated areas such as areas of critical environmental concern (ACEC), lands within an area designated as a Wild or Scenic River, and areas closed to off-highway-vehicle use; and

c. Activities that are proposed by an operator who, regardless of the level of operations, has been placed in noncompliance for causing unnecessary or undue degradation.

The review of plans of operations involves a NEPA environmental review to be completed no later than 90 days from the date of the submission of the plan. No plans of operations exist within the watershed at this time.

Mineral Potential

Locatable mineral potential is defined in the Medford District RMP (Chapter 3, p. 102) as low, moderate or high (USDI BLM, 1994). The mineral potential map in the RMP (Map # 3-15) shows that all three levels are within the watershed. The high areas are located along Grave Creek and Coyote Creek.

The lands are rated as low for coal, oil and gas.

Withdrawn Lands

Areas withdrawn from mineral entry include a ½ mile corridor along the recreation section of the Rogue River, this includes the confluence of Grave Creek. These withdrawn areas are popular for recreational dredgers and gold panning, who can mine for gold without a claim or the possibility of being on somebody's claim. The Rogue River from Applegate to Grave Creek is noted in the Medford District handout on gold panning/dredging areas. No permit is necessary. The handout does not specifically state recreational mining is permitted ¼ mile up Grave Creek. The legal description of the mouth of Grave Creek is T34S R7W Sec.6 W1/2W1/2.

The following lands are under Power Withdrawals and Classifications, this does not mean they are withdrawn from mineral entry.

T34S R7W Sec. 6 NENW
T34S R7W Sec. 5 W1/2NE; N1/2NW
T33S R7W Sec. 32 SWSE; SESW

These were withdrawn in 1926 and 1928 for project 143 and 903:

T33S R4W Sec. 31 SESE
T34S R4W Sec. 5 E1/2sw;SWSW

These were withdrawn in 1942 for project 330.

No other lands are withdrawn from mineral entry.

The King Mt. Rock Garden ACEC, is not withdrawn from mineral entry, but any proposed operation would require an approved plan of operations.

Mineral Patent Applications

Within the watershed there are two patent applications pending. Caroline Tucker (33-7-32) submitted an application before the patent moratorium took effect. However her application was incomplete so the State Office denied the application, she has appealed to IBLA. The other application is Bruce Crawford on the Daisy Mine (34-5-14). This was submitted after the patent moratorium. If patents are issued, those lands involved in the applications that meet the validity test would become private land. Those areas that did not meet the validity test would result in the mining claims deemed invalid.

Late-successional Habitat/Species

The present distribution of the late-successional habitat in the Grave Creek watershed is a function of the existing vegetative conditions before European settlement, the exclusion of fire, and the logging practices that have occurred since that time. Historically, the late-successional habitat probably occurred in a much more contiguous pattern with some open meadows and areas of sparse conifer cover in the low lying hillsides along Grave and Wolf Creeks. The late-successional conditions are presently quite fragmented on much of the watershed, due to clearcuts and small residential tracts. Road construction near the main travel routes and communities allowed for early access for timber harvesting, with harvest in the areas away from these travel routes occurring more recently. In addition to the clearcuts on non-federal and federal lands, there has been considerable partial cutting, especially on BLM lands. In some cases this has resulted in an open overstory and conifers have become established in the understory. It has also encouraged stands with multiple layers where the overstory has scattered large trees and the understory canopies have expanded with a mix of hardwoods and younger conifers of varying sizes. However, in many areas, the practice resulted in dense brush and hardwood stands with little conifer regeneration, under the residual conifer overstory trees.

Logging has altered vegetative communities within the riparian zones of many of the streams. On private industrial lands, logging has often occurred down to the edge of the streams, retaining scattered trees less than 8-10" dbh. Early seral herbaceous and shrub species are the dominant vegetative type within these areas. On federally managed lands no-cut riparian buffers have been retained since 1995 on all streams, and on the larger, fish-bearing streams before that. The resulting pattern of buffered and non-buffered areas along each creek has led to broken, poorly connected riparian corridors.

Fire has also greatly affected the vegetation patterns in the watershed. In pre-settlement times, frequent, low intensity fires were the rule in this area, resulting from both lightning and native American ignition. There have also been large, stand-replacement fires, most recently the Grave Creek burn in 1976 in the upper reaches of the watershed. This area, however, was planted after the fire, much of it to ponderosa pine. Effective fire suppression in the region has allowed many areas to develop a dense stocking level of small Douglas-fir, hardwoods or brush. This shift in plant species composition, and in density in some areas, has generated concerns for long term forest health. The high density of small trees and brush may result in increased risk of large, intense fires or increased susceptibility to disease or insect damage.

Large Down Wood

There have been two projects in the Grave Creek watershed, since 1996, that have had surveys performed for large down wood. The Grave Creek West timber sale involved 367 acres that were surveyed and Serpent’s Grave totaled 98 acres of surveys.

In the Grave Creek West project area, only down wood that was 16" diameter or larger (at the large end) that was considered Class 1 or 2 (least decomposed logs) was recorded. The older, Class 3 through 5 material was not measured so that information is lacking for this project area. Of the 367 acres surveyed, 102 acres (28 percent) had more than 120 feet per acre, 86 acres (23 percent) had less than 120 feet per acre, and 179 acres (49 percent) had no Class 1 or 2 down wood. The range of the amount of down wood in the areas having over 120 feet, was 228 feet per acre to 456 feet per acre. The Class 3 through 5 wood was not measured, however the majority of the acres surveyed did show the presence of some Class 3 through 5 woody material.

The Serpent's Grave project area is smaller, but the information is a little more complete. There were 32 acres (33 percent of the area surveyed) which had more than 120 feet per acre of Class 1 or 2 logs, 16" diameter and larger. There were 17 acres (17 percent) which had less than 120 feet per acre, and 49 acres (50 percent) which had no Class 1 or 2 down wood. The levels of down wood in the areas having more than 120 feet per acre ranged from 228 feet to 342 feet per acre. There is also information for the Class 3, 4 and 5 logs for all 98 acres surveyed. Amounts ranged from 295 feet per acre to 570 feet per acre.

An interesting observation for both of these areas, concerns the amount of area that had no Class 1 or 2 down wood, 16" or greater diameter. For both project areas, 50 percent of the acreage surveyed had none, while 28 percent to 33 percent had more than 120 feet per acre of Class 1 or 2 down wood. This is a fairly consistent number for both of the projects within this watershed. Both of these project areas have had some past timber harvest, to varying degrees. Fire exclusion in the last century has likely had some affect on this, in different ways. The lack of fires could allow greater accumulations of large down wood than would have occurred in pre-settlement times. However, more frequent fires before fire exclusion, might also have created more dead trees which would add to the amount of large down wood. Salvage harvest would, of course, reduce the amount of down wood and this likely occurred in the areas nearest the roads. It is hard to say, with any real certainty, what the actual effect of fire prevention efforts are on the levels of large down wood. Overall, the surveys probably give us the best hint of what is naturally occurring. These initial surveys, however small in sample size, suggest that the natural levels of large down wood in this watershed may have been below the 120 feet per acre of Class 1 or 2, 16" diameter and larger, amount that is suggested as naturally occurring on the Medford District forested lands.

Fire Hazard and Risk

In analyzing the potential for wildfire in the Grave Creek watershed, three primary factors were considered:

- -Hazard - How fuels, slope aspect and other factors affect a fire's intensity and spread.
- -Risk - The relative danger of ignition, either by lightning or human causes.
- -Value - The relative value of a resource which might be damaged by a wildfire.

Areas in the watershed were rated either High, Medium or Low for each of the three categories. Areas rated "High" in all three categories were mapped to determine highest priority for fuels management to prevent major wildfires and other management practices (Map 13).

High Hazard (defined as most dangerous fuels, flashy, dense, continuous fuel ladders)
- Pre-commercial thinning and brushing units since 1993
- timber harvest units since 1993
- dry pastures (agricultural lands)

High Risk (defined as greatest potential for ignition)
- major travel routes
- RIA/residential areas
- Burma and Dutch Herman ponds
- London Peak Trail
- King Mountain ACEC
- I-5
- area near historic Golden
- mining sites
- Illegal garbage and hazardous chemical dumping

High Value
- Northern Spotted Owl core areas
- communication sites
- progeny test sites
- RIA - neighbors
- King Mountain ACEC
- Commercial size conifer stands under 120 years old

Within the Rural Interface Areas there exist moderate to high fire hazards and risks to adjacent lands, BLM to private and private to BLM, due to site prep burning and the burning of trash and/or debris piles from land clearing activities.

Historic fire frequency in this area can be as low as 15-30 year intervals for ponderosa pine and mixed conifer types in this region (Agee, 1993). Most of the areas in this watershed have not had any fire events in the last 70 years, and often much longer than that, resulting in stands that have an abnormally high fire hazard. Vegetation type, soils, and aspect have an important effect on the magnitude of this hazard.

The highest hazard areas are also the result of values that are at risk and this determines how they are ranked as a priority for treatment. The risk of having a fire start is also an important factor in placing priority on treatment. Areas above well-traveled roads, those in close proximity to the rural interface, or that are close to popular recreational areas, all have a high risk of having an unplanned fire.

Stands with a conifer overstory 60-100 years old, with a canopy closure of 40-70 percent, and an understory and mid-canopy of scattered conifer saplings with a major shrub component, usually canyon live oak, are some of the highest priority areas for hazard reduction treatment. They have a relatively high value from a commercial conifer perspective, and have a high hazard due to the amount of ladder fuels and high fuel concentrations. Areas such as this that are also in high risk areas for fire starts are a high priority for treatment. Stands that have a very scattered conifer overstory 60-100 years old, canopy closures under 40 percent, but with a "well-stocked" to "over-stocked" dense understory of conifers and shrubs are a medium to high priority for treatment. The hazard of these stands being lost to fire is as high as the previous example with a heavier overstory, but the resource value is not as great due to the fact it is a younger stand and less time would be required to return the stand to its present size and seral stage. Areas that have scattered "old growth" with canopy closures under 50 percent and dense conifer and shrub layers are also high hazard areas, but a medium priority for treatment due to a lesser risk to the large overstory trees. These high hazard areas are shown on Map 12.

The combination of high hazard areas, high risk areas for fire starts, and high replacement value of resource dictate which areas are the highest priority for fuel treatment (Map 13).

Another priority for treatment are areas of high risk, generally due to their proximity to residences and well-traveled roads. These treatments would be strictly for reducing the risk of starting a fire in areas most likely to receive a human-caused fire.

Current seral stages

Table 16 shows the seral stage distribution within the Grave Creek watershed. Table 17 shows the seral stage distribution on BLM lands in more detail. Locations of seral stages on BLM lands are illustrated on Map 16.

Table 16. Seral stage distribution in the Grave Creek watershed, by ownership.

Age/Structure Class	BLM Acres (Percent)		Estimated Private/State Acres (Percent)		Total Acres (Percent)	
Non-forest	1,138	2	7,764	14	8,902	8
Early Seral (0-20 yrs)	7,349	15	7,904	15	15,253	15
Mid Seral (21-40 yrs)	5,111	10	14,751	27	19,862	19
Closed Poles (41-80 yrs)	4,880	10	20,756	39	25,636	24
Mature (81-200 yrs)	20,006	40	1,826	3	21,832	22
Old Growth (200+yrs)	8,141	16	841	2	8,982	9
Modified Older Stands (81+ yrs)	3,590	7		0	3,590	4
Total	50,215	100	53,842	100	104,057	100

Table 17. Acres of seral stages on BLM lands, by land use allocation, within the Grave Creek watershed.

Seral Stage or Structural class	Owl core & LSR	Rec Sites / ACEC's / River Corridor	TPCC Withdrawn in Matrix & Connectivity	Riparian Reserves*	Connectivity Blocks	Available NGFMA	Available SGFMA	Total Watershed
Non Forest	2	15	1,070	13	5	33	0	1,138
Early Seral 0-20 yrs	11	9	159	2,781	207	4,028	155	7,349
Mid Seral 21- 40 yrs	40	0	272	2,234	87	2,323	154	5,111
Closed Small poles 41-80 yrs	76	5	493	1,570	72	2,637	27	4,880
Mature , late successional 80 - 200 yrs	836	137	4,593	5,685	773	7,756	226	20,006
Old Growth, Late Successional 200+ yrs	680	60	1,552	2,291	745	2,804	9	8,141
Older Modified 80+ yrs	154	0	566	1,155	119	1,595	0	3,590
Totals	1,798	227	8,705	15,729	2,009	21,176	571	50,214

*Riparian Reserve acres only reflect acres within NGFMA, SGFMA and Connectivity allocations. Other Riparian Reserves exist within LSRs, owl core areas, etc.

Late-successional Habitat

This is a key issue because of the considerable controversy and planning emphasis given it in the Northwest Forest Plan and the Medford District Resource Management Plan.

In this watershed, late-successional forest habitat generally includes all forest stands more than 80 years old, including mature and old-growth seral stages. These stands represent approximately 58 percent of the BLM-owned forest lands. Some stands have received substantial partial cutting, so that the canopy is too open to provide late-successional habitat characteristics; these are called "Older Modified" stands and are not considered late-successional habitat. These lands occur on less than 10 percent of the BLM-owned forest lands, however.

Among the forest stands that are greater than 80 years old, there are many areas that do not have a dense overstory component due to various reasons such as soil characteristics, wind damage, past fires, insects, disease pockets and any of these factors combined with age. When stocking levels of overstory trees are taken into consideration, the amount of late-successional habitat drops.

Defining late-successional habitat using the existing data from forest inventories is problematic. In the Microstorms data base, stocking level 3 equates to 70 percent+ canopy closure, level 2 is 40-69 percent, and level 1 is 10-39 percent. There are 4,272 acres of stands 80 years old and greater, with overstory stocking level 3 (9 percent of federal land). There are 18,307 acres with stocking levels of 2 or 3 (37 percent of federal land). Some of the stands that have a reduced component of large overstory trees also have an advanced size-class of understory conifers or hardwoods or multi-layered canopies under the scattered large overstory. There are 19,353 acres with an overstory stocking level of 1 and an understory greater than 11" dbh and stocking level of 2 or 3 (39 percent of federal land).

The results of this analysis indicate that the original figure of 58 percent of the watershed being in late-successional habitat is somewhat misleading. When actual canopy closures are taken into account, the figure for late-successional habitat drops. Stands with large overstory conifers at stocking levels of "2" or greater can generally be considered good late-successional habitat with only those stands at the lower fringes of the "2" stocking level being marginal habitat. The stands that have a "1" overstory stocking level with a "2" or "3" level in the understory, have marginal conditions with a more open canopy. This indicates that the acreage of viable late-successional habitat is closer to the range of 39 percent of federal lands in the watershed than the original figure of 58 percent. This is important because while some late-successional species do well in mature stands, optimum conditions for most of these species occur in older stands.

Acreage and Fragmentation

One of the important aspects of quality late-successional habitat relates to the distribution of the remaining habitat. Many of the late-successional stands are highly fragmented and often isolated from other stands because of the checkerboard pattern of federal land ownership and past logging (Map 16). And many are too small to support "interior forest habitat"; that is, most of the stand is close to an edge which can have an effect on temperature and moisture regimes within the habitat patch.

There are six large blocks of late-successional habitat in the watershed that may contain the most significant blocks of this habitat type (Map 16). They are spread around the watershed; the first four are in the northern portion of the watershed, the last two are more southern.

- The area east of King Mountain in Slate and Big Boulder creek has approximately 1,000 acres,
- the Board Tree drainage has about 1,200 acres,
- the Ramsey and Bear Gulch drainages have about 1,000 acres however the 2 sections that contain the majority of the late-successional habitat are separated by 640 acres of private ownership in earlier seral condition,
- the Reuben Creek area has the largest block with about 2,500 acres of late-successional habitat,
- the area north of Sexton Mountain in the Burgess Gulch drainage has around 1,000 acres in this watershed,
- the Angora Creek area has approximately 1,200 acres however it is younger and generally more open and smaller in overstory size than the other areas.

Generally in the rest of the watershed, late-successional habitat occurs in small, scattered patches smaller than 500 acres.

The Northwest Forest Plan calls for retaining late-successional patches in watersheds where less than 15 percent of the federal forest land remains (ROD pp. C-44,45). The Grave Creek watershed is well above this threshold now (58 percent) when using the figure that includes all stands older than 80 years. When stands that have poor or questionable habitat, due primarily to low overstory stocking, are removed from this total, the level of late-successional habitat becomes 39 percent.

There are currently 15,743 acres of late-successional habitat within established reserves; representing 35 percent of the federal forest lands. Reserves include 100-acre spotted owl core areas, Riparian Reserves (Map 17), TPCC withdrawn lands and recreation sites. This indicates that even if all the GFMA lands were logged, there would still be more than the required 15 percent of the federal forest lands in the watershed in a late-successional habitat condition. For this reason, the 15 percent late-successional stands were not specifically mapped as part of this watershed analysis process.

A question that is pertinent to this watershed, along with other adjacent fifth-field watersheds, concerns the future development and condition of existing late-successional stands. Most of the stands are under 300 years old and few are older than 400 years. The exclusion of fire in these stands adds to the uncertainty of whether these stands will maintain themselves in a late-successional conifer forest habitat condition in the long term, or whether the older conifers will gradually die out, leaving a stand dominated by hardwoods and brush. There are a number of areas where dense stands of Douglas-fir and incense cedar, along with shrub species such as canyon live oak and tanoak have proliferated under scattered overstory canopies. Some of these stands are also dominated by ponderosa pine in the overstory and have very little, if any, pine regeneration in the understory, due in a large part to the lack of frequent ground fires in the understory. The areas that have the stands with the highest hazard are shown on Map 12.

Distribution and Connectivity

Late-successional habitat in the Grave Creek watershed is concentrated in the eastern and western thirds of the watershed (Map 16). The center of the watershed and the bottom land along Grave Creek has more non-federal lands and these lands are dominated by more agricultural and residential areas than are the east and west ends of the watershed. The center also has the towns of Sunny Valley and Wolf Creek, and Interstate 5, and is dominated by the wide, flood plain valley bottom of Grave Creek. These conditions create a barrier to east-west movement of species associated with late-successional habitat.

The northern boundary of the watershed appears to be the most important for east-west connectivity. In this area, the federal lands are in closer proximity, with fewer and smaller barriers than elsewhere in the watershed. This area is also most directly between large Late-successional Reserves outside the watershed. Map 16 illustrates how this watershed is situated in relation to adjacent Late-successional Reserves. Providing for east-west connectivity should be a major consideration for management plans in this watershed.

At a smaller scale, connectivity within the watershed is also problematic. The checkerboard ownership pattern often allows for connectivity only at section corners and these do not usually correspond with riparian zones or other natural habitat connections. The small, isolated BLM parcels in the center of the watershed in particular are situated where long term connectivity will always be a problem, since non-federal lands around them will continue to be managed on short rotations.

Connectivity/Diversity Blocks

There are nine Connectivity/Diversity Blocks at least partially within the watershed (Map 4). The Northwest Forest Plan and the RMP designated these sections to provide islands of late-successional habitat to improve connectivity between Late-successional Reserves. Management direction for these Connectivity Blocks calls for maintaining at least 25-30 percent of the block in late-successional condition and retaining 12-18 trees per acre in regeneration harvests.

Table 18 summarizes the current seral stage distribution of the Connectivity Blocks. Eight of the nine blocks currently have adequate levels of late-successional habitat to meet the 25-30 percent standard. The Connectivity Blocks in the watershed range from 6 percent to 100 percent in late-successional condition. The one exception is T 33S, R 4W, sec. 27 where only 6 percent of the section is late-successional habitat. This section is located within the Grave Creek burn, a major wildfire which burned in the late 1970s. There is virtually no older forest within this burn area.

Eight blocks also have enough late-successional habitat currently within reserves to meet the minimum management guidelines of 25-30 percent. These blocks range from 26 to 76 percent of the block currently in late-successional habitat within reserves. Thus, all but one of the blocks could meet the 25-30 percent standard using only reserved lands; the GFMA could be available for timber harvest. However, each block will be examined in more detail when individual timber sale proposals are being considered.

Special Status and Survey and Manage Species

Special status species include

- federally designated Threatened, Endangered and Candidate species which are listed under the Endangered Species Act
- Species of Concern, which were formerly listed as Candidate species
- Bureau Sensitive species
- Bureau Assessment species
- species identified by the state of Oregon to merit special attention.

Survey and Manage Species are those which were identified in the Northwest Forest Plan and the RMP as needing special consideration because of their association with late-successional forest habitat.

Table 19 lists the wildlife species in these categories and their status in the watershed. Table 21 summarizes the plant species. Some of the species which have greater impacts on management activities are discussed in greater detail in this section.

Table 18. Preliminary Assessment of Connectivity Blocks in the Grave Creek Watershed Glendale Resource Area

C/D Block Legal	Total Federal Acres	Acres by Vegetation Classification						Acres Capable of LS** Habitat	Percent of Fed. Land in LS**	Acres in Reserves	%*	LS** Habitat within Reserves	%*
		Non Forest	0-40 years	41-80 years	81-200 years**	200+ years**	Modified (80+ yrs.)						
33-4-27	637	0	511	13	33	4	76	637	6	496	78	27	4
33-5-17	640	0	90	0	0	550	0	640	86	279	44	257	40
33-6-1	600	0	234	15	341	10	0	600	59	281	47	158	26
33-6-29	624	0	160	0	0	391	73	624	63	457	73	291	47
33-7-15	620	2	7	65	422	124	0	618	88	264	43	250	40
34-5-4	500	0	7	0	35	458	0	500	99	174	35	167	33
34-6-15	401	0	90	0	311	0	0	401	78	188	47	140	35
34-7-11	646	0	209	21	324	0	92	646	50	323	50	206	32
34-7-17	640	0	0	0	634	6	0	640	100	486	76	486	76

* Percentage of Federal Land within the Section
** Late-successional habitat includes 81-200 and 200+ age classes, but not the Modified stands
Note: Acreage for non-forest and other Vegetation Classifications do include road acres. Approximately 2 percent of acres are in roads.

Table 19. Special Status and Survey and Manage Wildlife Species within the Grave watershed.

Species	Status	Presence/ Inventory	Habitat	Monitoring
Peregrine Falcon	FE,ST	S/N	U	N
Bald Eagle	FT, ST	D/2	N	N
Northern Spotted Owl	FT, ST	D/4	Y	Y
Marbled Murrelet	FT, ST	U/3	N	N
Northern Goshawk	FC, AS, SC	D/2	Y	N
Great Gray Owl	PB,AS, SV	U/N	Y	U
Coho Salmon	FC,AS, SC	D/3	Y	Y
Steelhead trout (Winter run)	FC,AS	D/3	Y	Y
Del Norte Salamander	SM,SoC, SV	D/3	Y	N
Blue-grey tail-dropper slug *Prophysaon coeruleum*	SM	D/4	Y	N
Papillose tail-dropper slug *Prophysaon dubium*	SM	D/4	Y	N
Oregon Shoulderband snail *Helminthoglypta hertleini*	SM	S	Y	N
Crater Lake tightcoil *Pristiloma arcticum*	SM	S	Y	N
Chace sideband *Monadenia chaceana*	SM	S	Y	N
Western Pond Turtle	SC	D/3	Y	N
Cascades Frog	SoC, AS, SC,	U/N	N	N
Mtn. Yellow-legged frog	SoC, SU	U/N	N	N
Red-legged Frog	SoC, SU	U/N	U	N
Townsend's Big-eared Bat	SoC, SC	S/3	Y	U

Species	Status	Presence/ Inventory	Habitat	Monitoring
Fisher	SoC, AS, SC	U/N	U	U
Fringed Myotis	BS, SV	U/N	U	U

Status:
FE - Federal Endangered
FT - Federal Threatened
FP - Federal Proposed
FC - Federal Candidate
SoC - Species of Concern
SM- Survey and Manage
PB - Protection Buffer
BS - Bureau Sensitive
AS - Assessment Species (BLM)
SE - State Endangered
ST - State Threatened
SC - State Critical
SV - State Vulnerable
SP - State Peripheral or Naturally Rare

Presence:
D - Documented
S - Suspected
U - Uncertain
A - Absent

Inventory:
N - No surveys done
1 - Literature search only
2 - One field search done
3 - Limited surveys done
4 - Protocol completed

Habitat:
N - Habitat is not present
Y - Habitat is present
U - Uncertain

Monitoring:
N - None planned or completed
U - More information needed to monitor
NA - Not Applicable
Y - Currently being monitored

Spotted owls

There are approximately 24,500 acres of suitable spotted owl habitat in the Grave Creek watershed as of 1992. The amounts and distribution patterns parallel those discussed for late-successional habitat.

There are 18 active spotted owl sites within the Grave Creek watershed. Of these, 15 have 100-acre core areas designated under the RMP. The others are either new sites which do not receive a 100-acre core area designation, or are historic sites and were not considered active when the designations were made. The sites are distributed fairly evenly across the watershed, with a notable gap in the southeast part of the watershed.

Many of the owl sites are below the minimum levels of habitat required before "Take" occurs as defined by the Endangered Species Act (i.e. less than 40 percent of the area within 1.3 miles of the center of activity is suitable habitat. The stability and productivity of the owl sites in this watershed varies considerably. Generally, sites in the center of the watershed, where the habitat is more fragmented, have been less stable and less productive than sites in the eastern and western portions of the watershed.

There are parts of three spotted owl Critical Habitat Units (CHU) in the watershed (Map 18) although one (OR-65) barely touches the west boundary of the watershed. Table 20 summarizes the acreage included in these CHUs. Two of the CHUs are centered on large LSRs; but OR-64 is an exception in that it is placed over General Forest Management Area lands. Most of the CHUs are located on General Forest Management Area lands.

The primary function of most of the CHUs is to maintain the range-wide distribution of the northern spotted owl since this area provides an integral portion of the link from the Klamath Mountains province to the southern end of the Oregon Coast Ranges province. Management activities within the CHU need to ensure that its function is not impaired.

With the implementation of the Northwest Forest Plan and Medford District RMP, LSRs, Marbled Murrelet Reserves, and riparian reserves could supplement the CHU in providing this important provincial link. The original function of the CHUs should continue in the future despite timber harvest because so much of it is protected as marbled murrelet reserves, RNA, and riparian reserves. If management activities within the CHU are designed such that the designated reserves can sustain the function of the CHUs, despite a degradation of spotted owl habitat within the CHUs themselves, then these actions would not adversely modify spotted owl critical habitat or jeopardize the existence of this subspecies. Future management actions which may affect critical habitat or a listed species would need U.S. Fish and Wildlife Service concurrence through the consultation process under the Endangered Species Act.

The primary function of OR-64, however, was originally to provide more opportunities for viable owl sites, rather than provide movement and dispersal of owls across the landscape. Exactly how this emphasis will affect timber harvest and other management activities is uncertain, although it is likely the impacts on individual owl sites will be a larger concern than within other CHUs.

Table 20. Spotted Owl Critical Habitat within the Grave Creek watershed

CHU	Federal Acres within watershed
OR-32	14,263
OR-64	3,645
OR-65	2,340
Total	20,248

Marbled murrelets

Marbled murrelet habitat is defined to occur within 50 miles from the coast. The 50 mile line is located approximately through the center of the watershed, near the town of Wolf Creek. The closest point of the watershed to the coast is about 41 miles. The distribution and fragmentation patterns of murrelet habitat are similar to those described for late-successional habitat.

Surveys have been conducted since 1992 and have failed to document any murrelets using this watershed. An analysis done by the Siskiyou National Forest provides strong support for the contention that in this part of southern Oregon, murrelets do not fly inland beyond the first major coastal ridge, about 12 miles from the coast (Dillingham, et. al. 1995; Witt, 1998). This boundary is the limit of the coastal fog belt and the eastern edge of the Douglas-fir/hemlock community.

If this hypothesis is correct, the Grave Creek watershed should be considered outside the range of the marbled murrelet. In this case, the watershed would not play a part in the maintenance or recovery of this threatened species.

Del Norte Salamanders

Del Norte salamanders were designated as a protection buffer species in the NFP. Known sites become Managed Late-successional Areas, a distinct land use allocation under the NFP. This species is associated with rocky, talus slopes which provide adequate canopy cover to retain sufficient moisture to support the species. Del Norte salamanders primarily occur in stands with greater than 62 percent canopy cover (Survey and Manage Amphibian Subgroup 1995). Small pockets of talus habitat are patchily distributed across the watershed. Because this species requires habitat characteristics which occur in disjunct patches, the species is susceptible to activities that degrade or destroy the suitability of those patches. Salamanders are susceptible to micro-climatic changes, particularly temperature and relative humidity. As timber harvest progresses in the watershed, this species will need to rely on isolated talus patches connected by riparian reserves for gene pool exchange and population viability.

Del Norte salamanders have been documented in the watershed in the western portion of the watershed, roughly west of I-5. These sightings represent an extension of the species' known distribution and may be near the eastern limits of this species' range. Extensive surveys were conducted in conjunction with the Serpent's Grave timber sale, east of the freeway and none was found. It is likely they do not occur in the central and eastern parts of this watershed, but the exact limit of their distribution is uncertain.

Red tree voles

Surveys have documented red tree voles in most areas of the watershed. Red tree voles generally occur in forested stands older than 40 years old. Currently there are 24,200 acres of forest considered to be suitable habitat on federal lands in the watershed, which represents 48 percent of federal lands. However, the large areas of young stands and non-forested lands in the central part of the watershed may be a significant dispersal barrier for this species

Molluscs (terrestrial and aquatic)

Two species of slugs (the blue-grey tail dropper and papillose tail-dropper), which have been designated as Survey and Manage species are known to occur within the Grave Creek watershed. These species occur in moist conifer and conifer/hardwood forest habitats. These species have been found to be relatively abundant in the western portion of the watershed - the only area in which detailed surveys have been conducted.

Another Survey and Manage mollusk species has been documented in the watershed. The Crater Lake tightcoil snail (*Pristiloma arcticum)* has been confirmed from one location in the western portion of the watershed. This finding represents a substantial range extension for this species.

Other survey and manage mollusk species are suspected to occur within the Grave Creek watershed. Chace sideband (*Monadenia chaceana)* and Oregon shoulderband (*Helminthoglypta hertleini)* snails have not been documented, but are suspected to occur here. The Oregon shoulderband snail often occupies rocky areas, but is not dependent on that habitat. The other three species (Oregon megomphix,) occur in moist conifer forest habitat. Little is known of the distribution of these species. The first inventories took place in 1998.

There are no survey and manage aquatic mollusc species known to occur within the watershed.

Northern Goshawks

The Grave Creek watershed is on the edge of the known distribution for Northern Goshawks (ODFW 1992, Breeding Bird Survey data). They generally do not breed west of the Cascades and north of Josephine County. There have been several sightings, but breeding has been confirmed in only one location. It is likely they do nest more widely within the watershed, but only in very low numbers. However, they may have been more abundant prior to fire suppression.

Great grey owls

Great grey owls are generally associated with open grassy meadows, where they forage, with adjacent older forest for nesting habitat. Meadow habitat is extremely limited in this watershed. There are a few small meadows and open rock outcrops. It is possible this species could breed near the valleys where agricultural fields and pasture may provide some foraging habitat.

There are no confirmed great grey owl sightings within the watershed. Since this species will respond to spotted owl calls, and there have been extensive spotted owl surveys, it is likely this species does not occur, or is very rare in the watershed. Like goshawks, they may have been more abundant in the watershed before fire suppression became effective.

Special Status, and Survey and Manage Plants

Table 21 summarizes the current knowledge of special status and Survey and Manage plants within the watershed. The plant association groups were taken from generalized vegetation maps such as Map 14. In many cases, the listed species may be restricted to particular conditions within the association group. For example, a species may be restricted to small, moist microsites within areas mapped as a generally dry forest type. Alternatively, the species may be restricted to small ultramafic inclusions that do not show up on the scale of vegetation mapping. Therefore, the plant association groups are only indicative of the general landscape areas in which the species are found.

Table 21. Special Status, and Survey and Manage Plants in the Grave Creek Watershed

Species Common Name	Status	Habitat	Plant Association Groups	Number of Sightings
Allium bolanderi var. *mirabile* ALBOM Potato-bulb bolander's onion	Bureau Watch	Rocky clay soils, including serpentine; forest openings.	Douglas-fir on ultramafics; Douglas-fir, canyon live oak; Douglas-fir, shrub; Tanoak, Douglas-fir, dry; Canyon live oak.	10
Allotropa virgata ALVI2 Sugar stick	Survey and Manage, Strategy 2	Coniferous forest, old-growth associated.	Douglas-fir, salal; Douglas-fir, canyon live oak; Douglas-fir, shrub; Tanoak, Douglas-fir, dry; Tanoak, Douglas-fir, moist.	24
Camassia howellii CAHO12 Howell's camas	Bureau Sensitive	Dry, open slopes; serpentine soils	Douglas-fir on ultramafics; Douglas-fir, canyon live oak; Douglas-fir, shrub; Canyon live oak; Jeffrey pine, grass; White fir on ultramafics; White fir, dry.	12
Cypripedium fasciculatum CYFA Clustered lady's slipper	Bureau Sensitive, S&M Strategy 2	Coniferous forest; old-growth associated.	Tanoak, Douglas-fir, dry; Douglas-fir, shrub; Douglas-fir on ultramafics; Douglas-fir, canyon live oak; White fir, dry.	30
Cypripedium montanum CYMO2 Mountain lady's slipper	Bureau Tracking, S&M Strategy 2	Coniferous forest; old-growth associated.	Tanoak, Douglas-fir, dry; Douglas-fir, shrub.	5
Delphinium nudicaule DENU Red larkspur	Bureau Assessment	Moist talus; wooded, rocky slopes.	Douglas-fir, canyon live oak.	1
Eschscholtzia caespitosa ESCA Gold poppy	Bureau Assessment	Dry, open areas; often brushy.	Douglas-fir, canyon live oak; Tanoak, Douglas-fir, dry.	4
Fritillaria gentneri FRGE Gentner's fritillary	USFWS Proposed Endangered, Bureau Sensitive	Dry, open areas; usually oak woodland or chapparal.	Douglas-fir, shrub.	2
Fritillaria glauca FRGL Siskiyou fritillary	Bureau Assessment	Dry, open, rocky areas; often serpentine.	White-fir, high elevation.	1
Limnanthes gracilis var. *gracilis* LIGRG2 Slender meadow-foam	Bureau Sensitive	Wet areas on serpentine soil.	Douglas-fir, canyon live oak; Tanoak, Douglas-fir, dry.	4
Lotus stipularis var. stipularis LOSTS2 Stipuled trefoil	Bureau Assessment	Coniferous forest; disturbed areas or older forest.	Tanoak, Douglas-fir, dry; Tanoak, Douglas-fir, moist; Douglas-fir, canyon live oak.	4

Species Common Name	Status	Habitat	Plant Association Groups	Number of Sightings
Sedum moranii SEMO5 Rogue River stonecrop	Bureau Sensitive	Serpentine rock outcrops in full sun.	Tanoak, Douglas-fir, dry; Douglas-fir, canyon live oak.	4
Silene hookeri ssp. *bolanderi* SIHOB Bolander's catchfly	Bureau Assessment	Dry, open rocky areas; often serpentine, sometimes forested.	Tanoak, Douglas-fir, dry.	1
Sarcosoma mexicana Fungus	S&M Strategy 3, Protection Buffer	Litter and duff, rotting wood.	White fir, dry.	0

Sarcosoma mexicana, a fungus, has not been found in the watershed. It is included above because it is highly likely in the watershed, being found both to the north, in the Middle Cow Watershed, and to the south in the Butte Falls Resource Area.

Thirteen species have been found at 102 sites. These sites are generally small, covering only one to a few acres. More sites undoubtedly occur, and will be found with continued surveys. Protection is currently required for the Bureau Sensitive and Assessment species, the Survey and Manage strategy 2 species, and Protection Buffer species. Tracking and Watch species are tracked only for review purposes.

Social

As in much of western Oregon, BLM lands in this watershed are intermingled with a great deal of non-federal land. The interaction of BLM land and its management with this non-federal land was deemed as a sensitive issue in the Medford District RMP. The following discussion brings the issues to light for this watershed.

Some private lands in the watershed here occur as towns. Some are owned by logging interests. Many other parcels are owned by individuals and often these individual owners reside on their land in a rural setting.

It is estimated by the Sunny - Wolf Community Response Team (SWCRT, see below) that 1,500 people reside in the Grave Creek watershed in the Sunny Valley and Wolf Creek communities. These communities lie near the center of the watershed. The town of Wolf Creek itself lies between the confluence of Wolf Creek and Coyote Creek. Sunny Valley lies adjacent to Grave Creek. The greatest population concentrations occur near these two small communities although residences are located throughout the Grave Creek, Wolf Creek, and Coyote Creek valleys, usually within two miles of the creeks themselves. The historic community of Golden, located five miles east of Wolf Creek, has been partially restored in the last twenty years. The historic community of Leland, near the confluence of Grave Creek and Wolf Creek, no longer exits as a town but still has several nearby residences.

The Medford District RMP identified 6,500 acres of BLM land in the Grave Creek watershed as Rural Interface Area (RIA) lands. They are defined as those BLM lands within ¼ mile of non-federal lands zoned for five acre parcels. This definition was made in the RMP particularly to account for BLM land near residences. In this watershed, many BLM RIA designated lands that are adjacent to these private parcels do not actually have a residence. The sensitivity issue in these latter cases needs to be examined further.

However, based on recent experience with the public it is clear that other areas in the watershed have potential for being sensitive as well. This may be due to neighboring residents, visual concerns or other factors. These additional areas within the watershed have been identified in this analysis as ‘potential sensitive areas" (Map 21).

Some of the factors which surfaced in recent management activities and were brought to the attention of the BLM by its rural neighbors include logging noise, impacts on visual resources, potential impacts on private water sources and dust from log hauling. Others have voiced concerns over the increase in vehicle traffic in their area as a result of newly constructed roads built under timber sale contracts.

An increasing problem along BLM road systems within the RIA has been the dumping of trash, car bodies, and household appliances on federal lands. This is due in part to increases in fees at local landfills. Over thirty sites have been identified in the Grave Creek watershed in the period 1993-1998 as dump sites. The BLM has contracted for garbage removal and has hired professionals to examine these areas for the potential of hazardous materials.

In recent years, residents within the watershed have voiced their concerns about roads in the area being gated or decommissioned, thus denying access to traditional hunting and recreation areas. Most often, the decisions regarding gates or decommissioning come from weighing the effects of use by people and disturbances that could occur to sensitive vegetation, wildlife, riparian, or soil as directed by the NFP. The proximity of large populations by the residents of the Grave Creek valleys in the RIA can lead to conflicts in resource use. Construction, gating, and decommissioning of roads may thus be implemented within the RIA where necessary and feasible.

BLM interacts regularly with local residents regarding road maintenance. The BLM recognizes its role on roads where BLM has road maintenance responsibility for roads accessing rural property. The BLM makes repairs and upgrades there on a regular basis to mitigate emergency situations. Maintenance occurs in areas highly used by the public such as the King Mountain Rock Garden and the London Peak Trail and to maintain the integrity of the shoreline and dams of Burma and Dutch Herman ponds.

In 1996, the BLM established a link with the Sunny Wolf Community Response Team (SWCRT). This group began under Oregon CERT funding and seeks opportunities to enhance the quality of life for residents of the Grave Creek watershed. Improving the quality of life for residents in the Grave Creek watershed is also a goal in the Medford District RMP. As such, the BLM has sought opportunities to work in partnership with SWCRT and other groups or individuals in the Grave Creek watershed to enhance resource, social, economic, recreational, and aesthetic values.

BLM activities often involve questions of private water sources and water rights in the RIA. Springs and seeps are common and widespread in the watershed due to the geologic formations present. These smaller water sources are often where questions of private water sources and water rights occur. These sites are so numerous that mapping has not occurred for them all. Where the BLM proceeds with individual projects throughout the watershed, these water sources will be identified and any appropriate action regarding water rights will be considered and carried out.

Visual Resource Management (VRM) of BLM lands has guidelines stated in the RMP. VRM also has interactions with RIA lands in this watershed but is not strictly defined within the RIA issue. VRM classes are based on scenery quality ratings, public sensitivity ratings and distance zone-seen area mapping criteria.

VRM Classes and Management Descriptions relative to the Grave Creek Watershed:

Class I - This is the Wild and Scenic River Corridor, a portion of which occurs in the Grave Creek Watershed where Grave Creek enters the Rogue River at its westernmost point. Vegetative and visual management here is to preserve the existing character of landscapes.

Class II - This includes areas seen from trails, main highways, and reservoirs with high recreational use. It also includes areas seen from the Wild and Scenic River Corridor. The Medford District RMP currently states that VRM Class II includes lands seen in the foreground and middle ground within one mile of Interstate 5. Visual management here is to retain the existing character of landscapes.

The BLM manages any seen area within one mile of Interstate 5 as Visual Resource Management Class II. Other areas beyond the one mile limit, but still affecting the visual resource, can be managed as Class II or III depending on the duration of time that the area is visible to travelers on Interstate 5.

Specifically, the seen areas of T.33 S., R. 6 W., sections 1, 8, 9, 10, 13, 15, 17, 27, 29, 33, and 34, T. 33 S., R. 5 W., sections 5, 6, 7, 18, and 31, T. 34 S., R. 5 W., section 6, and T. 34 S., R. 6 W., sections 1 and 13 will be managed as VRM Class II as they dominate the view having no foreground ridges to obstruct the view of a casual observer.

Class III - This includes the view from RIA lands (as defined above) where private land parcels of 1-20 acres would be managed to mitigate potential conflicts with rural residents. Visual management here is to partially retain the existing character of landscapes.

Seen areas in T. 33 S., R. 6 W., section 31 and T. 34 S., R. 6 W., sections 7 and 17 will be managed as Class III as they are a more highly visible part of the background but still not obstructed by foreground ridges. The increased distance to the proposed Class III areas reduces the ability of the causal observer to view these areas when moderate precautions are taken during planning for proposed actions. Vegetation here is not removed from both sides of a skyline ridge.

Class IV - This includes all remaining areas visible from lesser used roads. It does not place restrictions on management activities. Visual management here allows major modification of the existing character of landscapes.

Recreation

Recreational users in the Grave Creek watershed usually come from within fifty miles of the watershed.

Dispersed hunting is a common recreational activity in the fall, mostly for deer and elk.

Fishing and camping occur in the designated sites of Burma and Dutch Herman Pond in the upper Wolf Creek area. Hiking and viewing wild flowers are also primary uses in these areas. The newly constructed (1998) London Peak Trail, designed to be wheelchair accessible, provides an opportunity for short day hikes and panoramic views of the town of Wolf Creek, King Mountain, and the area north looking over Interstate 5. The King Mountain Rock Garden Area of Critical Environmental Concern (ACEC) is the highest elevation point in the watershed and is noted for interesting rocks, geologic features, and rare plant species. A trail has been partially constructed to access a portion of the area. School and other groups such as the Audubon Society have visited the site in tours either self-directed or guided by BLM employees.

A recreation site that is gaining the interest of the public is the community of Golden. This is located on private land approximately five miles east of Wolf Creek. It is a ghost town from the 19th century related to timber and mining that is being renovated. It has received some attention in the press and will attract some tourists that may also wander onto adjacent BLM lands. Owners of the area are trying to put in a nature trail. Exact plans for the site and location of the proposed trail are not known to BLM at this time.

A destination point for tourists is the new (1998) Applegate Trail Museum in Sunny Valley. Locals and non-residents may wish to explore BLM lands for evidence of pioneer travelers.

There may be more diversity in the users at London Peak, Golden, and Sunny Valley as knowledge of these sites spread. This may lead to a need to improve the access road to London Peak. The SWCRT has also expressed an interest in extending the trail to the Rogue River Trail and possibly to the Pacific Crest trail. The State of Oregon once had preliminary plans that included a trail through London Peak, so it is possible there could be support for it if the non-federal parcels it would have to pass through could come together. The Tunnel Ridge road is also a popular recreation area for equestrian and motorcycle users.

It is possible that more trails will be developed, both by BLM and members of the public. There has been an inquiry about the possibility of building trails and running guided horse packing trips in the Sunny Valley area.

A portion of the Quartz Creek Off-Highway Vehicle (OHV) Area is located within the watershed (Map 6). The Medford District RMP states that OHV use in Quartz Creek is limited to "existing roads and designated trails" and that a management plan would be completed for the area. Currently, no trails are officially designated and no management plan has been completed.

Glendale and Grants Pass Resource Areas are currently looking at ways to map the existing trails using GPS equipment mounted on an all-terrain vehicle. The current proposal is to accomplish this during the summer of 1999. Once mapped, proposals for closure or designation of trails would need to be presented in a management plan for the area as stated in the Medford District RMP.

Rare reports of hang gliding and snowmobiling have been heard though there are no lands designated on BLM lands for these purposes. There are potential take off points for hang gliding, especially in the King Mountain area. Snowfall accumulation is light in this watershed and extensive snowmobile use is unlikely.

Groups and individuals, both in and out of the Grave Creek watershed, enjoy the presence and accessibility of older timber stands with late successional characteristics. Consideration has already occurred to include these types of BLM lands as an asset not only as timber commodity areas but as aesthetically significant to recreationists.

Should recreation activities continue to increase in the future, there will be increased issues of waste removal, road access, increased risk for wildfire ignition and increased concern for viewshed protection.

Several members of the public have expressed the desire for the Roosevelt elk population to increase in the area. Road closures, which reduces harassment and poaching, is one of the primary tools available to the BLM to help meet this goal. However, there are other issues with closing roads, as discussed in the social section of this document. Other influences on the elk population include the area of very early successional areas which provide forage for elk. Before fires were suppressed, these forage areas were probably continually created somewhere on the landscape. In recent times clearcuts have replaced fires in creating these forage areas. Such opportunities are now limited due to the fact that many areas which were recently cut are now growing young stands and also due to the constraints of non-timber resources on regeneration harvesting on federal lands.

The Oregon Department of Fish and Wildlife (ODFW) sets the hunting limits, seasons and determines many other important influences on game species such as elk. At this time ODFW's philosophy is not to manage for an increase in this species in the Sunny Valley, Ditch Creek, Speaker Road areas and other rural residential areas because of the potential for damage to crops and property.

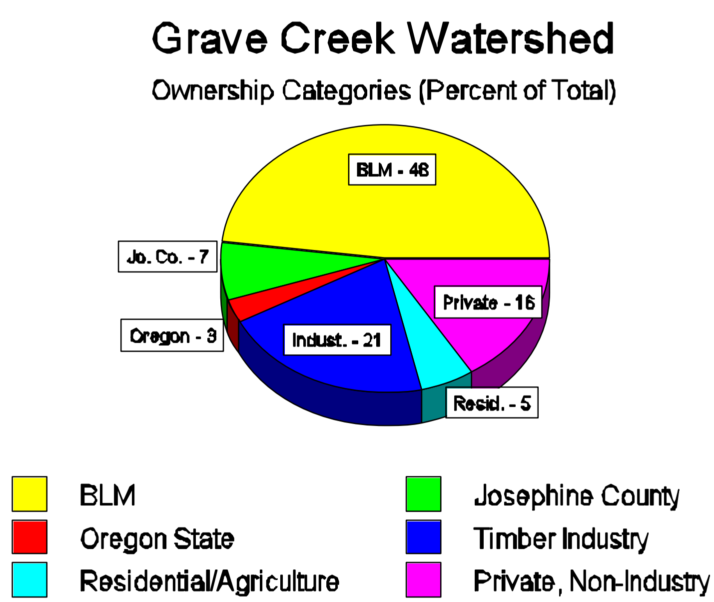
Ownership Patterns

There are six distinct classes of land ownership in the Grave Creek watershed:

- -BLM lands
- -Josephine County
- -Oregon state
- -large industrial timber owners
- -individual forest land owners.
- -residential/agricultural land owners and communities.

Map 3 displays the locations of these ownership categories and the relative acreage of each class is presented in Figure 4.

Figure 4. Ownership categories, Grave Creek Watershed.



The second largest land owner in the watershed is Josephine County with 7,000 acres. The State of Oregon also owns considerable acreage with 2,828 acres.

Much of the non-federal land in the western and eastern portions of the watershed is owned by private timber companies. These companies own relatively large blocks of land, on the order of a square mile in size. These lands are generally managed for intensive timber management. Large-block land owners include Boise Cascade Corp. and Superior Lumber Company.

Medium-size land owners occur throughout the watershed, and own blocks of land 20 - 200 acres in size. Generally these are private individuals with varying interests, but which tend to want to maintain residences or small timber management operations. Several mining patents, which are now privately owned, are included within this category.

The "small parcel" category includes most of the private residences along the major roads adjacent to Grave Creek, Wolf Creek and Coyote Creek. This category also includes the communities of Sunny Valley and Wolf Creek.

Historically settlement and major mining activity concentrated in the valley bottoms, along the major streams. These generally occur in relatively large, contiguous areas in the watershed (Map 3). This pattern is evident today, as most of the major streams remain in non-federal ownership. BLM administers very few lands adjacent to these larger streams.

Virtually all of the public lands in this watershed are subject to reciprocal right-of-way agreements between BLM and private timber companies. This allows each party to construct roads across the others' land and gives rights to each party for those roads. These agreements make it very difficult for BLM to barricade or decommission roads.

In some cases, access to BLM lands across non-federal lands is difficult to obtain, making management problematic. But this has not been a major problem in this watershed.

All the BLM lands within this watershed are classified as Tenure Class 2. This means the lands are available for disposal through exchange. The tenure classes were mapped during the RMP process.

IV. Synthesis and Interpretations

Range of Natural Variability

Paleoclimatological evidence from fossil and pollen data taken from lake and ocean sediments throughout the Northwest indicates that since 20,000 years before present (BP) up to present, climate and vegetation have changed (Whitlock 1992). Climate change associated with the recession of glacial ice sheets resulted in plant associations shifting on the landscape as a result of the environmental conditions. Vegetative communities changed with changing environmental conditions, such as extended cold, dry periods to periods of warm, wet climate. Present day vegetative communities did not become established until approximately 3,000 years ago and have continued to shift in location and range even during this time period.

Reneau and Dietrich (1990) described studies of colluvial deposits of hill slopes and discovered that landslides tended to occur during dry periods, presumably due to more frequent fires and or intense rainstorms. These events were dated to 10,000 years BP up to 4,000 years BP. This suggests mass movement activity has shaped present day topography and continues to be a change agent. Volcanic activity, earthquakes, landslides and floods have, and will, change the present day landscape.

Tree ring data dating from the 1600s to present day indicated periods of wet and dry conditions. Drought periods lasting up to 25 years have occurred during this time frame. Fire frequency was high during the periods of drought. Data from Graumlich (1987) indicates that the period of l910 to l935 was a drought period which corresponds to the age of many of the natural stands that are now between 50 and 80 years of age. This suggests that fire is an important agent of vegetative landscape change in the Klamath Province.

Human activities described by Boyd (1986) indicate that present day landscapes are not the same as they were 200 to 300 years ago. Native Americans in the valley regions used fire and other agricultural practices to control their environment for hunting and food gathering. Low lands and traditional hunting sites along ridges were burned repeatedly resulting in open understory conditions that favored vegetation adapted to frequent ground fires such as pine and oak. During European settlement of the western valleys in the mid-1800s, burning stopped and vegetative communities began to change. Fire frequency has declined since the period of active fire suppression (Taylor and Skinner 1994). Current day fire suppression activities continue to be a cause of plant community change across the landscape.

Wills and Stuart (1994) noted that pre-settlement landscapes on Douglas fir/hardwood forest in Northern California were a matrix of various aged forests. The Klamath Province, in which their study was done, includes all of the Rogue Basin and the Cow Creek basin of the Umpqua River, areas that are much more like Northern California than they are like regions to the north. This suggests that the region did not have continuous forests of old growth. Another study indicated that late seral forests comprised 43 to 71 percent of the landscape (Ripple 1994).

The Glendale Resource Area queried Forest Operations Inventory data to obtain the extent of naturally generated stands between the age of 46 and 86 years, which corresponded to a 25 year drought period that lasted from 1910-1935. Forests of this age class, which are thought to be of fire origin, comprised about 10 percent of the forest on federal land. It was assumed that non-federal land had approximately the same percentage. Openings within the forest included valley bottoms, accounting for 10 percent of the RA, and rock outcrop, natural meadows and serpentine effect areas, which accounted for another 5 percent. Postulating unequal distribution, openings within the forest canopy would have ranged between 15 and 25 percent at any given time. Entire seventh field watersheds (60 to 600 acres) would have been in completely open condition as a result of fire, as evidenced by fires in 1987 and l995. The denudation of the landscape by miners and earlier by Native Americans could have resulted in more than 25 percent of the area being in an open condition in the early part of this century.

The distribution and abundance of aquatic species and characteristics of stream habitat in the Rogue and Umpqua River basins have responded to changing climate for millennia. The extent that climate changes in the Rogue and South Umpqua basins have affected habitat and aquatic species has probably varied considerably depending on each species habitat and life history requirements. Spencer (1991) provides a model for how climate has affected streams, aquatic species and indigenous peoples in the Rogue basin and Klamath Province over the last 13,000 years.

During recent geologic times, climate in the Klamath Province has shifted between mesic and xeric conditions eight times over the last 13,000 years (Spencer 1991). Approximately 13,000 to 10,000 years ago when permanent glaciers and snow fields were in retreat, major floods caused by meltwater resulted in large scale mass wasting, unstable stream channels and extreme stream sedimentation. Depositional material may have created partial or total barriers to fish migration. This rapid shift to a drier climate after mesic conditions that had existed for at least the previous 60,000 years undoubtedly had dramatic consequences for fluvial ecology of the Rogue and Umpqua River basins. Many streams changed from perennial to intermittent. Stream flow decreased, as did the amount and extent of riparian vegetation. Water temperatures increased in response to lower flow and less steam shading.

As climate continued to warm and permanent snow field disappeared, summer peak flow from annual snow melt was replaced by a winter-spring peak originating primarily from rainfall. Salmon stocks migrating and spawning in the winter were enhanced; stocks dependent on a spring-summer peak, if they existed, were depressed or extirpated as the region entered a very xeric period 7000 years ago. Dramatic shifts in character of aquatic habitat during this time undoubtedly caused major changes in abundance, distribution and composition of aquatic communities.

Shifting of climate from xeric to mesic conditions about 4000 years ago resulted in an expanded network of perennial streams, higher stream flow, more riparian vegetation, cooler water temperatures and better spawning and rearing conditions for salmonids. Aquatic and riparian systems have continued to fluctuate and to affect suitability for various aquatic and riparian plant and animal species in response to climate change.

Animal species and populations have probably changed in response to environmental variation during the last 20,000 years. In addition, hunting pressure and habitat modification has most likely caused local shifts in species abundance and distribution. For instance, early trappers found beaver to be abundant in local streams in the early 1800s (Boyd 1987). But it did not take long for the beaver to be trapped out. Without beaver dams, low gradient stream channels and associated riparian zones experienced major and rapid changes which resulted in conditions that are typical today in some streams (e.g. vertical streambanks, disconnecting the stream from its flood plain). Ground water levels would have dropped and resulted in lower summer flow and presumably higher water temperatures.

The frequency of fire and its effects on stream and riparian habitat also changed as climate fluctuated. The amount of large wood in streams was probably higher during mesic than during xeric periods because trees were larger and higher stream flows undercut stream banks; saturated soils may have increased the potential for large trees to fall into streams through windthrow. Conversely, fire probably consumed sources of large wood for stream channels during xeric periods. But increased incidence of landslides following stand replacement fires (Reneau and Dietrich 1990) during xeric times may have delivered large quantities of wood and sediment to streams. Water temperatures probably increased in response to loss of riparian canopy.

Considering the dynamic nature of climate and its complex effects on streams and riparian habitat, it is questionable whether aquatic systems have ever been in “pristine” condition.

Table 23 summarizes some of the important watershed elements in comparison with a range of natural variability (RNV). The precise relationships are often very uncertain because we have so little data on pre-historic conditions. Most of the relationships are based on professional judgment and on observed ecological processes.

Table 23. Comparison of present conditions to the range of natural variability (RNV) thought to exist during the period of 3,000 years ago to 200 years ago. (Pre-European)

ELEMENTS, PARAMETERS, or INDICATORS	Less than RNV	Within RNV	Greater than RNV	COMMENTS
WATER QUALITY				
Temperature		X		Xeric periods in the past may have resulted in higher water temperatures due to extreme low flow periods. Riparian vegetation on many streams has a higher hardwood component than prior to European settlement due to timber harvest and agricultural and residential land clearing. Hardwoods are thought to be less effective at shading streams than conifers. Lack of riparian vegetation on lowland streams due to land clearing. Very low flow in segments of Grave Creek and tributaries have been recorded. Relatively shallow soils throughout the watershed have low water holding capacity, so stream flow responds quickly to storm events. Low ground water input to streams during summer, contributes to heating during low flow months.
Sediment/substrate		X	X	Episodic events probably produced more sediment but placer mining and roads probably produce more continuous risk to fish requirements by degrading spawning and rearing habitats.
AQUATIC HABITAT ACCESS				
Physical Barriers			X	Many culverts restrict movement of aquatic species at road crossings.
HABITAT ELEMENTS				
Fish	X			Affected by factors in and outside the watershed

ELEMENTS, PARAMETERS, or INDICATORS	Less than RNV	Within RNV	Greater than RNV	COMMENTS
Large woody debris	X	X		Lower than ODFW Standards for "desirable conditions"; Wildfire and Native American burning may have reduced LWD and potential LWD but fire suppression over the last 40 years is probably slowly contributing to more LWD. Timber harvest and placer mining have reduced both standing and down LWD. Broad valley bottom, as along Grave Creek, between Placer and Leland, may have been maintained in pine/oak savanna by Native Americans, so LWD was probably never abundant in this area. Pool formation in mainstem Grave Creek below Sunny Valley is dependent more on morphologic features than on LWD due to its size and hydrologic character.
Pool frequency	X	X		Logging and salvage of LWD from streams has reduced the amount for pool formation. Existing condition is highly variable between streams. Placer mining and road construction have channelized most of the major streams; less LWD for pool scour.
Pool quality	X			Less LWD for pool complexity and depth
Off-channel habitat	X	X		On lower gradient streams that were placer mined, braided channels and beaver dams are absent. Less LWD for formation of side channels, alcoves and backwater areas on all streams. Higher gradient streams probably more closely resemble historic conditions, within RNV.
Refugia	X			All subwatersheds in the basin that have been modified by human activities.
CHANNEL CONDITION AND DYNAMICS				
Width/depth ratio		X	X	Some low gradient streams or stream segments in broad valley bottoms are considered outside RNV due to placer mining and channelization; higher gradient streams are generally within RNV.
Stream bank	X	X		Same as above.
Flood plain connectivity	X			Due to historic placer mining and channelization major historic flood plains are now disconnected, especially in broad valley bottoms .

ELEMENTS, PARAMETERS, or INDICATORS	Less than RNV	Within RNV	Greater than RNV	COMMENTS
FLOW/HYDROLOGY				
Peak/base flows		X		Low flows may be affected by domestic and agricultural use of water and by partial conversion of riparian vegetation from conifer to hardwood, which consume large amounts of water. Peak flows in all streams may be affected to some degree by roads (timing) but riffle substrate does not currently indicate that peak flows have increased to a level that is causing adverse effects to aquatic habitat.
Drainage network increase			X	Roading of the watershed has created many more miles of streams resulting from road ditches. Miles of diversion ditches historically delivered water for hydraulic mining.
WATERSHED CONDITIONS				
Riparian reserves	X			Timber harvest on both federal and non-federal lands has reduced riparian structural diversity buffering the riparian microclimate, natural connections between lowlands and uplands, and areas of late-successional habitat in the part of the stand that is usually the most productive. Agricultural activities have also reduced quality of riparian habitat.
TERRESTRIAL HABITAT				
Large Down Wood (in upland areas)	X			Fire suppression has increased tree density, increased competition in stands and reduced growth. This has produced more *small* down wood (less than 16" diameter and 16' long) than in pre-European times and smaller diameters of snags and resulting down wood. Recruitment of large snags has been reduced by timber cutting and fires suppression (due to decreased mortality from fire)
Beaver	X			Historically beaver were abundant. Dams probably created fish rearing habitat in low gradient streams, channels were kept complex and connected to flood plains, habitat for wading birds, lacustrine habitat for amphibians, and production of prey for insectivorous birds, fish and mammals.

ELEMENTS, PARAMETERS, or INDICATORS	Less than RNV	Within RNV	Greater than RNV	COMMENTS
Elk, great gray owls, and other meadow associates	X			Reduction in fire frequency and extent, compared with pre-European times, has probably reduced the amount and quality of habitat. Development has also greatly reduced this open meadow habitat.
VEGETATION				
Old growth	X			The amount of old-growth forest habitat is probably less than what naturally occurred, based on regional studies. Logging has had the largest impact.
Oak savannah	X			Fire suppression, settlement and development for residential and agricultural land uses has greatly reduced this habitat.
Pine communities	X			Fire suppression has allowed pine stands to develop into dense Douglas-fir stands. Logging and replanting to Douglas-fir has also reduced this type.
Forest Openings		X		The amount of forested area in the watershed is probably within the range of natural variability, but the stands may be younger and of slightly different species composition due to selective logging and fire suppression.
PHYSICAL				
Soil Compaction			X	mainly as a result of roads, agricultural activities and timber harvest

Water Quality/Aquatic Habitat/Fish

Water quality

The main water quality concerns in the Grave Creek watershed are high water temperatures and sediment. The major factors that affect water quality are: roads, timber harvest, agricultural practices (i.e. ranching and farming), domestic use withdrawal and climate.

Temperature

Low gradient slows the flow of water which means longer retention time and more exposure to solar radiation and ambient air temperature resulting in higher water temperature. Shallow soils within the watershed result in limited ground water storage which results in very low surface flows within the streams during summer months. Thus, this watershed tends to naturally have relatively high water temperatures. There are no reservoirs to augment low flows during the summer months which would help to reduce water temperatures.

Temperatures greater than optimal for salmonid rearing have occurred due to lack of shading, irrigation diversion and other factors. There are irrigation diversions which reduce flow, which contribute to lower water levels in streams. Domestic use withdrawal of both surface and ground water also contributes to less recharge of streams during the summer period, but to a smaller degree. Eradication of beavers from the watershed also contributes to higher water temperatures.

Sedimentation

Sediment is linked to natural and human-induced causes. The major concern for sedimentation to streams is harm or potential harm to the life cycles of aquatic species. Excess erosion from disturbed ground as a result of ground based timber harvest, reduces productivity through loss of soil from already shallow soil layers. Most, if not all sediment enters streams during rainfall events. Episodic mass failure events along streams contributes large amounts at one time but tend to have less chronic impact.

Stream survey data from the Oregon Department of Fish and Wildlife indicates that most streams have some degree of erosion along the banks. The majority of the erosion is associated with human-induced disturbance, such as roads, logging and mining. Based on professional judgment, it appears this erosion is probably within the range of natural variability for this watershed. It is not known, however, whether it is near the upper or lower end of this range. The current erosional features are assumed to be associated with large, 100-year or greater flood events.

Contaminants from agricultural fields and failing septic tanks also contribute to impaired water quality.

Water quality is probably stable or declining on the major tributaries and along Grave Creek due to logging and other activities on non federal lands. Water quality on BLM will be on an upward trend in the long-term as riparian zones grow and provide better shading and filtration.

Aquatic Conservation Strategy

Designed to benefit riparian zones, both for fish and wildlife, the ACS has impacts on many management activities. Road construction, timber harvest, recreational opportunities are all affected by this strategy, usually by not allowing such activities to occur within the riparian zone. This has reduced the land available for timber extraction and reduces opportunities to provide transportation system expansion to extract timber. The ACS also restricts development of potential recreation sites near streams.

Much potential for plant and terrestrial animal corridors along riparian zones corridors, that would have been reserved in the NFP is currently non-existent due to roads.

Roads

Road density in this watershed is directly related to timber production, both on non-federal and public lands. Positioning of the roads on the landscape for commodity extraction affects the stability of the roads which were built in stream bottoms and in many cases through unstable slump areas and midslope.

Many roads have been constructed in the vicinity of stream courses. Many of these roads contribute sediment to the streams and have modified riparian vegetation so that shading and micro climate have been affected.

Inadequate maintenance of the roads particularly in slide-prone areas, lack of surfacing, unrestricted access and plugged culverts all affect the stability and integrity of the road system. Lack of funding prevents an aggressive maintenance program to avoid road failure. A major concern for roads occurs during the winter months when Pacific storms often cause erosion, particularly on unsurfaced roads. Recreational use and log hauling during the wet season causes road sub-grade failure and subsequent damage to other resources.

Lack of maintenance resulting from reduced federal funding sources, new construction on non-federal land and lack of maintenance on non-federal land often cause a decline in road stability and overall increase in sediment production. The trend for the long term will be continued deterioration of roads within the watershed. The lack of maintenance on both federal and non-federal lands is likely to continue. Roads that are barricaded or otherwise blocked may experience recovery over time and contribute less sediment.

Recent consultation with NMFS has indicated that when a new road is constructed, another road should be decommissioned to offset the environmental effects. This provides for opportunities for decommissioning, gating or barricading roads. However, intermingled public and non-federal land ownership patterns and existing reciprocal right-of-way agreements in most cases prevent BLM from closing or decommissioning roads in this watershed.

Fish and Fish Habitat

The major factors affecting fish and fish habitat are roads, activities on non-federal lands, habitat, and water temperature. Roads are adjacent to almost every fish stream in the watershed. Sediment generated by traffic, lack of maintenance and road failure enters the creeks and reduces spawning and rearing habitat. Removal of riparian vegetation from stream banks increases water temperature and has caused several low gradient streams within the basin to be listed by DEQ as water quality limited due to water temperatures in excess of 64 degrees F.

Large woody debris (LWD) is very low in most streams in the basin (Appendix D) and thus stream complexity and habitat conditions are less favorable to aquatic organisms including fish. Channelization caused by road building and mining has reduced habitat and riparian vegetation. Placer mining has affected fish and their habitat by removal of vegetation and displacement of gravels and sediment. Most of the lower elevation fish streams are bordered by non-federal lands or flow through non-federal lands. Timber harvest operations, including salvage, within riparian zones has reduced the recruitment of LWD and thus habitat producing structure. Eradication of beavers has also had an influence on LWD because their dams help create sources of LWD.

Habitat for salmonid fish is seen as being substantially lower than historic levels due to human activities. Data indicate a static to declining trend on private and industrial forest and agriculture lands where riparian vegetation, LWD and water temperatures are currently outside of optimum levels for salmonids. A short term 20 to 30 year upward trend may be apparent in Reuben, Poorman, Coyote, Wolf and upper Grave Creeks where recent harvest and fire has occurred, since little or no harvest activity is expected to occur in the near future. Historically rotation age on industrial lands is 40 to 60 years. BLM, and to a lesser extent, State of Oregon-controlled streams will see an upward trend due to better management of riparian zones through better habitat conditions long term.

Hydrologic Effects

The greatest impact from a hydrologic stand point occurring in this watershed is road density. There are approximately 1,000 miles of streams in the watershed (Table 10). Assuming half of the 800 miles of roads in the watershed have ditches, there is an estimated 40 percent increase in effective drainage density occurring as a result of ditching along the roads. This is likely to increase the peak flows and perhaps make them occur earlier.

Compaction resulting from many activities, especially roads, reduces productivity, percolation, and increases runoff which ultimately leads to erosion. In this watershed, the major problem is occurring along roads and tractor roads where erosion channels develop on compacted ground.

Data from stream surveys indicate that streams banks are relatively stable throughout the watershed. Based on these observations, the transient snow zone openings within the basin appear not to have substantial adverse impacts on stream stability, because the transient snow zone openings are not currently extensive enough to cause channel alteration. However, a major flood event may cause future channel damage because the soils are often shallow, resulting in flashy, fast runoff.

Commodity Production

Timber

Tables 16 and 17 in the "Current Conditions" section of this document, describes the distribution of the age classes of the stands in this watershed. Almost 50 percent of the forest stands on BLM land that are in the GFMA land use allocation within this watershed, are over 100 years old, approximately 30 percent are too small for commercial harvest, and the remaining 20 percent are between 50 and 100 years of age. This suggests that the stands that will receive timber harvest in the next 2-3 decades, will generally be these older stands, where regeneration harvests are normally called for.

Programmed timber harvest would occur only on designated GFMA lands or Connectivity Blocks, which comprise 43 percent of the BLM lands, or about 20 percent of the watershed. Inventory and growth projections indicate that roughly 20 to 40 million BF of timber harvest could be harvested per decade, on roughly 2000 acres per decade, in the Grave Creek Watershed. This guideline does not imply that an annual harvest will occur within this watershed, as it is only a portion of the area for which the sustainable harvest levels are calculated. These estimates are based on inventory and projections of the ability of the land to produce wood fiber in the Josephine Sustained Yield Master Unit.

However, several major factors could potentially reduce timber availability, including:

- protection of plant and animal habitat,
- social concerns,
- coarse woody debris and green tree retention, and
- site productivity.

An important factor that could reduce the harvestable land base is the presence of both plant and animal Special Status and Survey and Manage species. The extent of this effect is difficult to estimate, but with recent timber sales in this watershed it has reduced the available volume in virtually all proposed units. The greatest impacts on timber harvest in these recent sales has been related to Survey and Manage molluscs, salamanders and, to a lesser degree, red tree voles. The Del Norte salamanders appears to be limited to the western portion of the watershed.

Maps 3 and 21 identify the areas where residential areas are in close proximity to BLM land. Many of the forest stands in these areas are designated as GFMA in the NFP. Some of these lands are also included in the rural interface (RIA) designation. The RIA also is to be managed to reduce public health and safety hazards, fire risks and vandalism. The trend for projects that are planned in both the RIA and areas close to residences that are not designated RIA, has been to treat these lands as though they are within the RIA. This trend should continue with future projects in these areas. Consideration is likely to be given to visually sensitive areas that are in the immediate view of residences, whether or not they are designated RIA. A closer examination of the RIA and VRM projections for this watershed indicates changes to the original projections of the effects on timber availability will be relatively minor. The only ASQ adjustment was for VRM II - if this happened to overlap with RIA, then the Southern GFMA yield curves were used. - if not, then no alteration on ASQ was done for RIA.

Recent surveys for Coarse Woody Debris indicate that many proposed units do not contain the level of coarse woody debris called for in the NFP. As a result, additional green trees are often necessary to be left to provide for future CWD recruitment. Two project areas (465 acres) had an average of 30 percent of the acreage with greater than 120-feet per acre of Class 1 or 2 CWD that met or exceeded minimum size classes suggested by the Medford ROD. About 50 percent of the area had no Class 1 or 2 CWD and the remaining 20 percent of the area had less than 120 feet of CWD. If this trend holds true for the entire watershed, it is likely that at least one additional tree per acre would be required to be retained in 70 percent of the future regeneration harvest and overstory removal harvest units to satisfy the minimum requirements in the RMP. While this impact is not extensive, it does equate to an approximation of 1,000 board feet per acre on each unit that requires an extra leave tree. This may also be true for snag habitat, but the information is lacking.

Approximately 6,650 acres of northern GFMA acres may be better suited for uneven-age management, similar to management in the Southern GFMA designation, which generally retains 16-25 trees per acre (TPA) or 40 percent canopy cover (Map 22). This flexibility is called for in the RMP (p 73) to reduce risk of reforestation failure and to favor pine on pine sites. Commercial thins could be preferred, with the stand age for thinning being extended to 150 years of age, similar to Southern GFMA and connectivity blocks. These designations will likely affect the harvest levels on these lands, as fewer trees would be harvested under this scenario, at least in the first entry. The effect in the long term is highly uncertain. It is worth noting that the projection of 6,650 acres is also uncertain; it is based on aspect, soils and plant associations. Stands with a southerly aspect (90 - 270 degrees azimuth), and occurring within the tanoak/Douglas-fir-live oak/poison oak, the Douglas-fir-live oak/poison oak, or the Douglas-fir/dry shrub plant groups were projected to be treated in this manner. There is likely to be variation in actual acres receiving this type of treatment due to the relatively coarse map scale and microsite differences. Exact silvicultural prescriptions will be developed on a project-level basis, based on field examination of proposed stands.

Most of the southern GFMA lands (Map 4) are situated on north slopes. Based on this slope orientation and the plant communities present, these areas are more appropriately managed using the northern GFMA silvicultural regimes (e.g. retaining 6-8 trees per acre in regeneration harvests).

The most likely trend in the future appears to be toward less commodity management and removal than occurred prior to 1995. This trend may have begun in the environmental movements of the 1960s and 1970s with larger and larger proportions of the public seeing the forest as more than a repository for wood products, but as an ecosystem needing a more comprehensive examination. The NFP represents many diverse viewpoints and considers a wide variety of resources.

Concerned citizens and land managers will come together in the future to discuss these values. Their decisions will be based on the values they deem important. They should also be aware that if harvesting the wood commodity is deemed important, then adequate space and time will be needed for its regeneration. They will need to be aware that if no harvest is the decision that natural change will occur to the ecosystem regardless of human intervention. They will also need to know that decisions of the day will have persistent consequences in the short and long term.

Special Forest Products

In the NFP, there are guidelines for the harvest and sale of Special Forest Products (SFP). Generally, with fewer traditional forest related jobs present than prior to the NFP, some workers have converted to working with SFPs as an alternative occupation, full or part time. For this reason, there is a greater demand for SFPs, which should continue in years to come.

Firewood:

> The NFP standards and guidelines (S&Gs) has resulted in a lower supply and fewer sales of firewood from this area than prior to the NFP. This is as a result of fewer timber sales creating slash and fewer new road systems being constructed. When new road systems are constructed, easily gotten firewood is accessed adjacent to those roads. This low supply trend from these historical supplies will continue unless significant changes occur to the NFP.
>
> Recent Resource Area planning efforts within the NFP S&Gs are moving in a direction of new supply sources and new means of firewood harvest. This will result in sales specifically for firewood and poles and unit entries prior to final harvest that yield

firewood supplies. As these types of sales increase, it will offset supply losses from historical sources.

Other Wood Products:

Since the NFP, the demand for burls has increased in the watershed. As wood industries change, it's likely niche markets such as burl harvest will continue. Care must be made not to over harvest these trees as their presence is finite and difficult to replace.

Sales of posts and poles, less than 8" dbh, are present and will likely increase as supplies of merchantable timber in larger sizes becomes more scarce. Similar planning as above for firewood will allow demand to be met.

Other sales of specialty wood are rare and have not been increasing in recent years.

Decorative Trees Boughs:

Demand for Incense Cedar and Pines in the Grave Creek Watershed has increased slowly but steadily in recent years. It is thought that it will continue. Until now, supplies across the watershed have been adequate to meet these slow increases. If current demand accelerates, new projects to meet this demand will be need to be examined.

Demand for branches from manzanita species is increasing. Increased monitoring will be needed for this species.

Christmas Trees:

Current low demand, with the exception of King Mountain, should continue.

Beargrass:

Presence of beargrass in this watershed is low and rarely in commercial quantities compared to other watersheds in the Glendale R.A. However, harvest demand has tended to increase even here and will likely continue to have small increases in the future.

Mushrooms:

Demand and sales in this watershed have always been low and will likely continue.

Pacific Yew:

Demand and sales in this watershed have always been low and will likely continue.

Other Products:

Sales of evergreen broadleaf species (salal, grape) has had slow and steady growth and should continue.

Late-successional Habitat/Species

Fire and Fuels

Fire return intervals have been lengthened with the advent of modern fire suppression, beginning around the turn of the century. Many areas have abnormally dense understories, ladder fuels, and
"young" overstories susceptible to mortality from wildfire. There are two major implications to this shift:

- the risk of an abnormally severe fire due to this accumulation of vegetative fuel has greatly increased, and
- the overall health of the forest in general has been compromised.

The three fire rating factors (hazard, risk, value) combine to give an overall assessment of the priority for either treatment or special consideration. Those places in the watershed where all three factors were rated as "high" were determined to be the highest priority for treatment.

Only a small portion of federal land is actually adjacent to well-traveled roads. The major hazard and risk associated with the RIA are the non-federal lands that are adjacent to well traveled roadways and the forest stands on BLM land. The dry nature of this low elevation, non-federal land increases the risk of ignition. These hazards and risks are hard to gauge because some of these areas are irrigated pastures which have a low fire risk, and others are dry grassland or mixed hardwood/conifer forest land. As this is not under the control of the BLM, these risks and hazards can change yearly and are hard to measure. The RIA is mapped as those areas within ¼ mile of all private land that is zoned 5 acres rural residential. Since some of these areas have residences with associated activities (burning, haying, etc.) and some of the areas have no residences or even management activities, fire risk and hazard are both variable. There is risk involved here which may or may not coincide directly with what is mapped as RIA.

There are very few areas that have a high value in all three categories - only three locations. These are areas that received a recent pre-commercial thin or are young plantations, that are in the rural interface, and are adjacent to main travel routes.

There are a number of areas that have high ratings for two of the three parameters. The second highest priority for fuels treatment is where there are both high risk and high value (Map 13). In this watershed, these areas tend to be spotted owl core areas and rural interface stands (RIA), that are close to well-traveled roads.

The third highest priority for fuels treatments is where there is high risk and high hazard. In this watershed these are recent pre-commercial thin areas (PCT), young plantations, and stands with ladder fuels that are close to well-traveled roads. The areas that have received PCT exhibit a higher short-term hazard than unthinned stands of similar size and age, so while they are mapped as being higher priority for treatment, their location is transitory. Generally, different stands receive PCT each year allowing new areas to become high priority for fire hazard reduction treatment, just as past PCT stands fall out of high priority for hazard treatment as the slash breaks down and decomposes. PCT slash is at its highest hazard the first three years after it is severed, after which the hazard declines as it decomposes.

Another area of concern, which is more involved with forest health and commodity production, is the proximity of high hazard young plantations to high value spotted owl core areas. In some cases portions of the core areas have young plantations within the boundary and in some, the adjacent stands are either young plantations or recently pre-commercially thinned stands. These areas can also be considered a fairly high priority for treatment, especially when there is a well-traveled road nearby as is the case in three of the owl core areas.

It appears that the trend in future wildfire occurrence is that there is an increasing likelihood for more intense fires than have occurred in the past. But whether the acreage burned will tend to increase or decrease is uncertain; hazardous fuels are increasing, but fire suppression and access allows for more successful suppression.

Late-Successional Habitat

The removal of timber on public and non-federal lands has had the greatest effect on the direct loss and fragmentation of late-successional habitat in the Grave Creek watershed. Extensive clear-cut timber harvesting has resulted in a watershed which has highly fragmented patches of late-successional habitat. The lack of continuous intact late seral riparian vegetation on both non-federal and public land contributes to this fragmentation.

Two major obstacles to maintaining connectivity between late seral stands are roads and the intersection of Riparian Reserves by non-federal forest land because of the intensive timber harvest along the streams. The Interstate 5 corridor is the single largest road barrier for many species and it inhibits primarily east/west movement. Some species, even some considered highly mobile such as large carnivores, are stopped by major highways such as interstates. Other well-traveled roads can also form an effective barrier to movement; some of these roads are identified on Map 13 "High Risk roads." Also, roads within Riparian Reserves can reduce the effective size of the reserve, both by modification of habitat (temperature increase, moisture decrease) as well as impediments to species' movement through loss of hiding cover within the reserve. The extent of the road's effect however is variable depending on width of road, encroaching vegetation, and whether or not the road is gated or blocked. Some roads in Riparian Reserves have very little effect on some species' movement when "closed in" with vegetation and little human use, while wide, highly traveled roads can be effective barriers. Most of the non-federal forest land has been harvested and very little late seral habitat remains. These lands will generally remain less than 80-years old due to current management regimes. The riparian areas on most of these lands were often harvested and in the future they will likely be much narrower and younger than the reserves on BLM lands. The Riparian Reserves on BLM land, while either intact or protected for future growth, often end at private property boundaries so that connectivity is often greatly compromised across these lands.

As of January, 1999, up to 58 percent of the BLM lands in this watershed are comprised of stands that are older than 80 years. However, due to low overstory densities and crown closures in some stands, the actual effective late seral habitat is closer to 39 percent of the BLM lands in this watershed. It's important to note that the exact acreage is uncertain due to inadequate inventories of late-successional characteristics. The importance of this is that the late seral habitat within this watershed may be reduced earlier than projected in Table 13 with the planned harvest regimes. That is, the amount of late-seral habitat is closer to the 15 percent retention of late seral habitat that is required in each fifth-field watershed than the table indicates. The result is that the Riparian Reserves and connectivity blocks will constitute a larger proportion of the late seral habitat within the fifth field watershed sooner than if 58 percent of the watershed was in late seral condition.

This watershed may have naturally contained 40-70 percent in a late-successional condition (Table 22). Some level of natural fragmentation occurred due to fire frequency and rocky ground. Currently approximately 20- 30 percent of the entire watershed is in late-successional condition. This appears to be outside the range of natural variation. The primary reason is that timber harvest, on both federal and non-federal lands, has occurred at a faster rate than stand-replacement fires in pre-settlement times. Conversion to agricultural and residential use has also contributed, but these land uses are confined to the valley bottoms and are relatively small acreage.

It is particularly important to note the relative scarcity of large blocks of late-successional habitat. The six largest, relatively contiguous blocks in the watershed are displayed in Map 16. These areas have the greatest potential for providing interior forest habitat, which is least affected by edge effects. Large blocks of older forest habitat are difficult to manage for in this watershed because there are few contiguous areas of federal ownership. Intermingled non-federal lands are managed for other purposes. Even on federal lands, most of these six large blocks are located on General Forest Management Area lands, where timber production is a primary objective. Under the RMP and the NFP, much of these lands will be subject to timber harvest. Regeneration harvest would be a primary harvest method, since they are generally older stands. In any event, they currently provide a relatively high degree of habitat quality and provide for some of the east-west connectivity across the watershed.

While the Riparian Reserves will provide connectivity for movement of some late-successional species through the watershed, fragmentation and removal of late seral habitat on Matrix land, primarily through timber harvest, may not retain sufficient parcels to sustain some of the species. Many species associated with late seral habitat are expected to decline on the Matrix and non-federal lands. The Late-Successional Reserves that are at the east and west ends of the watershed hold the greatest chance for these species in the long-term, with Riparian Reserves, Connectivity Blocks, and late seral patches helping to facilitate movement across the landscape. But with the high level of fragmentation, connectivity will still not be adequate for many species. For those species intolerant of early seral stages, local extirpations will likely occur.

The trend on public land in the GFMA land allocation (43 percent of BLM lands) under the RMP, is to further fragment late-seral habitat. This leaves owl core areas, TPCC withdrawn areas, connectivity blocks, and Riparian Reserves to constitute the majority of the future late seral conditions. Commercial thinnings may be designed to increase the rate of attainment of late-seral conditions in these reserves. The trend within the reserve lands (57 percent of BLM lands) is to grow and improve late-successional conditions. But it is also likely future wildfire will not allow all those reserve lands to achieve those older seral conditions. The trend on non-federal land is not certain, but the assumption can be made that there will be no late seral habitat and that it likely will remain in a younger (under 80 years of age and often younger) stand condition. Overall, it appears that the watershed is below the range of natural range of variation, timber harvest on BLM lands will reduce it further in the short term. In the long term, BLM reserves will provide a maximum of about 28 percent of the watershed in late-successional conditions, still well below the 40-70 percent which may have naturally occurred here.

In the future, the amount of large, coarse woody debris (CWD) is likely to increase in the Riparian Reserves, as these stands are left to grow or are commercially thinned to increase the size of the trees in the residual stands. There will be less mortality of the residual stand after a thinning occurs but the average residual tree size will increase. The result is that there will likely be fewer downed trees, but larger ones over time. In the matrix land, existing snags and downed wood are being retained after harvest under the NFP, particularly if surveys show there is less than the recommended amount. Also, residual large overstory trees are being left in all regeneration harvest units and extra overstory trees retained if surveys show less downed wood than recommended in the NFP. In this watershed, a majority of the forest stands are lacking large down wood (≥ 16"diameter & 16' in length) in decay Class 1 and 2 (These decay classes show the least amount of decay; logs have tight bark, still have limbs and the wood is sound). Surveys for CWD on 2 project areas, indicate that approximately 30 percent of the acres in the 2 areas had CWD meeting the above criteria with over 120' per acre. The rest of the project areas was devoid of CWD or had lesser amounts. During the process of harvesting, there will be some boles of cut trees that will be left on site. However, harvesting of any overstory trees in general will naturally reduce the number of potential large downed trees. The result is that immediately after harvest, large downed wood will normally increase in numbers, but future recruitment of CWD is reduced due to overstory harvest. The extremely large trees, those used by swifts for nesting and bears for denning, will be reduced on the GFMA lands; some of the green trees retained in regeneration harvests may provide this structure, but it is unclear how many will reach this size class.

Social

Many activities on BLM lands affect the lands around them. When people occupy and use those lands, the BLM considers those effects. In some cases, especially at smaller scales, local social concerns may take on greater importance and may outweigh larger planning efforts, such as the Medford District RMP. This is due to historic uses as well as more recent initiatives.

The population of the Grave Creek watershed is estimated to be 1,500 people. No large increase is expected in the near future, nor are new areas likely to be developed for residential or agricultural use.

The Rural Interface Area (RIA) was originally mapped during the development of the RMP. A more site-specific examination of this watershed resulted in additional areas potentially deserving special consideration because of nearby residents and other concerns (Map 21).

The major factors influencing social issues in the Grave Creek watershed include:

- potential wildfires,
- timber harvest and special forest product harvest,
- visual and aesthetic values,
- surface water sources,
- recreation,
- road closures,
- mining,
- the presence of Interstate-5.

The effects of fire risk on BLM lands because of their proximity to non-federal lands are analyzed in the fire portion of the Late-successional Reserves section. Activities such as brush burning, fireplaces, or electrical accidents increase the risk to BLM lands that may already have high hazard present. Risk to non-federal lands from fires occurring on BLM lands also exists.

Timber harvest is expected to continue in the watershed, both on federal and non-federal lands and there will be "people concerns":

- Logging will continue to produce noise and dust from logging and log hauling. With the restrictions on road construction, it is likely that the use of helicopters will increase in the next few years, also producing more noise disturbance to nearby residences.
- Logging will also continue to create openings in the forest visible from residences and roads. Only the I-5 corridor is slated to be protected using VRM Class 2 guidelines.
- Logging will lead to the loss of older stands which many people find to be esthetically pleasing. Some local recreationists value these stands so that they can be visited as they now appear. Others find appeal in the mere existence of such stands, whether they are visited or not.

- Logging will also potentially continue to affect water tables. As more areas are logged, water tables may temporarily fluctuate, but then recover over the first 20 years after harvest. The numerous locations of surface water originating on BLM land and used at residences will also be affected.
-It is not thought that future BLM logging will have any significant effects on flooding or stream bank degradation. However, there may be effects on fishing recreationists from past logging activities, from logging on non-federal lands and from the extensive existing road network causing increased surface runoff, siltation and covering of spawning beds.
- The presence of roads, whether open or closed, makes access to BLM lands easier for hunters, possibly increasing hunting visits. Gating or barricading roads to motorized vehicles generally increase the habitat value for big game and some hunters place a high premium on such areas for hunting. Others prefer motor vehicle access for hunting and other recreational uses..
- While the kinds and amounts of special forest product sales have remained steady or slightly increased in recent years, it does not appear that BLM management will cause degradation of resources by commercial harvesters. As a recreational activity, SFP harvest has many positive experiences for the local public.

Road closures and maintenance questions also interact with social issues in several ways:
- Closing of roads due to wildlife or vegetation issues or to alleviate road degradation may conflict with recreational drivers or some hunters.
- Access to non-federal property across BLM lands and on BLM roads is an ongoing gating and maintenance question.
- Trash dumping on BLM roads has been increasing. The extensive road system in the watershed and the inability to frequently patrol them with law enforcement is a concern. There are high costs of cleanup of these sites, as well as a public health question from possible hazardous materials.
- BLM takes on the responsibility and the costs for maintaining roads in high use recreational areas such as London Peak, King Mt., Dutch Herman and Burma Ponds. BLM also maintains the upper reaches of Placer Road along Grave Creek which provides access to several residences.
- The current Quartz Creek Off Highway (OHV) Area in the southwest portion of the watershed will have many road maintenance questions. At this time there is a designated area but no designated roads or trails and no formal management plan. There may be adverse effects and some road degradation from this use.

The BLM pays for the costs of maintenance for some of the above activities. In recent years, budgets for maintenance have been decreasing, limiting the amount of maintenance work that can be accomplished.

Recreational activities in the watershed have grown, in the last ten years, from primarily local residents to include a wider array of participants and a slightly larger regional audience. Publications and internet web pages have expanded the knowledge of the Grave Creek watershed as an area worthy to visit. Recent trail construction at London Peak, maintenance at Dutch Herman and Burma Ponds, the King Mountain Area of Critical Environmental Concern (ACEC), King Mountain Trail, the OHV area have occurred primarily as a result of local use, but their effect and attraction reaches beyond the Grave Creek valley. In the near future, this trend will probably increase, although at a slow rate.

It should be noted that there are differences of opinion among the local residents of the Grave Creek watershed whether it is wise to continue expanding and developing sites on BLM land for recreation. No doubt these different views will continue to be held.

Mining activity on BLM lands, both recreational and as an occupation, are outlined in the Current Conditions section. As a result of laws and regulations, if there are conflicts with other BLM goals, these laws generally take precedence over RMP guidance. There is little the BLM can do to prevent detrimental effects to non-mineral resources as long as miners adhere to past laws. The BLM, however, can and does work with miners, to mitigate detrimental activities. There does not appear to be an increase in mining activity in this watershed, in fact many claims were abandoned within the last few years after the new mining regulations took effect. Mining may increase if gold market conditions improve.

Ownership Patterns

Substantial changes in ownership patterns in this watershed are not expected to occur in the foreseeable future. Some increase in residential development will probably occur, but it likely will not expand far from the existing residential areas. Minor changes in land ownership are likely to occur, for example BLM is actively pursuing a land exchange involving two parcels in upper Grave Creek.

One of the major land uses in the watershed is timber production. This occurs across all ownerships, including BLM, state, county, industrial timber companies and small private land owners.

The Oregon Forest Practices Act restricts, to some degree, activities on non-federal lands through restrictions on logging activities. The major factor controlling harvest activities in the Grave Creek watershed is economics (timber market).

The intermingled ownership pattern has a profound effect on all the other issues and factors in this watershed. It is difficult to manage any of them without considering the implications of federal and non-federal lands. BLM is limited in how effective its management is for fish, water quality, late-successional habitat and other values because so much of the land base is under other ownership (Table 2), with other management goals and priorities.

V. Recommendations

Management recommendations are presented here based on the analyses in this document. First a long-term landscape design is described and presented in Map 22. Following this is a discussion and map showing priority management actions for the next 10-20 years (Map 23). Finally, specific recommendations for individual issues are presented.

It should be stressed that these recommendations are not to be considered management decisions. They are intended as recommendations to be considered for future management actions and may help frame the context for developing future projects. They should not be viewed by the public, BLM staff or managers as a commitment or as binding on future management. Watershed analysis is clearly not a decision document. Actual implementation decisions need to be developed through the NEPA process using this watershed analysis, public input and other information and considerations.

A. Projected Long-Term Landscape Design

The primary factor shaping the long-term landscape design for the Grave Creek watershed is the land use allocations in the RMP and the Northwest Forest Plan (Map 4). This watershed analysis did not develop significant departures from, or modifications to, these allocations.

The projected long-term landscape design is presented in Map 22 This map shows the general vegetative condition expected to be present in the watershed 100 years from the present.

There are six categories of vegetation conditions and land uses based on the projected management in this watershed:

- Private timber industry lands,
- Private forest, non-industry,
- State,
- County,
- Agricultural/Residential,
- Federal managed lands
    - Late-successional habitat,
    - Connectivity/Diversity Blocks,
    - Lands withdrawn from intensive timber management due to biological limitations,
    - General Forest Management Area (GFMA), and
    - GFMA where connectivity is an added consideration.

These categories are briefly described here.

Private timber industry lands: It is assumed these lands will continue to be intensively managed for timber. The remaining older stands will be cut within the next decade; in the future, forest stands will be 0-40 years old. Only very limited areas will exist in an older condition.

Private forest, non-industry lands: It is assumed that these lands will continue to be managed for timber to varying degrees. Some will resemble industry lands, while others will be allowed to older conditions, perhaps averaging 100 years old. Only very limited areas will have stands over 100 years old.

State Lands: It is assumed that these lands will continue to be intensively managed for timber, but on a slightly longer rotation than industry lands. Only very limited areas will exist in stands older than 60 years old.

County: It is assumed that these lands will continue to be intensively managed for timber, but on a slightly longer rotation than industry lands. Only very limited areas will exist in stands older than 60 years old.

Agricultural/Residential: These areas will continue in their current rural character. Housing density will increase to some degree, but not substantially. Some conversion from agricultural to residential property will take place. Where or to what extent that will occur is difficult to project.

Federal lands

Late-successional forest habitat: This category includes several land allocations where late-successional habitat is a direct management objective (e.g. spotted owl core areas and Riparian Reserves). Virtually all the late-successional forest habitat will occur on BLM land.

Lands withdrawn from intensive timber management due to biological or physical limitations (TPCC): These lands will generally resemble conditions in the late-successional category. There is no direction to manage these lands for late-successional habitat, but they are not to be managed for timber either, so they will generally develop into late-successional conditions on their own. A sub-set of this category will naturally remain in a non-forested or relatively open, brushy condition due to their rocky soils or low productivity.

Connectivity/Diversity Blocks: In this allocation the blocks will consist of at least 25-30 percent late-successional habitat. The rest will contain lands similar to those found in the northern GFMA.

General Forest Management Area (GFMA): These lands have intensive timber management as a primary objective. In this watershed, there are three classes of GFMA lands: northern GFMA, southern GFMA and zone-constrained northern GFMA.

Northern GFMA: These lands are prescribed for a rotation length of 100 years. The result will be a mosaic of stands between 0 and 100 years old distributed relatively evenly within the watershed, with each age class in approximately even proportions. Large structure legacies (green trees, large snags and coarse woody debris) will be retained on these lands.

Southern GFMA: These lands are designated in the RMP. The normal southern GFMA harvest regime calls for retaining 16-25 trees per acre in regeneration harvest units. However, the bulk of these lands are on north slopes and have vegetation types typical of the northern GFMA. As a result, they may be managed more using the northern GFMA prescriptions than the southern GFMA. On Map 22 they are depicted to be the same as northern GFMA lands.

Zone-constrained Northern GFMA: These lands are located within the area designated as northern GFMA in the RMP. However, they are low elevation, south and west facing slopes with a high component of pine and should be considered for management similar to the southern GFMA regimes (i.e. favor pine and retain higher levels of residual trees at harvest age). In the long term, these lands will have a multi-age, multi-canopy aspect, with some areas having relatively open pine stands.

B. Short-Term (10-20 years) Landscape Recommendations

Map 23 displays the priority management recommendations for federal lands over the next two decades based on this watershed analysis and the desired long term conditions.

Plantations resulting from past timber harvest are located throughout the watershed. Management in these stands should focus on maintaining conifer stands, promoting their growth and developing habitat conditions. The specific prescriptions will vary, based on the land allocation in which the plantation occurs. Priority should be given to plantations in GFMA connectivity bands on the north and south ridges.

Modified older stands have been partial cut in the past and may not be fully stocked. Management in these stands should promote establishment of fully stocked conifer stands.

Stands 40-80 years old should be examined as a high priority for **commercial thin treatments**.

The four large blocks of late-successional habitat in the northern portion of the watershed should receive special consideration and management in the short term to allow late-successional habitat to recover in reserves, such as Riparian Reserves and spotted owl core areas. These four are highlighted for special consideration because they directly contribute to the east-west connectivity objective for the northern portion of the watershed. Timber harvest, and other management activities in these areas should consider prescriptions and unit designs that delay fragmentation and maintain connectivity.

The GFMA connectivity band on the north boundary ridge should be managed in the next decade or two to allow more contiguous forest stands to develop.

The highest priority fuels management areas should be treated to reduce fire hazard and the risk of wildfire.

C. Recommendations for Key Issues

Fish/Aquatic Habitat/Streams

- An aggressive effort should be made to reduce open road densities in the watershed through decommissioning, barricading and gating. Specific road closure recommendations considered under this watershed analysis are included in Appendix P.

- A major focus of future road decommissioning should be to remove valley bottom roads in order to restore proper functioning of riparian habitat. Other possibilities will come up as projects are examined in more detail.

- Opportunities to improve non-federal roads or reduce road densities on non-federal lands should be explored through partnerships, cooperative agreements and other means possibly through Water Quality management plans and efforts through Community Response teams.

- The most effective, long-term approach for restoring habitat complexity and productivity is through riparian restoration, protection and ensuring that all activities within and outside the riparian area are conducted in accordance with Aquatic Conservation Strategy objectives; this applies to public as well as on non-federal lands. Potential activities include creating openings in dense alder stands and under planting with shade tolerant conifers, thinning stands of conifer saplings, thinning around conifers in dense hardwood patches and falling large alders and conifers into streams to create pools and spawning areas. Thinning dense stands of conifer sapling and poles along streams should be a high priority, provided that increases in water temperatures and adverse effects to terrestrial wildlife are short term.

- Riparian Reserves should be protected and enhanced where necessary to improve habitat conditions both for aquatic species and species associated with late-successional terrestrial habitat.

- Existing culverts should be improved, where necessary, to provide free passage of aquatic organisms both up and down stream. A list of culvert needs and status is provided in Appendix E. Other problems will arise as projects are developed in more detail. In general, culverts should be maintained and replaced as needed to prevent road failures.

-In sensitive soil areas (Map 8):

  - special care and consideration should be given to retain vegetation when conducting regeneration harvests (similar to the Southern GFMA prescriptions in the RMP),
  - road construction should be restricted, or alternatives considered to constructing new roads, and
  - existing roads should be decommissioned where feasible.

- Reintroducing beavers where conflicts with other uses would be minimal should be considered.

- A more thorough inventory of road conditions should be conducted and the information placed into the GIS system to more accurately portray the road system and attributes.

Timber Commodities

- Continue to plan for timber sales in the Grave Creek watershed within the guidelines of the NFP.

- Use the adaptive management process of the NFP to monitor the effects of harvests.

- Use comprehensive inventory procedures across the watershed to accurately measure the existing timber commodity and to more accurately project what timber commodities will be present in future decades.

- Especially on matrix land, use intensive silvicultural techniques to accelerate growth rates of trees. Efforts towards commercial thinning and other methods in the decade to come will spread out the necessity to only harvest large trees to meet an ASQ.

- Low elevation, south and west facing slopes with a high component of pine and should be considered for management similar to the southern GFMA regimes (i.e. favor pine and retain higher levels of residual trees at harvest age). In the long term, these lands will have a multi-age, multi-canopy aspect, with some areas having relatively open pine stands.

- Commodity harvests that also reduce fire hazard and risk should be given greater importance.

- Prescribed fire to reduce fire hazard and risk should be used to help preserve the existing timber commodity and non-timber resources, and to help the interaction with rural interface issues.

- Seek opportunities to enhance non-timber resources by harvest and manipulation of stocking in the reserves.

- Increase harvests of smaller poles to achieve the above recommendations and do so in a way that reduces fire hazard and risk and produces a saleable commodity.

- Coordinate the harvest of Special Forest Products (SFPs) with the harvest of timber commodities through the NEPA process. Initiate SFP projects that work in tandem with timber commodity harvests and benefit the presence and future management of SFPs.

-In some areas application of urea fertilizer, with or without other nutrients, may be beneficial to attaining resource, land use allocation, ACS, or other management objectives. Analyze areas to determine if application of urea fertilizer and other nutrients would help achieve resource, allocation, ACS, or other management objectives. Apply fertilizer as appropriate.

Special forest products

- Use comprehensive inventory procedures across the watershed to accurately measure the existing SFP commodities and to more accurately project whether those commodities will be present in future decades.

- Build a coordinated inventory of SFPs, accessible through GIS.

- Coordinate the harvest of SFPs with the harvest of timber commodities through the NEPA process. Initiate SFP projects that work in tandem with timber commodity harvests and benefit the presence and future management of SFPs and timber.

- Seek out contracting methods that facilitate cost effective extraction of SFPs.

- Reach out to local residents and traditional buyers to expand the attractiveness of the SFP commodity in this watershed and to provide employment alternatives for displaced forest workers.

- Christmas tree areas on King Mountain should be inventoried, monitored and managed to avoid over cutting true fir species.

Late-successional habitat/Sensitive Species

-When planning regeneration harvest in older stands, priority should be given to first cutting the smaller, more isolated stands of late-successional habitat, rather than the larger, more contiguous blocks.

- Promote east-west connectivity across the watershed, especially within approximately one mile of the northern boundary to promote movement of organisms between provinces.

- The four large late-successional blocks in the northern portion of the watershed (Map 23) should be managed to maintain interior habitat over the next decade or two. When timber harvest is planned for these areas, the prescriptions should retain as many of the late-successional characteristics as possible, in order to delay interruption of connectivity.

-Where feasible, maintain some level of connectivity between the large blocks of late-successional habitat and the corridor along the north boundary.

- Pursue potential land acquisitions along the northern boundary, to promote connectivity, and within the four northern large blocks of late-successional habitat to improve interior habitat conditions.

-A more detailed strategy for managing the connectivity/diversity blocks should be developed.

-Utilize silvicultural techniques to promote late-successional habitat in T33S R4W Sec. 27, which is the connectivity/diversity block in the Grave Creek fire.

- Overstocked stands, and stands with remnant pines over dense Douglas-fir reproduction should be examined as a high priority for commercial or non-commercial density management treatments to improve forest health and reduce abnormally high fuel loadings. Priority should be given to stands in rural interface areas and near other residents, owl core areas, and in Riparian Reserves.

- Manage Riparian Reserves to enhance late-successional characteristics and accelerate the development of those characteristics.

- Marbled murrelet surveys should not be considered necessary for projects in this watershed. There is no evidence this species utilizes the vegetation types in this area.

-Better inventories for special status, Survey and Manage and keystone species of wildlife and plants should be conducted.

-Consider reintroducing beavers in the watershed where conflicts with other users would be minimal.

- Inventory snags and large down wood and use by wildlife

-Inventory special habitat features (e.g. meadows, cliffs, caves)

- Develop a management plan for Connectivity/Diversity blocks in the watershed.

- Continue to take advantage of opportunities to close and decommission roads and work with non-federal land owners to close roads in areas where elk management is a priority (e.g. Sunny Valley, Ditch Creek and Speaker Road).

Fire and Fuels

-In high priority fuels areas, treatments should be carried out to reduce the hazard through piling, underburning and other means, especially within 150' from a major road or residence. The highest priority for treatment are shown on map 23; second priority areas are shown on map 13.

- In older stands, underburning should be done to reduce understory vegetation, remove dead fuels and improve the vigor of the stand. This could also be accomplished in some cases through removing the intermediate canopies to reduce ladder fuels and lower the risk for crown fires. This may or may not be a commercially viable option, based on value of the material and the costs of removal.

- A fuels management plan, including a better assessment of fire history, should be prepared for the spotted owl core areas, RIA, large blocks of existing late-successional habitat and other high value areas.

Social

-Implement the recommendations regarding reduction of fire hazard and risk, particularly in the RIA, to improve forest health and address the concerns of adjacent landowners.

-Mitigate, where possible, the short term effects of logging actions in close proximity to landowners, especially helicopter and yarder noise and dust from logging traffic.

-In timber sale design and implementation, consider the effects that harvest will have on the visual aesthetic, not only to traffic along Interstate 5, but also to residents in the RIA.

-In timber sale design and implementation, consider the effects that harvest will have on removal and change in the structure of older timber stands to recreationists and other concerned groups that enjoy the presence of older stands.

-In timber sale design and implementation, consider the effects that harvest will have on local water sources and springs used for domestic water consumption.

-Continue to maintain existing recreational sites to prevent degradation.

-Continue road maintenance, where feasible, to allow for access to visitors and to uphold BLM responsibilities to adjacent land owners.

-Where road closures are the best overall tool for management, consider the detrimental effects to recreationists and consider mitigation to those effects.

-Finish the Quartz Creek Off Highway (OHV) Area management plan and begin its implementation. Consider in the plan the sources of funding for maintenance concerns and the interaction with other resources besides roads or trails (e.g., seasonal wildlife restrictions).

-Continue to seek out partnerships with local groups on a case by case basis, particularly groups in the watershed concerned with resource management issues.

-Actively seek new sources of road maintenance funding and volunteers and groups to augment current low funding.

-Maintain and improve the Tunnel Ridge road system that connects the Cow Creek and Grave Creek watersheds. The intent would be to improve safety and reduce adverse environmental effects while retaining the esthetic aspects of this rural road.

- Finish construction work on the King Mountain ACEC trail system.

- Continue to work with local miners to mitigate adverse effects of mining activities on other resources.

- At this time ODFW's philosophy is not to manage for an increase in this species in the Sunny Valley, Ditch Creek, Speaker Road areas and other rural residential areas. This is because of the potential for damage to crops and property. However, BLM roads may be decommissioned in areas of high road density, not only for elk, but for other wildlife species.

Ownership Patterns

- Pursue land acquisition opportunities, as they arise, to block up federal lands within the large late-successional habitat blocks and within the connectivity band along the northern boundary of the watershed.

VII. Data Gaps and Monitoring Needs

Fish/Aquatic Habitat/Streams

- A thorough inventory of current road conditions and culvert characteristics should be done to identify future improvement projects, decommissioning opportunities and maintenance priorities.

- Detailed information on stream and riparian characteristics should be gathered. ODFW, under contract with BLM, has nearly completed stream habitat surveys for this watershed. Quality information is critical for establishing a baseline for measuring effects of land management activities on aquatic resources on-site, as well as cumulative effects across a landscape. This information can also provide an estimate of a stream's steelhead and salmon smolt production capability. Surveys should be repeated at 10 to 15 year intervals and more frequently if a major hydrologic event or project causes major changes in stream condition.

- Source and flow characteristics of each stream reach (intermittent or perennial), including proper functioning condition classification should be obtained through field observation.

- Monitor the number of salmon and steelhead that spawn in each stream annually.

- Monitor the number of smolts that emigrate from selected subwatersheds during spring. This information in combination with counts of spawning adult fish the previous winter(s) could provide an estimate of fish survival from egg to smolt and an indication of watershed health.

- Monitor the range of daily water temperatures and the duration that they exceed 60F in all fishery streams during summer

- Determine population characteristics of fish and other aquatic life (including macroinvertebrates) in several representative subwatersheds throughout the watershed to track response of aquatic animal communities to projects that are implemented, to document their recovery as degraded habitat recovers and to track population fluctuations in watersheds with no management activity.

- Obtain better information on sedimentation rates, causes and trends is needed. It is widely held to be a major concern, but there is very little hard data.

Late-successional habitat/Sensitive Species

- A more detailed strategy for managing the Connectivity/Diversity blocks, as well as the GFMA connectivity areas on the north and south ridges, should be developed.

- An assessment of the habitat characteristics, fuels and management opportunities in the spotted owl core areas should be conducted.

- An inventory of the habitat conditions in "Modified Older Stands" should be undertaken. These stands are generally old partial cuts; some provide no value to late-successional species, others may provide fairly high quality habitat.

- The stand dynamics of older forests should be examined to project future consequences of protection measures and long term retention of late-successional habitats.

- An inventory of special habitat features (caves, cliffs, talus, etc.) should be conducted.

- An extensive inventory of Survey and Manage species should be conducted to better understand habitat requirements, determine the affects of past management actions, determine distributional limits for species and establish baseline conditions for the Riparian Reserves and other areas.

- Information on noxious weeds and invasives should be gathered in the Grave Creek watershed including: an inventory of species distribution, determining invasive mechanisms and routes, and evaluation and monitoring of current condition and expected growth.

- A detailed assessment of late-successional habitat from a conservation biology perspective should be conducted in the watershed. This would involve patch size analysis, corridor design, gap analysis, etc.

- An inventory of snags and large down wood should be undertaken to determine the relative values and appropriate levels to be retained in managed stands.

- The Operations Inventory (OI) should be ground-truthed to determine the validity of volume estimates and characterization of stands in terms of late-successional habitat conditions.

Commodity Production

- A more effective inventory of the Modified Older stands should be conducted, both in terms of timber management and habitat characteristics for plants and wildlife.

Appendix A. Issues and Key Questions for the Grave Creek Watershed Analysis.

Water Quality/Aquatic Habitat/Fish

- # Where is the transient snow zone in the watershed and what is its condition? How does it affect future management?
- # How does the presence of roads, drainage structures and their condition affect the quality of riparian and aquatic habitat?
- # What are the sources of sedimentation?
- # Have past management practices and changes in watershed vegetation affected the timing and quantity of peak flows and thus affected aquatic plant and animal communities?
- # What are the effects of mining, agricultural activities and rural urbanization on riparian and aquatic habitat and water quality?
- # What is the current status of water quality and quantity in the watershed? How have activities on non-federal and public lands altered stream flows and water quality? How are the current conditions related to Oregon Department of Environmental Quality (DEQ) water quality-limited streams?
- # How are the timing and quantity of runoff affected by compaction (from roads, skid trails and landings) and by other management activities?
- # How do roads, drainage structures and their distribution/condition affect water quality and quantity?
- # How do the aquatic conservation strategy objectives (NFP p. B-11) relate to this watershed?
- # What is the current distribution of habitat for Special Status fish species in the watershed?
- # How would future management activities affect the presence of these species and their habitats?
- # Are present land allocations contributing significantly to the viability of habitats for aquatic species now and will they in the future?
- # What is the present quality of aquatic habitat within the watershed? Where is the best habitat and where are the greatest opportunities for improvement?
- # Are there natural or human-caused barriers to movement of aquatic species? If so, what are the effects?
- # Are riparian zones in the watershed functioning at their hydrologic and biological potential for the benefit aquatic of ecosystems?
- # What are the current conditions of riparian zones? Are there opportunities to improve riparian habitat and where?
- # How does mining affect aquatic habitat and water quality?

Commodity Production

- # How does BLM timber management affect riparian zones, fish, VRM and other resources, and vice-versa?
- # Where do noxious weeds occur? How do they affect land management?
- # Where are low site lands?
- # What are the reforestation problems and where do they occur?
- # Are there access problems for commodity management?
- # What are the available timber volumes and what are the potential volumes?
- # What are the conditions of the roads?
- # What are the special forest products?
- # Are tree diseases a problem?
- # Where are existing timber sales?
- # What are natural vegetation types and how do they affect commodity productions?
- # What are the effects of measures to maintain biodiversity on commodity production?
- # What are the effects of the current age class distribution on federal and non-federal lands on BLM management practices? What age class distributions are likely in the future?
- # Can harvest of special forest pro
- # What types of mining occur, where? What types may occur in the future?
- # What are the mining occupancy issues?
- # What are government regulations toward mining?
- # What are the timber rights on mining claims?
- # Does mining affect access to public lands?
- # Are there active or abandoned mine adits and shafts? What are issues for safety and for bats? ducts within the watershed be maintained at a sustainable level?

Late-successional Habitat/Species

- # What are the special status species in the watershed and what are their habitats?
- # Where do the special status species and their habitats occur?
- # How do special status species affect commodity management and vice-versa?
- # How fragmented is the late-successional habitat?
- # How good is connectivity for LS species?
- # What is the status of Connectivity/Diversity blocks? How should they be managed?
- # What is the status of LS habitat in the watershed?
- # Where is late-successional habitat located?
- # What quality is the current LS habitat?
- # How should BLM manage the Special Status Species habitats?
- # What's the role of fire and other disturbances in the development and maintenance of habitats and biological diversity?
- # What has been the effect of previous management on quality and quantity of wildlife habitat? How do roads affect habitat?
- # Where are special habitat features? How do they contribute to biological diversity?
- # Are the amounts, distribution and spatial arrangement adequate to maintain wildlife populations? How will they change?
- # How do management practices affect spread and control of noxious weeds and their impacts on native plant and animal communities?
- # What are the condition of Riparian Reserves in relation to fish and wildlife habitat?
- # What are the values of this watershed in relation to habitat on larger scales?

Social

Where is the Rural Interface Area? What is the definition?
How do local residences affect road management and maintenance?
How does RIA affect fire danger and vice-versa? How does fire danger in the RIA affect BLM management?
How does BLM management affect water tables?
What are the impacts of trash dumping? Where does it occur?
How does RIA affect timber harvest and management?
How does public land management affect private land owners?
Where is VRM important? How does VRM affect BLM management?
What is the current management direction in the RMP for the RIA?
What are the local public interest groups?
What are opportunities for partnership agreements with private landowners?
What are locations of private water sources and water rights?
Where are recreational opportunities?
How does recreation affect local residences?
Who are the recreational users?
What types of recreation are currently occurring? Where do they occur?
What are the potentials for future recreation?
What are current management actions concerning recreation, both agency and individuals?
How does recreation affect other resources?

Ownership Patterns

What are the legal public and non-federal access implications?
What are the sizes of individual land ownership parcels? How are they distributed?
What are the effects of non-federal land ownership on federal timber harvest?
How do intermingled non-federal lands affect LS habitat?
Where are the other public agency lands?
Who are the large private land owners?
What are the opportunities for land exchanges?
Are there mining patents currently being processed?
What are effects of non-federal timber management on water quality, fish and wildlife?

Appendix B. Natural Vegetation of the Grave Creek Watershed.

Potential natural vegetation was mapped on three levels. The series is determined by the most abundant reproducing tree in the understory of late-successional stands. Often, this is the most shade-tolerant species present. Plant associations are fine scale divisions based on the indicator species present in late-successional stands. These associations are further aggregated into plant association groups, to ease interpretation. Plant association groups are italicized below and are presented in Map 14. The plant associations used are described in Atzet et al. (1996). This book gives more detailed information on species composition.

Tanoak Series 32,076 acres

Tanoak-Douglas-fir, dry 28,578 acres

Tanoak-Douglas-fir-canyon live oak/dwarf Oregon grape 11,577 acres

This association was widespread and diverse. Included were stands with canyon live oak and salal, and stands with neither canyon live oak or salal, but having dwarf Oregon grape. Grand fir was found in this association near the eastern extent of the tanoak series. It was one of the most abundant associations, and occurred in the west and north-central portion of the watershed.

Tanoak-Douglas-fir-canyon live oak/poison oak 17,001 acres

The driest tanoak sites supported this association. This association was distinguished by its lack of salal and dwarf Oregon grape. Hairy honeysuckle was common. The association was mostly found on south and west facing slopes, and supported stands of ponderosa pine overstory with Douglas-fir, tanoak in the understory, particularly on the ridges.

Tanoak-Douglas-fir, moist 2,934 acres

Tanoak-Douglas-fir/salal-rhododendron 1,305 acres

Only the far northwestern portion of the watershed supported this association, mostly on north slopes. Salal and rhododendron were always abundant. Dwarf Oregon grape was less abundant.

Tanoak-Douglas-fir/salal-evergreen huckleberry 1,013 acres

This association was found at on north slopes in the southwestern portion of the watershed. It was distinguished by the dominance of salal and huckleberry. Dwarf Oregon grape was less abundant.

Tanoak-Douglas-fir/salal-dwarf Oregon grape 616 acres

This association had little or no rhododendron or evergreen huckleberry, and was the most widespread of the wetter tanoak associations. The association was sparsely scattered in the western portion of the watershed.

Tanoak on ultramafics, shrub dominated. 1 acres

Tanoak/manzanita/bear grass 1 acres

This association was found in only one small area. Most of the area was in the Middle Cow Watershed, with only 1 acre extending into the Grave Creek Watershed. Manzanitas (*Arctostaphylos patula, A. canescens, A. nevadensis*) were abundant in the shrub layer. Huckleberry oak also occurred in the vegetation type. Due to disturbance, it was difficult to determine the potential natural vegetation at this site.

Tanoak with white fir and/or Sadler's oak, cool site. 563 acres

Tanoak-white fir/dwarf Oregon grape 563 acres

This type was relatively uncommon, occurring on north slopes and in canyon bottoms where the tanoak, Douglas-fir and white fir series were nearby, in the north-central potion of the watershed. White fir (actually grand fir, in this case) was found consistently, increasing in late-successional sites. Canyon live oak and salal were uncommon to absent.

Douglas-fir Series 59,057 acres

Douglas-fir on ultramafics 5,147 acres

Douglas-fir/huckleberry oak 1,147 acres

Huckleberry oak distinguishes this association. It occurs on the slopes of King Mountain and adjacent areas. Bear grass, and sometimes rhododendron, was prominent in the understory, at high elevations, on moister sites. Drier sites had more pinemat manzanita. Huckleberry oak hybridizes with canyon live oak (Hickman 1993), and plants on intermediate sites often appeared to be intermediate between the two species. Huckleberry oak occurred at higher elevations, and on sites with a stronger ultramafic character, than canyon live oak.

Douglas-fir-incense cedar 4,000 acres

This association was highly variable in both canopy cover and species composition. The drier sites were similar in composition to those described in Atzet et al. (1996), having Jeffrey pine, rock fern and fescue. Open areas sometimes included buckbrush. Canyon live oak and poison oak were also sometimes present. Cooler, wetter sites at high elevation contained bear grass, pinemat manzanita, dwarf Oregon grape and sometimes rhododendron. These sites were not adequately described by any association in Atzet et al. (1996), but were best grouped with the Douglas-fir-incense cedar association. Sites near Sexton Mountain had Oregon white oak, and were much like adjacent douglas-fir/dry shrub sites. All of the various sites mentioned above were similar in that they had ultramafic substrates, relatively open forest, and codominance of incense cedar with douglas-fir.

Douglas-fir with salal and/or sword fern, cool 2,864 acres

Douglas-fir/salal-rhododendron 948 acres

Only the easternmost portion of the watershed supported this association, except for a small area in the northwestern end. Salal and rhododendron were always abundant. Dwarf Oregon grape was less abundant. This association was often developed on ultramafic rocks, in which case canyon live oak was often prevalent.

Douglas-fir/salal-dwarf Oregon grape 1,897 acres

This association was found on cool, wet sites east of the tanoak series, and in the northwest tip of the watershed. Grand fir and tanoak were absent to sparse or localized. Canyon live oak was sometimes present.

Douglas-fir/dwarf Oregon grape/sword fern 19 acres

This association is very close to the previous, being distinguished only by the relative amounts of salal and sword fern. Most occurrences were on small, north-facing coves, and were not mapped. The only large, mappable occurrence was developed in the northeast corner of the watershed.

Douglas-fir-canyon live oak, hot and dry 31,107 acres

Douglas-fir-canyon live oak/poison oak 17,017 acres

This association was the most widespread and abundant, occurring on rocky, dry sites all across the watershed. Canyon live oak was often abundant, and reached its greatest stature in this type. Canyon live oak was relatively small and sparse on deeper soils where many large, fast-growing Douglas-fir and madrone occurred. Poison oak was often absent from the higher elevation sites, but hairy honeysuckle was more consistently present. Many of these sites are withdrawn from the commercial timber base due to stand regeneration problems. Well-developed old-growth stands had an open canopy of large Douglas-fir, and a somewhat dense lower canopy of canyon live oak. Some of these areas also support an overstory of ponderosa pine with site index for pine better than Douglas-fir.

Douglas-fir-canyon live oak/dwarf Oregon grape 14,090 acres

Like the previous association, this type was often found on rocky sites. It is wetter, and has dwarf Oregon grape and often sword fern. This association included some areas without much or any canyon live oak, but having an understory of dwarf Oregon grape, vanilla-leaf, and whipple vine. Moist inclusions sometimes had salal, rhododendron, and vine maple.

Douglas-fir, shrub, moderate temperatures 19,939 acres

Douglas-fir/creambush oceanspray/whipple vine 6,683 acres

This common association was found in the relatively dry, central portion of the watershed. On valley floors, most of the area was converted to pasture or other anthropogenic landscapes. Ponderosa pine is sometimes present as a result of historic fires or other disturbance; it does not reproduce in older stands.

Douglas-fir/dry shrub 13,256 acres

The driest south-facing slopes and valleys in the central part of the watershed supported this association. Common shrubs included snowberry, poison oak, hazelnut, hairy honeysuckle, and Piper's Oregon grape. This association had frequent California black oak and madrone, even in old growth stands; these trees are often only seral in other associations. Some areas on non-federal lands are currently grasslands ringed with ponderosa pine and Oregon white oak. This state is probably a result of historic fires, along with continued grazing, although a few areas may be in the ponderosa pine or Oregon white oak series. Ponderosa pine can be dominant on these sites with Douglas-fir slow to invade, and usually does not establish in open areas. Instead, douglas-fir established under the cover of the oaks and pines within these dry associations.

Western Hemlock Series 2,663 acres

Western hemlock, salal 127 acres

Western hemlock-incense cedar/salal 127 acres

One area of this association was found, developed on or near serpentine. The relatively great abundance of incense cedar coincided with the serpentine influence. Species composition was highly variable, with much dwarf Oregon grape and sword fern. Salal and rhododendron were sparse, except in patches less influenced by serpentine. This site does not fit the description in Atzet et al. (1996) very well, but was grouped with the best-fitting association. The type was a patchy mosaic, intermediate in character between douglas-fir - incense cedar, and hemlock/rhododendron-salal.

Western hemlock, rhododendron 2,536 acres

Western hemlock/rhododendron-salal 2,536 acres

This association was found in the northeast corner of the watershed. It was often found on or near serpentine; the serpentine sites sometimes included huckleberry oak. Salal and rhododendron formed a dense shrub layer.

Jeffrey Pine Series 1,659 acres

Jeffrey pine on grass, low precipitation 1,659 acres

Jeffrey pine/buckbrush/Idaho fescue 1,489 acres

This association was developed on dry serpentine sites. The canopy was very open, with Jeffrey pine, incense cedar and Douglas-fir. Buckbrush and fescue were the most abundant understory cover. Dry, low elevation sites sometimes had whiteleaf manzanita (*Arctostaphylos viscida*). The site near the west end of the watershed had huckleberry oak, box-leaved silk-tassel, and hoary manzanita (*Arctostaphylos canescens*).

Jeffrey pine/Idaho fescue 170 acres

This association occurred at high elevation, on dry, open, grassy sites. Scattered trees included some incense-cedar and canyon live oak. Although there was often little or no shrub layer, sometimes shrub form Oregon white oak, greenleaf manzanita (*Arctostaphylos patula*), and pinemat manzanita (*A. nevadensis*) were present. A stonecrop endemic to serpentine, *Sedum laxum* ssp. *laxum* was often present. This association was found mostly on ridge tops southeast of King Mountain.

White Fir Series 7,827 acres

The white fir series includes areas with both white fir and grand fir; these species are lumped in Atzet et al. (1996). These species grade into one another over a large area. Variation with environment has been reported, with more grand fir characteristics in warmer, wetter environments, and more white fir characteristics in cooler, drier environments (Zobel 1973). Physiological characteristics vary along with morphology (Zobel 1974, 1975). The Oregon firs in this species complex appear to be either grand fir, or grand/white intermediates (Donald Zobel, personal communication). No pure populations of white fir have been recorded in Oregon, although some trees within intermediate populations may not show grand fir characteristics. In Oregon, it is conventional to call intermediate trees "white fir," to distinguish from typical grand fir (Donald Zobel, personal communication).

Within the Grave Creek watershed, most of these trees are grand fir. There are intermediates at higher elevations (>4000') in the King Mountain. area. The bark of most of these intermediates is red inside (a grand fir trait), but some trees have yellow bark, and have stomates (whitish bands) on the leaf upper surfaces; the latter traits are characteristic of white fir. These populations are intermediate in genetic composition.

White fir at high elevations, often with Shasta red fir 625 acres

White fir/bear grass 625 acres

This association occurred at the highest elevations near King Mountain. Bear grass was prominent, as well as dwarf Oregon grape, oceanspray, pinemat manzanita and rhododendron. Shasta red fir was codominant at the very highest elevations, but absent somewhat lower. Firs intermediate in character between grand fir and white fir were present. Old growth sites sometimes had a high understory diversity, with thin-leaved huckleberry, twinflower, vanilla leaf, *Orthilia secunda*, *Chimaphila umbellata, Tiarella trifoliata, Rubus nivalis,* and *Clintonia uniflora*. Much of the area was highly disturbed, making determinations difficult, but the area appeared to be a complex of plant associations, including perhaps White fir-Shasta red fir/vanilla leaf. Shasta red fir and pinemat manzanita increased in disturbed sites.

White fir with western hemlock, moist sites 610 acres

White fir/salal-dwarf Oregon grape 490 acres

Valley bottoms and north slopes, widely scattered, supported this association. Tanoak and western hemlock were sometimes found, along with grand fir and Douglas-fir.

White fir/rhododendron-dwarf Oregon grape 120 acres

This association was found on northeast slopes, adjacent to areas in the Douglas-fir series. The association occurred in the eastern portion of the watershed.

White fir/vine maple/Oregon oxalis Not mapped

This association was found on stream terraces, along the upper reaches of Grave Creek. Only a small area was found; it was not mapped. There was grand fir, some western hemlock, vine maple, oxalis, sword fern and dwarf Oregon grape.

White fir on ultramafics 1,141 acres

White fir/huckleberry oak 1,141 acres

Serpentine and adjacent sites supported this association, on mostly south slopes east of

King Mountain. Grand fir was present, or intermediates at higher elevations. Also present were Douglas-fir, incense cedar, huckleberry oak, dwarf Oregon grape, and pinemat manzanita. Some moister sites included rhododendron, salal, and western hemlock. At the highest elevations, Shasta red fir was also present. Most of the area had been subjected to partial cuts; no old growth stands were found.

White fir on moderately dry sites 5,451 acres

White fir/dwarf Oregon grape/twinflower 1,107 acres

This association was found in valley bottoms, apparently on deep alluvial soil, in the upper Grave Creek region. Grand fir was the characteristic fir.

White fir/dwarf Oregon grape/vanilla leaf 1,167 acres

High to mid-elevation slopes in the eastern portion of the watershed supported this association. It was generally found above the western hemlock series. Grand fir, or intermediates at the highest elevations, were found. Understory vegetation included dwarf Oregon grape, vanilla leaf, twinflower, whipple vine, and baldhip rose. Thin-leaved huckleberry was found at the highest elevations, and patches of rhododendron were sometimes found.

White fir-Douglas-fir/baldhip rose 3,177 acres

This association was the driest of the white fir series, and contained grand fir. Grand fir was codominant with Douglas-fir. The presence of canyon live oak, creambush oceanspray, or madrone distinguished the association. The Douglas-fir-white fir association is the same in composition, the only difference being relatively more Douglas-fir in old growth stands. As most stands were not in an old growth condition, these two associations could not be readily distinguished. Therefore, some areas mapped as white fir-Douglas-fir/rose may actually be the Douglas-fir-white fir type.

Oregon White Oak Series 472 acres

Oregon white oak, Douglas-fir 290 acres

Oregon white oak-Douglas-fir/poison oak 290 acres

This association occurs in small areas on south-facing slopes at mostly low elevation. Most areas with white oak were classified in conifer series, as white oak was not a major reproducing species in the understory of closed forests. In addition, small groves of oaks on non-federal land were impractical to map. Even the areas mapped under the white oak series may eventually become Douglas-fir series forests (probably Douglas-fir/dry shrub) with continued fire suppression. Fire may be necessary to preclude conversion to conifer forests. Steep, dry, rocky slopes in the middle of the watershed are probably climax Oregon white oak sites. These rocky sites included buckbrush, canyon live oak, box-leaf silk-tassel, and mountain mahogany.

Oregon white oak, grasses 182 acres

Oregon white oak/hedgehog dogtail 182 acres

These dry, rocky sites were very open, with no Douglas-fir except in the most favorable spots. Buckbrush was often abundant. These areas appeared to be climax Oregon white oak sites. The association occurred in the Grave Creek canyon, around the confluence with Wolf Creek.

Shrub fields 652 acres

Manzanita 325 acres

Greenleaf manzanita 325 acres

One area supported a shrub field of manzanita spp. (mostly greenleaf manzanita), buckbrush, and huckleberry oak. Some scattered Douglas-fir and white fir were present, but this dry, rocky site did not appear to be able to support a closed forest. The trees that were present were sparsely scattered, stunted and windswept. This area was on the top and the southwest side of Green Mountain. This plant association is not described in Atzet et al. (1996).

Another area occurred on the south slopes of King Mountain. This area was mostly greenleaf manzanita, with additional pinemat manzanita, box-leaf silk-tassel, squaw carpet, bitter cherry, tobacco brush, and shrub form Oregon white oak and chinquapin. Again, the area appeared unable to support a forest.

Canyon Live Oak 327 acres

Canyon live oak/buckbrush 327 acres

These open areas, developed on dry, rocky sites, had scattered canyon live oak, ut no Douglas-fir overstory. Besides canyon live oak and buckbrush, box-leaf silk-tassel and mountain mahogany were often present. These sites were developed on the Witzel soil series - rock outcrop complex map unit. This association was related to the Douglas-fir - canyon live oak/poison oak type, but was open and shrubby, with buckbrush. The association was also similar to the Oregon white oak sites, but had very little or no Oregon white oak. This plant association is not described in Atzet et al. (1996).

Anthropogenic Prairies or Pastures

Valley bottoms and adjacent south slopes were often not forested. The potential natural vegetation was difficult to ascertain, but small, relatively mature groves existed on roadsides.

These groves indicated that most of the area was in the grand fir or Douglas-fir series, and the areas were mapped accordingly.

These prairies were probably created by Native Americans, using fire, as is documented for the Willamette Valley. The prairies are currently maintained by grazing and other human activity. These areas are used as pastures and rural residential areas. Droughty soils on the slopes, saturated soils in the valley bottoms, and competition from dense grass cover may further inhibit tree establishment. Oregon white oak and ponderosa pine are prominent on the drier edges. Riparian forests of big-leaf maple, alder and ash can occur in the middle of these pastures; these forests are highly variable, and influenced by disturbance.

Limitations in the Mapping Techniques and Effects of Disturbance

Due to the time allowed, and the mapping scale used, small variations were not mapped. These variations include rocky areas, riparian areas, canyon bottoms, and some ridge top variations. In general, most variations smaller than the size of the county soil map polygons were not mapped.

The plant association is the closest fit from Atzet et al. (1996), but the actual map unit will not always be the same as the book description. Vegetation which fell outside the range described in Atzet et al. (1996) was found; especially prominent cases are noted above.

Some large areas were heavily affected by disturbance; potential natural vegetation was difficult to discern. Intensive clearcutting, site preparation, herbicide use and dense plantations had often affected the understory vegetation. Where the vegetation was early successional, the potential was assumed to be the same as types on similar soils and aspects within the local area. This assumption may lead to errors.

Extensive placer mining occurred in the upper Grave Creek and Coyote Creek areas. The mining destroyed the soil profiles in the canyon bottoms. These areas were mapped as what they might look like, had no mining occurred, by extrapolating from adjacent areas. Because of access problems on non-federal land, the new potential of these areas with hummocks and cobble substrates was not determined, but they probably support a complex of potential types.

Recent clearcuts generally included the indicator species, and were identifiable to plant association. None of the indicator species appeared to be highly restricted to late-successional forest. Older clearcut sites, however, that had been subjected to greater disturbance and perhaps shading in dense plantations, often lost their indicator species. An extreme case was the Grave Creek fire, from the early 1970's. By extrapolating from adjacent sites, the area appeared to be potentially white fir/dwarf Oregon grape/twinflower, and Douglas-fir-canyon live oak/dwarf Oregon grape. The burn area was dominated by mostly ponderosa pine, manzanita species, and upland willow. Very few remnant dwarf Oregon grape occurred, while no white fir, canyon live oak or twinflower were found.

Management Implications

Historical fire frequencies may be determined as a related to plant association. This knowledge may then be used to determine desirable prescribed fire regimes. Timber productivity is also related to plant association. Plant associations might also be used to determine the potential for wildlife habitat. Finally, plant associations may be useful in determining potential areas for Research Natural Area designation, providing a system of Research Natural Areas covering representative vegetation types.

Appendix C. Methodology For Stream Habitat Rating

Maximum Water Temperature:
Based on data collected by the Resource Area June to October since 1993; data on file. 64EF or lower for "Good" condition is based on State criteria for 303(d) water quality - limited streams.

# 64EF	=	4
65-70E	=	2
>70E	=	0

Habitat Integrity Rating For Aquatic Insects (Sediment on NMFS Matrix):
Reports on file. Although the rating considers many factors, crevice space (embeddedness) is primary.

Very High/High	=	4
Moderate	=	3
Low	=	2
Severe	=	1

Barriers To Fish Movement (human related):
Derived from Appendix E of this watershed analysis.

None	=	4
One or more located high in the watershed	=	3
Several throughout the watershed	=	2
One or more near the mouth or main stem	=	0

Large Woody Debris (Minimum size of a key piece is 0.6m x 10m)
Data source is ODFW stream survey data. Score is dependent on how close the amount of LWD is to the ODFW benchmark for "Good" condition.

$3 pieces per 100m	3
2-3 " " "	2
1-2 " " "	1
<1 " " "	0

Pool Frequency:
Not applicable to streams when average gradient exceeds about 7 percent because the methodology for measuring pools (by definition a "pool" is longer than the average stream width) tends to overlook small pools of turbulent water in high gradient streams. Streams that are pinched by roads, have low levels of down wood, or that have been extensively placer mined tend to have low pool frequency. Data source is ODFW Stream survey data Rating criteria based on NMFS Matrix.

5-8 channel widths per pool	=	3
9-20 " " " "	=	2
>20 " " " "	=	0

Pool Quality:
Number of complex pools per km of stream surveyed by ODFW. Rating based on ODFW benchmark.

>2.5 per km	=	4
1-2.4 per km	=	2
<1 per km	=	0

Off-Channel Habitat:
Alcoves, side channels, LWD on low gradient streams (<3 percent). Virtually all Grave Creek tributaries exceed 3 percent, Rosgen A and B type channels. This factor primarily applies to most or all of main stream Grave Creek, Wolf Creek and Coyote Creek. Other streams are usually rated as "Good" because higher gradient streams typically do not have alcoves and side channels. Historic mining or road proximity would lower the rating, especially on low gradient reaches/streams. Points/rating depends on how far existing conditions deviate from projected pre-settlement conditions.

Good	=	3
Fair	=	2
Poor	=	1

Refugia:
Quality aquatic habitat in the watershed or subwatershed that serves as a gene pool to repopulate adjacent streams in the event that habitat is lost through human-related or natural events. All of the Grave Creek watershed has been extensively altered by human activity.

Good	=	3
Fair	=	2
Poor	=	1

Width : Depth Ratio:
Rating based on ODFW stream survey data and suggested NMFS benchmarks. An indicator of excessive peak flows or physical alteration.

Stream Gradient	Rosgen Channel Type	Ratio Considered "Good"
4 - 10%	A	<12
2 - 4%	B	12-30
< 2%	C	12-30

The score/rating for this factor represents how far the average ratio for the stream or stream reach (lower, middle, upper) deviates from the NMFS benchmark.

Well within the expected range:	3 points
Somewhat outside the expected range:	2 points
Well outside the expected range:	0 points

There is a great deal of natural variability that is dependant on geology, soil type, rainfall characteristics, etc. It is questionable whether NMFS benchmarks can/should be applied only on the basis of stream gradient. Score has been designed to allow for W:D ratios that are somewhat outside the expected range in order to allow for natural variability.

Percent Habitat Units With Erosion:
Data from ODFW stream survey records. Rating is based on percentage of habitat units surveyed with active bank erosion. Unfortunately their data does not tell us the percentage of stream bank length that is eroding. But the way it is recorded *does* give an indication of how stable the streambanks are.

<10% unstable= 4 points
10-25% unstable = 2 points
25-75% unstable = 1 point
>75% unstable= 0 points

Flood plain Connectivity:
Since most streams in the watershed are Rosgen A and B channels, there are few riparian terraces that could be inundated during peak flow. Unless there is channelization, stream bank rip rapping, a road or historic mining next to or within A and B channels, most are considered properly functioning. The degree of development (agricultural land, homes, roads, railroads, historic mining, etc.) determines the rating. A road next to an A or B channel is potentially less damaging than a road or other development on a C channel.

A+ potential = 3
Moderate impacts = 2
Highly impacted = 1

Score for each stream is based on field observations, but not data.

Road Density and Location (Disturbance History):
Road density information was derived from Table 6 in this Watershed Analysis. Road location derived from aerial photos and field knowledge. Threshold/benchmark for road density is based on NMFS matrix. Rating points can be affected by road location (i.e. valley bottom vs. Mid-slope or ridge top).

#2 miles per square mile	=	4
2-3 " " " "	=	3
3-4 " " " "	=	2
>4 " " " "	=	1

Riparian Reserves Intact:
Highs rating dependant on riparian reserve being in mature/old growth condition with no or few roads adjacent to fish habitat benchmark per NMFS matrix.

$80% mature or old growth	=	3
60-80% " " " "	=	2
<60% " " " "	=	1

Equivalent Clearcut Area (Disturbance History):
ECA value for each subwatershed is derived from Appendix Q of this Watershed Analysis.

None/Low	#15%	=	3
Moderate	16-25%	=	2
High	26-50%	=	1
Extreme	>50%	=	0

Compaction (Disturbance History):
compaction value for each subwatershed is derived from Appendix Q of this Watershed Analysis.

Low	#5%	=	2
High	>5%	=	1

Total Score For Each Subwatershed:

80-100% of potential points	(39-49)	Good (Properly Functioning)
60-80% " " "	(29-38)	Fair (Functioning At Risk)
<60% " " "	(<29)	Poor (Not Properly Functioning)

All factors were given equal weight when determining a total score. That is, riparian condition was not considered more important than road density or large woody debris. Many factors are inter-related and some may in fact be more important than others for determining stream health. However, weighting several factors that seem to be of primary importance may be imposing a personal bias on the procedure.

Appendix D. Habitat and Watershed Factor Rating For Most Fish Bearing Streams In The Grave Creek Watershed.

Stream	Summer Water Temps	Habitat Integrity (Aquatic Insects)	Fish Migration	Large Woody Debris	Pool Frequency	Pool Quality	Off Channel Habitat	Refugia	Width to Depth	Streambank Erosion	Flood Plain Connectivity	Road Density & Location	Riparian Reserve Age And Integrity	Equivalent Open Area	Compaction	Total Points
Big Boulder	2	3	4	3	2	0	3	0	3	4	3	1	1	3	1	33
Reuben Trib	2	2	4	3	3	0	3	0	2	2	3	3	1	3	2	33
Boulder	3	3	4	1	2	2	3	0	3	2	3	1	1	3	1	32
Reuben	2	2	4	1	3	0	2	0	2	4	2	2	2	3	2	31
Tom East (Sec 1)	2	3	4	0	2	0	2	0	3	2	1	2	1	3	2	27
Slate	2	2	0	0	2	0	3	0	3	4	3	2	1	3	2	27
McKnabe	2	3	3	1	2	0	3	0	0	4	3	1	1	3	1	27
Grave Creek	0	2	4	0	2	0	3	0	3	4	3	1	1	3	1	27
Board Tree	4	1	4	0	0	0	3	0	3	1	3	1	2	3	2	27
Butte	4	2	4	0	2	0	3	0	0	1	3	1	1	3	1	25
Last Chance	4	3	4	0	0	0	1	0	3	2	2	1	1	3	1	25
Grave Creek	0	3	4	0	2	0	2	0	2	4	2	1	1	3	1	25
Wolf (Upper)	4	3	4	0	0	0	0	0	3	1	3	1	1	3	1	24
Wolf Trib. A	4	3	4	0	0	0	2	0	2	0	3	1	1	2	1	23
Wolf (Mid)	2	2	4	0	2	0	1	0	3	1	1	2	1	3	1	23
Rock	2	2	0	0	2	0	3	0	2	2	3	2	1	3	1	23
Clark	4	2	2	0	2	0	2	0	0	2	2	1	1	3	2	23
Wolf (Lower)	0	1	4	0	2	0	2	0	3	2	3	1	1	3	1	23
Bummer	4	3	3	0	0	0	2	0	2	1	2	1	1	2	1	22
Poorman Trib	2	2	4	0	2	0	2	0	0	2	2	1	1	3	1	22
Poorman	2	2	4	1	2	0	2	0	0	1	2	1	1	3	1	22
Grave Creek (Mid)	0	2	4	0	2	0	1	0	3	2	1	1	1	2	1	20
Coyote	0	1	4	0	2	0	1	0	2	2	1	2	1	3	1	20
Flume	2	2	4	0	0	0	2	0	0	0	1	1	1	3	1	17

Scoring

39-49 points:	Good Condition/Properly Functioning
29-38 points:	Fair Condition/Functioning At Risk
<29 points:	Poor Condition/Not Properly Functioning

Note: This table presents all the stream survey data available at this time. Surveys have been completed on 90-95 percent of the fish streams in the watershed.

Appendix E. Status of Fish Passage at Road Crossings in the Grave Creek Watershed.

Stream	Road Number	Quarter-Section		Culvert Dimensions L X W X H(ft)	Percent Slope	Culvert Outfall Drop (ft)	Passage	
							Coho/St.	Res/Juv
Grave #1	34-5-9	9	NE	Bridge			Y	Y
Grave #2	34-5-2	2	NE	Ford			Y	Y
Grave #3	34-4-28	5	NE	Bridge			Y	Y
Grave #4	33-4-22	21	NE	Ford			Y	Y
Grave #5	33-4-21.3	15	SE	Bridge			Y	Y
Grave #6	34-5-10	11	SW	85x10x8	3	1	P	N
Grave #7	33-4-3.3	2	SW	80x10x7	3	0.5	P	N
Reuben	County Road	31	SE	Bridge			Y	Y
Rock	County Road	32	SE	80x9x6	10	2	P	N
McKnabe	34-7-3.1	4	SW	100x10	3	3	NA	N
Poorman	County Road	33/ 34		Bridge			Y	Y
Butte	34-7-3	3	SE	bottomless arch			Y	Y
Wolf #1	33-5-7	23	SE	50x10	0	1	P	N
Wolf #2	33-5-10	10	NW	70x8x6	0	0	Y	Y
Seccesh G.	33-5-10.5	10	SE	Ford			Y	Y
Bummer G.	33-5-10.6	10		75x8x6	5	3	P	NA
Coyote #1	33-6-24	24	SE	Bridge			Y	Y
Coyote #2	33-5-21	22	SW	40x5	5	1	NA	N
Clark #1	34-5-10	1	NW	70x10x8	3	1	P	N
Clark #2	34-5-35	26	SE	70x4	5	1	P	N
Clark #3	34-5-26.3	26	SE	pulled 1998				
Clark #4	34-5-26.3	26	Center	pulled 1998				
Clark #5	34-5-26.3	26	NW	pulled 1998				
Clark Trib.	34-5-26.4	26	SE	65x3	5	0	NA	N
Boulder	34-5-10	6	SW	80x10x8	5	1	P	N
Baker	34-5-10	32		50x6	5	0	P	N
Slate	34-5-10	29	SE	100x8	5	2	P	N

Stream	Road Number	Quarter-Section		Culvert Dimensions L X W X H(ft)	Percent Slope	Culvert Outfall Drop (ft)	Passage	
							Coho/St.	Res/Juv
Little Boulder	34-5-10	16	SE	50x5x3	not fish habitat			
Big Boulder #1	34-5-10	15	NW	75x8	5	1	P	N
Big Boulder #2	33-4-15.1	9	NW	90x6	10	1	N	N
Big Boulder #3	33-4-9	9	NW	60x5	15	2	NA	N
Last Chance #1	34-5-10	15	NW	60x10x7	3	1	Y	P
Last Chance #2	33-4-15	10	SW	60x8x6	5	1	P	N
Last Chance #3	33-4-15	10	NW	65x5	10	0.5	P	N
Last Chance #4	33-4-3.4	3	SW	75x5	15	2	P	N

-Numerous crossings on non-federal lands are not included on this list. Refer to ODFW fish presence/absence surveys for barriers on non-federal lands (Resource Area files)
-Multiple crossings on the same stream are numbered consecutively in an upstream direction.
-Tributaries are numbered and lettered consecutively in an upstream direction.
-Culvert Dimensions are approximate.
-Percent Slope: Refers to culvert.
-Culvert Outfall Drop: Distance from the bottom of the downstream end to the pool or streambed surface.
-Passage: Coho/Steel refers to upstream movement of adult coho and/or steelhead. Res/Juv refers to cutthroat trout and juvenile salmon and steelhead.
-Passage: Y=yes N=no P=partial, depending on stream discharge and/or water velocity through the culvert.

Appendix F. Water Temperature Monitoring Sites in the Grave Creek Watershed: Summer 1998.

Stream	Location
Grave Creek	
Grave Creek @ Pease Ranch (Mel Greenup) (#1) (Ranch house just upstream of Ditch Cr. Road)	T:33S R:04W S:05 NW 1/4
Grave Creek @ Pleasant Creek Road (#2)	T:33S R:04W S:21 NENE
Grave Creek @ Last Chance Creek (#3)	T:33S R:04W S:15 NW NW 1/4
Grave Creek @ Road 33-4-11 (To West Evans Cr.) (#4)	T:33S R:04W S:11 SW 1/4
Grave Creek @ Road 33-4-3.3 (#5)	T:33S R:04W S:03 SE 1/4
Big Boulder Creek	
Big Boulder Creek @ confluence with Grave Creek (#1)	T:33S R:04W S:16 SE NE
Big Boulder Creek (#2)	T:33S R:04W S:9/16 Border
Big Boulder Creek @ top of Road 33-4-15.1 (#3)	T:33S R:04W S:09 SE NW
Slate Creek	
Slate Creek (#1)	T:33S R:04W S:29 Center
Slate Creek (#2)	T:33S R:04W S:19/20 Border
Boulder Creek	
Boulder Creek @confluence with Grave Creek (#1)	T:33S R:04W S:06 SE NW
Boulder Creek (#2)	T:33S R:05W S:25/36 Border
Boulder Creek (#3)	T:33S R:05W S:25 NW NW
Wolf Creek	
Wolf Creek above Hole in the Ground Creek @ lower BLM line Sec. 9 (#1)	T:33S R:05W S:09 SW NE
Wolf Creek @ Road 33-5-10 culvert (#2)	T:33S R:05W S:10 SE NW
Bummer Gulch @ mouth (#3)	T:33S R:05W S:10 SE NW
Poorman Creek	

Stream	**Location**
Poorman Creek @ confluence with Grave Creek (#1)	T:33S R:07W S:33 SE 1/4 N ½
Poorman Creek (#2)	T:33S R:07W S:22/23 Border
Reuben Creek	
Reuben Creek @ Grave Creek confluence (#1)	T:33S R:07W S:31 SW SE 1/4
Reuben Creek (#2)	T:33S R:07W S:31 NE NW
Reuben Creek (#3)	T:33S R:07W S:18 SW SW
Reuben Creek (#4) (Border between T:33S R:07W S:18 & T:33 R:07W S:13)	T:33S R:07W S:18/13 Border

Appendix G. Habitat Integrity Rating Using Aquatic Macroinvertebrates As Indicators.

Stream	Year Sampled	Habitat Type			Comments
		Erosional	Margin	Detritus	
Big Boulder at Grave Cr Road	1994	64.5	63.3	82.3	Extreme drought
Boulder at Grave Cr Road	1996	66.9	78.8	67.0	
Butte near mouth	1993	56.5	72.4	71.9	
Clark at Grave Creek Road	1996	61.3	76.8	49.5	
Grave at mouth	1994	35.5			Extreme drought made sampling impossible
Grave above Wolf Creek	1996	46.0	68.7	55.7	
Grave at McCoy Cr. Road	1995	51.6	45.9	57.3	
Grave at McCoy Cr. Road	1991				rating system different than in subsequent years
Grave at Pleasant Cr. Road bridge	1992	56.0	78.0	81.0	
Last Chance at Grave Cr Road	1994	64.5	63.3	82.3	Extreme drought

Stream	Year Sampled	Habitat Type			Comments
		Erosional	Margin	Detritus	
Poorman at Grave Cr Road	1996	57.3	61.6	55.7	
Reuben at Grave Cr Rd	1996	54.8	54.5	58.8	
Rock at Grave Cr Rd	1996	60.5	71.7	57.7	
Slate at Grave Cr Rd	1996	59.7	55.6	63.9	
Wolf at Sec 8/9 boundary	1993	71.0	72.4	77.1	
Wolf above mine seepage	1994	60.5	64.3	74.0	Extreme drought
Wolf below mine seepage	1994	66.9	68.4	78.1	Extreme drought. Habitat more diverse downstream of seepage than above. No effect of iron discharge. Refer to contractor's report

Biological Condition Categories

Habitat Type

Biotic Integrity		**Erosional**	**Margin**	**Detritus**
Very high		90-100	90-100	90-100
High		80-89	80-89	80-89
Moderate		60-79	70-79	70-79
Low		40-59	50-69	50-69
Severe		<40	<50	<50

Appendix H. Acres of Seral Stages (by Age Class) on BLM lands, by Land Use Allocation.

Acres of Seral Stages (by Age Class) on BLM lands, by Land Use Allocation within the GV07 Lower Grave (HUC 6) Watershed. 3/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Wild Rogue Rec/ACEC	TPCC	Riparian *	Connectivity Blocks	Available NGFMA	Available SGFMA	Total Watershed
Non Forest	0	0	0	59	1	1	0	0	61
0-10 years	9	0	0	13	589	56	664	0	1,331
11-20 “	0	0	0	4	227	34	364	0	629
21-30 “	1	0	0	19	99	26	92	0	237
31-40 “	0	0	0	2	170	0	179	0	351
41-50 “	0	0	0	3	144	0	134	0	281
51-60 “	0	0	0	0	76	72	177	0	325
61-70 “	0	0	0	0	35	0	79	0	114
71-80 “	0	0	0	0	67	0	99	0	166
81-200 yrs.	225	8	98	2,033	1,954	381	2,191	0	6,890
201+ “	222	0	35	598	743	58	848	0	2,504
81+ Modified	104	0	0	16	383	69	507	0	1,079
Total Acres:	561	8	133	2,747	4,488	697	5,334	0	13,968

***Reflects Riparian acres in Connectivity Blocks and NGFMA allocations.**

Acres of Seral Stages (by age class) on BLM lands, by land use allocation within the GV06 Lower Wolf (HUC 6) watershed. 3/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Rec/ ACEC	TPCC	Riparian	Connectivity Blocks	Avail. NGFMA	Avail. SGFMA	Total Watershed
Non Forest	1	0	0	217	6	0	6	0	230
0-10 years	0	0	0	2	54	0	100	0	156
11-20 "	0	0	0	0	8	0	3	0	11
21-30 "	0	0	0	21	30	0	33	0	84
31-40 "	0	0	0	0	6	0	3	0	9
41-50 "	0	0	0	0	69	0	78	0	147
51-60 "	0	0	0	6	0	0	0	0	6
61-70 "	0	0	0	5	109	0	136	0	250
71-80 "	0	0	0	22	63	0	93	0	178
81-200 yrs.	102	0	0	77	201	0	307	0	687
201+ "	112	0	0	363	150	97	200	0	922
81+ Modified	0	0	0	0	44	9	62	0	115
Total Acres: A	215	0	0	713	740	106	1,021	0	2,795

Acres of Seral Stages (by age class) on BLM lands, by land use allocation within the GV05 Coyote (HUC 6) watershed. 3/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Rec/ ACEC	TPCC	* Riparian	Connectivity Blocks	Avail. NGFMA	Avail. SGFMA	Total Watershed
Non Forest	0	0	0	115	1	0	4	0	120
0-10 years	0	0	0	19	146	0	188	0	353
11-20 "	0	0	0	1	144	0	275	0	420
21-30 "	0	0	0	16	92	0	108	0	216
31-40 "	1	0	0	14	115	0	130	0	260
41-50 "	0	0	0	4	58	0	65	0	127
51-60 "	0	0	0	25	37	0	75	0	137
61-70 "	0	0	0	0	6	0	19	0	25
71-80 "	0	0	0	10	40	0	131	0	181
81-200 yrs.	100	0	0	419	700	0	1,165	0	2,384
201+ "	92	0	0	2	240	50	273	0	657
81+ Modified	0	0	0	39	90	0	86	0	215
Total Acres: A	193	0	0	664	1,669	50	2,519	0	5,095

***Riparian acres reflect only those in Matrix allocations (Connectivity, NGFMA)**

Acres of Seral Stages (by age class) on BLM lands, by land use allocation within the GV04 Upper Wolf (HUC 6). 3/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Rec/ ACEC	TPCC	* Riparian	Connectivity Blocks	Avail. NGFMA	Avail. SGFMA	Total Watershed
Non Forest	1	0	7, 4	201	2	4	5	0	220
0-10 years	0	0	0	6	4	0	21	0	31
11-20 "	0	0	0, 9	33	231	6	227	0	497
21-30 "	2	0	0	6	105	52	56	0	221
31-40 "	31	0	0	7	113	17	104	0	272
41-50 "	18	0	1	64	185	0	160	0	428
51-60 "	30	0	0	118	3	0	38	0	189
61-70 "	11	0	0	37	29	0	32	0	109
71-80 "	18	0	0	17	74	0	90	0	199
81-200 yrs.	272	0	0, 28	136	489	182	625	0	1,704
201+ "	255	0	1	32	250	243	507	0	1,288
81+ Modified	0	0	0	101	143	0	145	0	389
Total Acres:	638	0	48	758	1,628	504	2,010	0	5,547

Acres of Seral Stages (by age class) on BLM lands, by land use allocation within the GV03 Sunny Valley (HUC 6) watershed. 3/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Rec/ ACEC	TPCC	* Riparian	Connectivity Blocks	Avail. NGFMA	Avail. SGFMA	Total Watershed
Non Forest	0	0	0	126	0	0	0	0	126
0-10 years	0	0	0	1	263	51	355	67	670
11-20 "	0	0	0	0	162	13	337	88	512
21-30 "	5	0	0	1	98	0	91	94	195
31-40 "	0	0	0	0	134	0	132	27	266
41-50 "	0	0	0	0	4	0	25	0	29
51-60 "	0	0	0	0	6	0	8	0	14
61-70 "	0	0	0	0	28	0	118	27	146
71-80 "	0	0	0	0	8	0	157	0	165
81-200 yrs.	107	0	0	616	795	176	1,078	128	2,772
201+ "	0	0	0	11	24	2	23	9	60
81+ Modified	51	0	0	0	187	37	362	0	637
Total Acres	163	0	0	755	1,709	279	2,686	440	5,592

Acres of Seral Stages (by age class) on BLM lands, by land use allocation within the GV02 Placer (HUC 6) watershed. 3/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Rec/ ACEC	TPCC	* Riparian	Connectivity Blocks	Avail. NGFMA	Avail. SGFMA	Total Watershed
Non Forest	0	0	0	82	1	0	2	0	85
0-10 years	0	0	0	0	105	0	271	0	376
11-20 "	0	0	0	9	79	0	172	0	260
21-30 "	0	0	0	13	59	0	156	3	228
31-40 "	0	0	0	48	170	0	286	30	504
41-50 "	0	0	0	7	56	0	81	0	144
51-60 "	0	0	0	0	13	0	17	0	30
61-70 "	0	0	0	0	13	0	98	0	111
71-80 "	0	0	0	2	16	0	88	0	106
81-200 yrs.	22	0	0	935	671	34	1,397	98	3,059
201+ "	0	0	0	199	95	292	47	0	633
81+ Modified	0	0	0	117	139	0	254	0	510
Total Acres	22	0	0	1,412	1,417	326	2,869	131	6,046

Acres of Seral Stages (by age class) on BLM lands, by land use allocation within the GV01 Upper Grave (HUC 6) watershed. 3/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Rec/ ACEC	TPCC	* Riparian	Connectivity Blocks	Avail. NGFMA	Avail. SGFMA	Total Watershed
Non Forest	0	0	4	271	2	0	16	0	293
0-10 years	0	0	0	51	279	40	372	0	742
11-20 "	0	0	0	20	478	0	624	0	1,122
21-30 "	0	0	0	20	245	0	208	0	473
31-40 "	0	0	0	106	677	0	681	0	1,464
41-50 "	0	0	4	148	405	0	496	0	1,053
51-60 "	0	0	0	0	35	0	52	0	87
61-70 "	0	0	0	14	60	0	109	0	183
71-80 "	0	0	0	14	63	0	95	0	172
81-200 yrs.	0	0	11	376	871	0	986	0	2,244
201+ "	0	0	24	346	788	2	906	0	2,066
81+ Modified	0	0	0	293	168	5	180	0	646
Total Acres	0	0	43	1,659	4,071	47	4,725	0	10,545

Acres of Seral Stages (by age class) on BLM lands, by land use allocation within the Grave Creek (HUC 5) watershed.   2/99 data from GIS

Age Class Seral Stage	Owl Core	LSRs	Wild Rogue Rec/ ACEC	TPCC	* Riparian	Connectivity Blocks	Avail. NGFMA	Avail. SGFMA	Total Watershed
Non Forest	1	0	11, 4	1,070	13	5	33	0	1,133
0-10 years	10	0	0	91	1,440	147	1,971	67	3,659
11-20 "	1	0	0, 9	67	1,329	53	2,002	88	3,452
21-30 "	7	0	0	95	728	78	744	97	1,652
31-40 "	32	0	0	176	1,386	17	1,515	57	3,126
41-50 "	18	0	5	225	922	0	1,039	0	2,209
51-60 "	30	0	0	149	170	72	367	0	788
61-70 "	11	0	0	56	279	0	592	27	938
71-80 "	18	0	0	64	331	0	753	0	1,166
81-200 yrs.	828	8	28, 11, 98	4,593	5,682	773	7,748	226	19,660
201+ "	680	0	25, 35	1,551	2,291	745	2,804	9	8,096
81+ Modified	154	0	0	566	1,155	119	1,595	0	3,589
Total Acres: A	1,790	8	221	8,703	15,726	2,009	21,163		49,468

***Riparian acres reflect only those in Matrix LUA's (Connectivity, NGFMA)**

Appendix I. Historical Mining.

Gold was discovered on Daisy Creek (near present day Jacksonville) in the Rogue Valley in 1851. Although gold was previously discovered in the summer of 1850 near the confluence of Josephine Creek and the Illinois River, this gold discovery brought an influx of thousands of miners to the region.

Gold mining began within the watershed in 1883 along Grave Creek. In 1895 several small placer mines were active on Grave Creek and its tributaries, Coyote and Wolf Creeks. Historically, between 1890's and 1940's there were 115 operating mines in the area, these are mines that were actually worked and had some production, even if small. Seventy four were lode or hard rock mines and 31 were placer mines (Mineral Deposits and Probability of Exploration, Medford 1 x 2 Quad., OR and CA, Smith and Peterson, MF- 1383-F, 1985 and Gold and Silver in Oregon, DOGAMI, Bulletin No. 61, 1968).

Gold is the precious metal that the miners were prospecting for and mining. Secondary minerals were silver, platinum, and other minerals. Most of the lode mines are on shear planes were two types of bed rock moved over each other- typically greenstone and serpentine. A few of the lode mines are in sheared serpentine.

Many of the mines were closed as a result of World War II's Administrative Order L-208. This order was designed to stop the mining of gold, thus forcing the workers to seek employment in the base metal mines, especially copper, to help with the war effort. After the war, reopening of the mines was difficult because of lack of maintenance, plus the cost of labor and supplies had multiplied, but the price of gold remained the same.

The following are highlights of some of the larger historic mines:

The Columbia placer or Greenback Consolidated was a hydraulic mine located on Tom East Creek, just north of Placer, in T34S R5W Sec. 5 & 8. This was a major Oregon mine and was in operation from 1895 to 1941. They mined about 6 acres per year, the deposit was 4 to 50 feet thick and 2 miles long, it covered 400 acres.

The Greenback lode mine was near the Columbia placer in T33S R5W Sec. 33. This tunnel or hard rock mine is in greenstone along a quartz vein. It had 7,000 feet of tunnels on 12 levels. The Greenback was in operation from 1897 to 1941.

The Benson placer mine is in T34S R7W Sec. 2 E1/2E1/2. This hydraulic mine was in operation from 1890 to 1940, in addition to gold platinum was also mined. One million yards were mined from a old high channel deposit which was 20 feet thick, and 1 mile long.

The Steam Bear in T34S R6W Sec. 6 SE 1/4. This hydraulic mine was in operation prior to 1954 and 20 acres were mined for gold.

The Gold Note lode mine is in T33S R4W Sec. 30, this gold and silver mine had 9 adits within metavolcanic rocks. It was in operation from 1936 to 1952. It had small production.

The Puzzler lode mine is in T34S R4W sec 34, near the top of Last Chance Creek. In 1938 it had a 12 foot shaft and a 44 foot tunnel, ore was milled on site with a 16-foot arrastra. Production unknown.

The Warner mine is in T33S R4W Sec. 4. This lode mine has 600 feet of workings. It is a 160 acres patented land, it has been worked off and on to 1960.

The Dorothea or Marshal mine is in T33S R5W Sec. 22. This lode mine had 1,500 feet of shafts, tunnels and raises. There was a steamed powered stamp mill at the mine.

The Anaconda mine is in T33S R5W Sec. 29. This lode mine had 3 or 4 levels (now collapsed), it has been worked since 1890's. A 25-ton mill was installed in 1941 - no production records.

The Shot mine is in T33S R5W Sec. 33, it had 750 feet of workings. It was in operation from 1890 to 1940. Production unknown.

The Martha Mine is in T33S R5W Sec. 28. It has four adits with 3,000 of underground tunnels. It first opened in 1900, and in 1904 was purchased by the Greenback Company. In 1906 it was connected to the Greenback mine by aerial tram. After closure of the Greenback a five stamp mill was erected at the mine. Production not reported. Four claims are patented.

The Copper Queen mine is in T34S R6W Sec. 15. This lode mine had 7 tunnels and several test pits, total underground development is about 1,000 feet. The copper in the ore turned out to be a low percentage- two carloads were shipped in 1916. Production record unknown.

The California mine is in T33S R8W Sec. 25 and 30. Total development of this lode mine is 8,500 feet. It was discovered in 1890.

The Oro Grande mine is in T33S R5W Sec 28. It was located in 1959, and total production to 1966 is estimated at $1,000. This is the most recently located mine in the DOGAMI bulletin 61.

Appendix J. Grave Creek Watershed: Environmental History.

Introduction

The Grave Creek watershed has been home to people for thousands of years. The native peoples followed a way of life which emphasized resource enhancement, especially of those resources which were of primary use to them as food, materials, or items of trade. This way of life came to an abrupt end in the middle of the nineteenth century, with the advent of western civilization to southwestern Oregon. The immediate thrust of this new movement was resource extraction: first of fur-bearing animals, then gold. Settlement followed, with major changes in human-land relationships characterized by agriculture, ranching, logging, and connections to distant markets. During the twentieth century, the advent of federal land management systems has brought a new dimension to human-land interactions, with land management policies linked to national and international politics and concerns, as well as to a global market.

The Native Ecosystem

The Grave Creek watershed was inhabited by Takelma Indians at the time of direct contact with Euro-American explorers and trappers in the early nineteenth century. These people followed a way of life which had evolved over many thousands of years, and which was based on hunting, gathering, and fishing. People lived in permanent villages along major streams, such as Grave Creek, Wolf Creek, and Coyote Creek. They obtained all the foods and materials they needed from the natural environment, and used a number of resource-enhancing techniques to ensure abundance of desired items. Their cultural patterns were closely adapted to the environment, and the environment in turn reflected their management actions.

Throughout southwestern Oregon, native peoples used a variety of cultivation techniques to enhance desired crops (see Pullen 1995 for extended discussion of native land management practices and effects). Root-gathering areas (such as fields of camas) were burned to remove competing vegetation, tilled, weeded, thinned, and replanted; reserve areas were also deliberately maintained. Other crops, such as grass-seeds (e.g. tarweed), oaks, and deer browse may have been spread by deliberate planting. Conservation measures were also employed in the management of fish and wildlife populations. Deer and elk were not hunted during the spring birthing season, for example, and an elaborate system of rituals regulated fish harvests, ensuring the maintenance of anadromous fish runs.

Fire was perhaps the most potent tool used by native peoples. Fires were set during the spring, summer, and fall, for a variety of purposes. Fires were set by specialists who took into account the season, temperature, wind direction, humidity, and impacts to specific plants. Fires were used to maintain the oak savannah and oak-pine woodlands in the lowlands, and meadows in the uplands, which were particularly useful ecosystems to the native way of life. Such purposeful burning was concentrated at lower elevations near villages, and at higher elevations near seasonal camps.

A general model of the native environment of southwestern Oregon provides a basis for assessing the landscape of the Grave Creek watershed at the time of contact between native peoples and the first Euro-American explorers and settlers (Pullen 1995):

> 1. Riparian areas were heavily timbered, primarily with conifers. Dense brush and thickets of willow occurred at the waters' edge, and downed logs were common.
>
> 2. Valley floors were regularly burned by native people, promoting open prairies, groves of oak, and scattered ponderosa pine, and suppressing chaparral.
>
> 3. Valley slope vegetation also reflected the influence of natural and anthropogenic fire. North-facing slopes were covered with open stands of ponderosa and sugar pines, with an occasional Douglas-fir. South-facing slopes were grassy, with white oaks, chaparral, and scattered ponderosa pine in ravines.
>
> 4. Mid-elevation forests were less affected by human action, and were covered with fairly uniform, mature coniferous forests with brushy under stories. Oak and chaparral dominated on the south-facing slopes and north-facing slopes were heavily timbered. Natural fire cycles had more effect than fires set by people.
>
> 5. Upper elevations were characterized by a high diversity of environmental zones, with prairies, brush fields, downed logs and open stands of conifers. Many animals flourished, and native peoples used this zone intensively. Human-caused fires helped promote and enhance the resources of this zone.
>
> 6. Deer, elk, bear, small mammals, and predators all flourished. Native burning promoted a highly diverse landscape with many ecotones, providing good habitat for these species.
>
> 7. Beaver were abundant, and anadromous fish populations were high.

Occasional historic references and ethnographic data support this general picture for the Grave Creek watershed.

Takelma survivors recalled village and locality place-names in Sunny Valley, along Grave Creek, many years after their removal from that spot (Gray 1987); Indian sites are noted at several spots along Grave Creek and Wolf Creek. The earliest historic record for this area (Peter Skene Ogden's journal) notes numerous Indians in the area, as he headed north approximately along the route of I-5 in 1827 (LaLande 1987:86-87). These people engaged in the practices mentioned above, and would have influenced the environment.

Ogden’s party struggled north from the Rogue Valley in search of beaver, noting--as did others after them--the ruggedness of the mountains and difficulty of the terrain. They reached Grave Creek near Leland, noting that the country they had passed through was “woody and well stock’d in Red [elk] and Black tail deer” (LaLande 1987:86). Trappers were left to trap the stream, as Ogden pushed on through a “most hilly and woody country”, following Wolf Creek north and then west over Hungry Hill to Cow Creek.

In the early 1850's Jimmie Twogood provided one of the first settlers’ accounts of Grave Creek valley. Noting the nearly impassable road from Canyonville to the Rogue River, he remarked on the “beautiful little valley with clover six inches high” (Sunny Valley) (McLane 1995:2). Later in the decade, government surveyors mapped these meadows along Grave Creek (GLO 1986). There are few references to valley trees, though Grave Creek itself was named for a pioneer child who was buried beneath a large oak, perhaps attesting the existence of the oak savannah at lower elevations in the watershed. The small, narrow valleys of upper Grave Creek (in the vicinity of Placer) were reportedly along a main travel route of the Indians, where elk, deer, bear, native pheasants, and salmon were abundant in season (McLane 1995:185). A well-traveled Indian trail ran along Grave Creek, from upper Grave Creek to below Wolf Creek, connecting to Sam’s Valley in the south and to Cow Creek (via Poorman’s Creek) in the north.

Mid-elevation slopes were timbered and often brushy. Indian fighters in the 1850's noted that the trail down Grave Creek (to Hungry Hill) was “very narrow, through thick underbrush and heavy fir timber” (McLane 1995:12). Coyote Creek was heavily timbered with old growth fir trees in the 1850's (McLane 1995:271), and surveyors in the 1850's noted that the route from Wolf Creek to the Rogue River passed through a “densely timbered area”, and that “Wolf and Grave Creeks are separated by high and steep hills, covered with thick timber and underbrush”. The same route between Grave and Jump-off Joe Creeks “passed over a steep and heavily timbered divide” (Webber 1985:178; 234).

Higher elevation ridges may have been more open, and contained meadows. Indians purportedly camped at a meadow south of Sugarloaf Mt., on the range separating Grave Creek and Cow Creek watersheds, along an Indian trail between Grave Creek and Lower Cow Creek. The Applegate party, exploring the area for route through, noted that they could see Indians dash from “tree to tree” on the ridges above Grave Creek, a description which implies a rather open forest on the ridge tops (Beckham 1971:39).

At the time of historic contact, the Grave Creek watershed was inhabited throughout its length by native peoples who engaged in numerous land management activities. Valleys contained meadows and prairies and were probably ringed by foothills with an open oak or oak-pine savannah. The hills and mountains were heavily timbered and often brushy, especially in the narrow canyons of the tributary streams. Ridge tops may have been more open, with meadows maintained by natural as well as anthropogenic fires. Game and fish were abundant, as were predators such as bear, wolves, and coyotes (for which several streams are named). Indian trails along Grave Creek, and along tributaries such as Wolf Creek, connecting the inhabitants to others in southern Oregon.

Historic Era (1827-1990)

Exploration

The first emissaries of western civilization to record their passage through this area were Peter Skene Ogden and his fur trapping brigade in 1827. Ogden was on a mission for the British Hudson's Bay company, to locate and eradicate the beaver from the southern part of the Oregon Territories, in order to discourage American trappers from entering the region. Following Ogden, trappers regularly worked the region in the succeeding decades, until beaver was largely eliminated. Also during this time numerous expeditions and exploring parties came through the area, generally following the north-south trail which connected the Willamette Valley with California and crossed Grave Creek near Leland.

These early visitors emptied the region of beaver with consequent effects upon the rivers, streams, and riparian areas; brought trade goods and diseases to the native peoples; and opened the region to settlement in the following decades.

Settlement

With the discovery of gold in the early 1850's, people poured into southern Oregon, and settlement of the Grave Creek watershed took place. The influx of new people led to bitter fighting between the native peoples and the newcomers, with some of the fiercest incidents taking place in the Grave Creek watershed. By 1856 those aboriginal peoples who survived were removed to reservations in the north of the state. Today, their descendants maintain an active interest in the affairs and management of their ancestral lands.

Between the time of removal of the native peoples and the turn of the century, there were major changes in land management practices with consequent effects upon the land. Mining, farming, ranching, settlement, and the advent of the railroad brought fundamental changes to the land.

James Twogood was one of the first settlers in the watershed. He located a land claim in 1852, along Grave Creek at the original site of Leland near present day Sunny Valley, along the main road. Early settlement also occurred just to the north, with an 1853 land claim which later became the location of the first Six Bit House, about a mile east of present day Wolf Creek. Settlement continued throughout the remainder of the century, with many people taking homesteads in the valleys. By the turn of the century, there were a number of small towns servicing the area--such as the towns of Placer, Golden, Leland, and Wolf Creek. Mining contributed to the establishment of most of these towns.

The town of Placer came into being in the late nineteenth century, after productive mining began along upper Grave Creek. The town was tied to major mines such as the Columbia placer mine, which ran almost constantly from 1883 to 1942, and mined about 900 acres along the creek. In 1894 the hard rock Greenback mine opened up Tom East Creek, just north of the town of Placer, sparking further development at the town site. By the turn of the century Placer had a post office, two hotels, three saloons, two mercantiles, a school, library, and various other establishments. A stage ran at least daily from Placer to Leland and Wolf Creek, and the town had two large sawmills in operation shortly after the turn of the century. Just after the turn of the century, also, the mining town at Greenback surpassed Placer in inhabitants, reflecting that mine’s productivity. By the first World War, mining had ceased to be so productive and the town of Placer had dwindled to a small residential area (McLane 1995:185-216).

The town of Golden also prospered with the productivity of the mines. By the 1890's it was a bustling little town with about 100 residents, serving the mines and miners of Coyote Creek. It lasted about 25 years as a mining town, reaching it’s demise around the first World War. An effort to restore and maintain the town and its old buildings began in the 1950's and continues today.

Old Leland or Fort Leland was established near Jimmie Twogood’s original claim, where the road ran through Sunny Valley north of Sexton Mountain, and at the site of Martha Leland Crowley’s grave, for whom Grave Creek is named. Following the advent of the railroad, the little mining settlement of Altamont at Brimstone and Grave Creeks boomed as a supply center for the railroad, and for the mining industry along lower Grave Creek. In 1888 the station was re-named Leland, and in 1892 the post office of Leland was moved to this active center. Reportedly, about 1500 men were employed in the construction of the railroad during this time, including a considerable number of Chinese laborers. By the time of the first World War, the mines had played out and many locals had left to join the war effort. The town burned in 1924; nothing of the old town remains.

Like other towns, the settlement of Wolf Creek prospered with placer mining along the Wolf Creek and lower Coyote Creek. It served as a stage stop and wayside for travelers along the wagon road, and prospered after the advent of the railroad in the 1880's. The current Wolf Creek Tavern and hotel was built during the 1880's , partly to serve the mining trade which was booming in the area (McLane 1995:350). Unlike other towns in the Grave Creek watershed, Wolf Creek has remained a small settlement through the twentieth century and up to the present day.

Transportation

Along with settlement came the need for improved transportation routes through the region, and in 1856 James Twogood was appointed to supervise construction (or improvement) of the section of wagon road running north-south from about Sexton Mt. to the Douglas County line (McLane 1995:7). This wagon road followed the earlier path known as the Applegate Trail (or earlier the Oregon-California Trail), and was later the approximate route of the Pacific Highway (Old 99), and later Interstate 5.

Twogood listed thirteen (male) residents of the Grave Creek-Wolf Creek area at this time, who owed labor on the road; eight were farmers, one a blacksmith, and four were miners. An additional ten "Chinamen" were listed as miners and conscripted to work on the road. Other miners in the area claimed to be residents of Jackson County, and therefore not liable for labor tax on the roads (McLane 1995:7).

In addition to the main road through the region, numerous trails and wagon roads cris-crossed the region by the turn of the century, linking the miners and settlers. By 1859 a primitive road led to the headwaters of Coyote Creek, crossing the creek three times and providing access for transport of lumber for sluices and for packers bearing other goods (McLane 1995: 271). A trail ran along upper Grave Creek, crossing north and west over the divide to Quines Creek and the Cow Creek valley. Another trail headed west from the confluence of Wolf Creek with Grave Creek, towards the Rogue River, and a trail linked Tom East Creek with Coyote Creek.

The railroad came through the region in the 1880's. It followed Wolf Creek to Grave Creek, then up Grave Creek to Dog Creek, where a tunnel was constructed to pass through the mountains dividing Grave Creek from Jump-off Joe Creek to the south. The railroad brought immediate access to outside towns, cities, and markets, and stimulated local industries such as logging and mining.

In the twentieth century, the old wagon road was improved and paved to become Highway 99 (the Pacific Highway), and later Interstate 5 followed this familiar route. During the 1930's the Civilian Conservation Corps operated in the region; as elsewhere, CCC projects included improvements to the transportation system, such as the construction of the swinging bridge at Grave Creek built in 1935. Following the second World War, access to the uplands increased dramatically with an explosion of roads built for logging and recreational purposes.

<u>Mining</u> [See mine list at end of report]

Gold was discovered along Grave Creek and along its tributaries such as Wolf Creek, Coyote Creek and Tom East Creek. During the 1850's and 60's, placer deposits were worked along these streams, as well as along productive tributaries. Nearly thirty miners' cabins were noted up the upper reaches of Coyote Creek in the 1860's (McLane 1995: 271). As elsewhere in the region, Chinese miners formed part of the workforce, and in the 1860's several hundred mined along lower Grave Creek and Coyote Creek.

By the 1880's and through the turn of the century, major hydraulic mining operations took place along these gold-bearing streams in the watershed. Miles of ditches and flumes brought water to the mines. Hard-rock prospecting also opened up mines above the placer-bearing streams, especially above Tom East Creek (west of Sunny Valley) and Coyote Creek, and above Reuben Creek and Lower Grave Creek. The major mines employed large numbers of men and contributed to the prosperity of little towns such as Golden, Placer, and Leland. In the western part of the watershed, mines near Leland, lower Grave Creek, and Mt. Reuben were working nearly a thousand men, employed in "mining, building mining ditches, mining flumes, cutting lumber, clearing ground, or packing supplies” (McLane 1995:163).

By 1900, old maps show mines, ditches, and flumes throughout the watershed. Placer and lode mines and ditches are noted along upper Grave Creek (above Clark Creek); along Boulder and Clark creeks; north and south of the town of Golden, and along Coyote Creek; along Grave Creek and up Wolf Creek above its confluence with Grave Creek, and above Reuben Creek.

Mining continued to be important in the region through the first World War. A description of mining operations in southwestern Oregon in 1914 noted that there were about half a dozen placers in the Wolf Creek and Coyote Creek district and that near the mouth of Bear Gulch Coyote Creek had been mined for a half mile (Diller 1914:104). This same study called the Grave Creek District one of the most important mining streams in the state with almost twenty placers still in operation, including the Columbia mine near Placer with three, 5-inch giants working nearly six acres of gravel annually. Diller also notes that above Baker Creek, the bed of Grave Creek had been extensively washed for six miles (Diller 1914:104).

During the Depression era of the 1930's there was a resurgence of mining in the region, and both small and large operations occurred in the watershed. Dredges worked the placers on Grave Creek near Leland (Rogue River Gold Co.) from 1935-38; a dragline dredge operated along lower Coyote Creek in 1937 (Brooks and Ramp 1968:220); and individual miners “sniped” up and down the creeks as in the early days (McLane 1995:294). A number of the hard rock mines continued through this period as well; the Greenback mine was worked by outside operators in the late 1930's.

Logging

Early settlers and miners cleared land and cut trees for a variety of purposes, including the construction of houses, fences, flumes, and sluice boxes. But the coming of the railroad stimulated logging for railroad construction, and provided transport for lumber out of the region. The heavily timbered hills above Coyote Creek, for example, were logged, cleared, and farmed beginning in the 1880's, as were the “dense stands of large old growth timber” at the confluence of Coyote and Wolf Creek (McLane 1995:271) . Sawmills operated a mile south of Wolf Creek and in upper Coyote Creek in the 1890's. Areas of heavy mining, such as the Greenback mine up Tom East Creek, were denuded of trees for houses, mills, tunnels and steam engines. The Greenback mine area reforested itself after the peak mining years (after c 1920), and was logged in the 1950's. Poor roads, however, prevented heavy logging of much of the watershed’s timber in the higher elevations until after the second World War. In the second half of this century, an extensive system of roads as well as improvements in timber harvest and transportation technology has allowed harvest of timber throughout the watershed.

Management

While farmers and ranchers transformed the valleys, and miners operated along creeks and in the gold-bearing uplands, the federal government assumed management of much of the watershed's hill and mountain lands in the early twentieth century. As elsewhere west of the Cascades, alternate sections of land throughout much of the watershed had been given to the railroad to finance construction of the line from Oregon to California. Mismanagement of these lands, however, resulted in the federal government taking back these lands beginning about 1916. These "revested" lands were managed by the General Land Office until 1946, when they became part of the newly formed Bureau of Land Management.

Management of these lands included strong fire suppression policies beginning early in this century, and management for timber harvest, especially in the decades following the second World War. In recent years national environmental protection legislation has also affected federal lands, with protections for natural and cultural resources.

Historic Era Effects Upon the Land

The early trappers worked the streams of southern Oregon, eventually eliminating much of the native beaver population by 1850. Early explorers introduced diseases to the native peoples, and may have reduced their populations as well. Removal of beaver would have affected riparian areas, changing somewhat the course of the streams and riparian vegetation; reduction of native human populations may have reduced the effects of their actions upon the land.

Miners had an immediate effect upon the land, especially upon the waterways. Heavy hydraulic mining rechanneled streams, eliminated riparian vegetation, and muddied the waters of fish-bearing streams. Miles of ditches and flumes cut across the landscape and brought water from one place to another, affecting local hydrology. Mining even significantly affected the local topography. According to McLane (1995:271), for example, the entrance to Coyote Creek canyon was a narrow valley where the hills met at creek's edge, prior to extensive mining operations. Through the years of mining, however, large flat acreage has replaced the hill slopes, "giving the impression that it has always been a fairly wide valley much like that of Grave Creek Crossing." The last hydraulic mine operated on Coyote Creek in 1964, when environmental concerns caused its closing (McLane 1995:295). One toxic legacy of the early miners is the presence of mercury in the streams; mercury was used as an amalgam to attract gold and sometimes escaped into the local environment where it occasionally shows up in gold pans today (McLane 1995:294).

Hard rock miners dug out the hillsides, washed tailings down the slopes, built roads and trails, and denuded the hills to provide lumber for their structures and visibility for their operations. During the heyday of the mining era--in the decades preceding and following the turn of the century--thousands of men worked the mines. Today, many of these mines are closed and new growth covers the scarred landscape.

Farmers, ranchers, and townsfolk brought changes to the land as well. In the nineteenth century, lowland timber and forests were cleared, transforming the native prairies and woodlands. By the 1880's, lower Grave Creek by new Leland contained "large open fields" below heavily timbered hillsides (McLane 1995:71). As elsewhere in the region, settlement brought new agricultural species to replace native root crops and grasses, and domestic animals whose grazing and foraging affected local plants as well. Unscreened irrigation ditches brought salmon out of the streams and into the fields, where they were reportedly caught by hand as late as the 1930's (McLane 1995:289).

In the 1870's settlers noted that bear were still plentiful on Grave Creek, that salmon runs were excessively large, and that there were still large amounts of forage for game. Local history records 22 grizzlies killed along Grave Creek in the 1880's (McLane 1995:71). Throughout the succeeding decades predators were largely eliminated in the region, as bounties were placed on wolves, coyotes, bobcats, cougars, and raccoons (Beckham 1986:124). Hunting provided subsistence for local settlers, but ungulate herds were severely diminished when the coming of the railroad brought a lively trade in hides, antlers, pelts, and dried deer meat. After the turn of the century, declines in once abundant herds throughout the region prompted state and federal officials to regulate hunting, so that herds have rebounded somewhat during the twentieth century (Beckham 1996).

Twentieth century federal policies have contributed in other ways to the condition of the present landscape. Following the elimination of native burning practices, fire suppression in the twentieth century has interrupted natural cycles. Logging and Silvicultural practices have also affected the condition of upland forests, and roads throughout the watershed contribute to erosion and sedimentation in the streams. Environmental policies of the last thirty years have also affected the land, by placing limits upon human action within it.

Appendix K. Grave Creek Place Names

Golden: Named for the mining activity of the area. The first post office was established in 1896, and lasted until 1920. There was a quartz and stamp mill at the site.

Grave Creek: Grave of Martha Leland Crowley, died 1946, on the Applegate Trail at Grave Creek.

Hungry Hill: Site of a battle during the Rogue Indian Wars, Nov. 1, 1855, where the Indians defeated the army. Also known as the battle of Bloody Spring.

Mt. Reuben, Reuben Creek: Named for Reuben Field of Linn County, who fought in the Indian wars of 1855.

Leland: Originally known as Altamont, the town grew up with the advent of the railroad in the 1880's. The post office was moved there in the 1880s and closed in the 1940's.

Placer: Town named for the major placer mines in the vicinity; a post office was established there in 1894 and lasted unto 1924.

Pollard: Station on the Southern Pacific Railroad, named for Joseph Pollard who filed a homestead there in 1882; later sold to SP, nothing remains today.

Sexton Mt.: Named for early settlers in the vicinity.

Speaker: A post office established at a small settlement along the railroad, lasting from 1905-1925, named for the postmistress Josephine Speaker.

Sunny Valley: The location of Old Leland or Fort Leland, one of the first homesteads in the watershed. A post office was established there in 1855. The name was changed in 1928 to Sunny Valley.

Tom East Creek: There are two creeks by this name, both tributary to Grave Creek, named for the miner Tom East who mined in Josephine County from 1855 to his death in 1897.

Wolf Creek: The town got its origins from the first wayside hotel established in the Grave Creek watershed, known as Six bit House, and located about a mile east of present day Wolf Creek. The town was a stage stop in later years, and is the site of historic Wolf Creek Tavern (built in the 1880's).

Appendix L. Historic Grave Creek Watershed Mines.

Note: Many mines are noted on the 15' series USGS topographic maps, and others are referenced in the literature. This list briefly describes those mines for which information was available in Brooks and Ramp (1968) and DOGAMI (1952). All are gold mines unless otherwise noted.

Placer Mines

Aman Ranch Placer (33S/6W/23) Located on Coyote Creek, the mine consists of about 40 acres of patented land, of which about 5 acres were dragline operated in 1937.

Columbia Placer: On Tom East Creek and Grave Creek, estimated to have produced more then $400,000 by 1914, and continued until 1941, with a dredging ground about four miles in length and a depth of 70 feet.

Goff Mine (34S/6W/5): A placer mine worked for over 60 years in 1941. A giant with an 8-inch pipe was used during 1939-40, with water pumped from Flume Gulch ditch.

Klum Placer: (34S/7W/1) This mine was patented in 1890 and worked intermittently until the mid 20th century.

Payne Placer (33S/5W/19): This placer near Foley Gulch on Coyote Creek was worked in the early decades of the twentieth century, and again in the 1930's.

Rogue River Gold Co. (34S/6W/9 and 10): The dredge from Foot's Creek was moved to Grave Creek upstream from Leland in 1935, and worked upstream until 1939. It employed about 40 men daily and worked an old channel of Grave Creek south of the present stream.

Speaker Placer (33S/5W/9): This placer, located on Wolf Creek about six miles north of the town, was operated intermittently from about the turn of the century, using two no. 2 giants, two no. 3 giants, and several hundred feet of hydraulic pipe.

Wolf Creek Placer (33S/5W/10): This placer mine is on upper Wolf Creek above Speaker Placer, and was worked for a number of years before 1940.

Lode Mines

Anaconda Mine (33S/5W/29): This mine was opened in the 1890's and worked in a small way. A huntington mill was installed in 1941.

Copper Queen Mine: (34S/6W/15) Copper and gold were mined in the early 20th century; there were seven tunnels and about 1000 feet of underground development at the mine.

Cougar Mine (33S/5W/22): On Coyote Creek, this was a small pocket mine.

Daisy (Hammersly) Mine: (34S/5W/14) Located on the divide between Grave and Jump-off Joe Creeks, the mine was discovered in 1890 and produced an estimated $250,000, using a five-stamp mill, amalgamation plate, and table. The mine was worked in the 1930's and to 1940.

Dorothea Mine: (33S/5W/22) This mine was operating about 1914 and also in the 1950's; there was a 5-stamp, steam-powered mill at the mine, with about 1500 feet of underground development.

Gilbert Eri Prospect (33S/5W/11): This was a small pocket mine, worked earlier under a different name and under development in the late 1930's.

Gold Note Mine (33S/4W/30): This mine was operating in the early decades of the century and through World War I, with nine tunnels and numerous cuts; it produced gold and a little copper, and was under exploration in the 1960's.

Greenback Mine: (33S/5W/33) This was a major lode mine located above Tom East Creek. It was discovered in 1897, with ore first processed at an arrastra at Placer; most of the production was between 1898 and 1912. Ore was processed in an electrically operated, 100-ton capacity 40-stamp mill installed in 1905, together with concentration tables and cyanide tanks.

Hayden Mine: (34S/6W/13): This mine was discovered in 1897; about $10,000 was taken out between then and 1905, using an overshot waterwheel-driven arrastra.

Horseshoe Lode Mine: (33S/5W/28) This mine had produced about $5,000 by 1940.

Jim Blaine Mine: (34S/5W/4 and 5) This mine operated during the early 1900's and was equipped with a small, water-powered stamp mill in 1916.

John Hall Group (34S/5W/18): This mine consisted of six tunnels totaling 1400 feet, and much surface work; dates of operation are not given.

Little Arctic Mine: (33S/4W/8): The mine was located in 1936, with production estimated at $10,000 to 1965.

Livingston (Spotted Fawn): Discovered in 1901, total production to 1937 was about $20,000. The mine was equipped with a five-ton Chilean mill.

Macabee Mine (33S/5W/20): This property was worked before the first World War, with locations made again in the 1930's.

Martha Mine: (33S/5W/28): This mine was first operated about 1900, then bought up by the Greenback mine and connected in 1906 by an aerial tram. A five-stamp mill was erected at the mine after closure at Greenback.

Mountain View (Copper King): (33S/4W/17 and 20) Located in 1913, the mine produced copper and gold, It was equipped with a 16-ball mill and small table.

Puzzler (32S/4W/34): A shaft and 44-foot tunnel were cut in 1938; ore was milled in an arrastra driven by a 16-foot, overshot water wheel.

Reed Mine: (33S/5W/28) Claims were held on this mine dating from 1929.

Shot Mine (33S/5W/33) This mine operated from about 1890 to 1940, with some ore originally treated in an arrastra.

Silent Friend Mine (33S/5W/15): Located at the head of Wolf Creek, this mine was worked in the early decades of the century, and had mining equipment at the mine in 1941.

Warner Prospect (33S/4W/4): On the head of Last Chance Creek, this was a small mine with a shaft and mill in the early 1940's.

Appendix M. Current mining claims in the Grave Creek watershed

Mining Claims in Grave Creek Watershed as of August 1998 (Note: Hundreds of claims closed in the late 1980's - early 1990's)				
Legal Township - Range	**Section**	**Placer**	**Lode**	**Tunnel Site**
33 - 4	15	2		
33 - 4	17		1	
33 - 4	21	3		
33 - 4	29	2		
32 - 4	34		2	
33 - 5	10		1	
33 - 5	15		2	
33 - 5	19	1		
33 - 5	22	1	9	1
33 - 5	26	1		
33 - 5	27	7	8	
33 - 5	28	1	15	
33 - 5	30	1		
34 - 5	1	11	1	
34 - 5	2	1		
34 - 5	4		6	
34 - 5	8		4	
34 - 5	9	1		
34 - 5	11	2		
34 - 5	18		1	
33 - 6	11	1		
34 - 6	None			
33 - 7	30	3		
33 - 7	31	1		

Mining Claims in Grave Creek Watershed as of August 1998 (Note: Hundreds of claims closed in the late 1980's - early 1990's)				
Legal Township - Range	**Section**	**Placer**	**Lode**	**Tunnel Site**
33 - 7	32	5		
33 - 7	33	1		
33 - 7	34	4		
34 - 7	1	2		
34 - 7	3	2		
34 - 7	5	1		
TOTAL		**54**	**50**	**1**
104 mining claims 1 tunnel site 0 mill sites				

Appendix N. Mining Claim Occupancies and Mining Notices (11/98)

Name	(OR#)	Location (T, R & S)	Occupancy Present
Bradley Berg	43796	33- 4- 15	Yes
Bruce Crawford	47165	34-5-14	
Bruce Burrow	53129	33-5-22	
Ricky Childers Junette Sherman	49449	34-5-1	
John H. Cook	49953	33-7-34	
Bill Corbin	48456	33-4-15	
Arthur Cox	45980	33-4-21	Yes
William Cox	45980	33-4-21	Yes
Laura Crist	43820	33-4-21	
Carl R. Duncan	44222	33-5-27	
Sue Gibby	43912	33-7-33	Yes
Gilmore/Killian James Hunt	43910	33-7-30	Yes
Mary E. Gray	49991	34-7-3	Yes
David Hern	53213	33-4-21	yes
Morg Hollamon Randy Johnson	43797	33-4-21	
Jim Hunt	43910	33-7-30	Yes
Jack McCain	43793	34-5-1	
Harry & Donna Michelbrink	53412	33-7-33	
Jeannie Sherman	49449	34-5-1	Yes
Caroline Tucker	44014	33-7-32	Yes
Norbert Zwan	47075	33-5-22	

Appendix O. Potential Noxious and Invasive Weeds, Grave Creek watershed.

GENUS/SPECIES	COMMON NAME	LOCATION	HABITAT	NOTES
Cirsium vulgare	Bull Thistle		wide range of conditions	seeds
Cirsium arvense	Canada Thistle		wide range of conditions	seeds/roots
Centaura diffusa	Diffuse knapweed		roadsides/dry sites	
	Distaff Thistle			
Isatis tinctoria	Dyers woad		sandy/gravel soils	Jackson/Jos. Co./seeds.
Sorgham haepense	Johnson grass		disturbed areas/good soils	Douglas, Josephine Co./seed & roots/agr /roadways
Hypiscium perfatum	Klamath Weed		Wide range of conditions	
Euphorbia esula	Leafy spurge		streams/open areas	seed producer/roots
Taeniatherum caput-medusae	Medusahead rye		pasture/open forest	seed producer
Lythrum salicaria	Purple loosestrife		riparian/ wetlands	seed/rhizomes
Chondrilla juncea	Rush skeletonweed		disturbed areas/ roadways	Douglas, Josephine Co./seed & roots
Centaurea repens	Russian Knapweed		good soils/ disturbed areas	
Cytisus scoparius	Scotch broom		good soils/ disturbed areas	roadways/seed producer

GENUS/SPECIES	COMMON NAME	LOCATION	HABITAT	NOTES
Senecio jacobaea	Tansy ragwort		wide range of soils	Jackson, Josephine, Douglas Co./seeds.
Centaurea solstitialis	Yellow starthistle		wide range - roadways/dry sites	Jackson, Josephine, Douglas Co./seeds

Appendix P. Recommended Road Closures, Decommissioning and Other Management.

ID No.	Road No.	Proposed Action	Length (miles)	Road Control	Comments
	33-7-7	Fully Decommission	0.8		Past switchback to the east
	33-4-21 - spur	Fully Decommission	0.4		From Jct with rod 33-4-22 downstream
	34-7-4, in sec. 9	Fully Decommission	1.0		Stream bottom road
	34-7-9.2	Fully Decommission	0.8		# 2 of 3 hillslope roads
	34-7-11.7	Fully Decommission	0.2		Pit run rock surface
	34-7-2 segment	Fully Decommission	1.1		In T 32, R 7, sec. 1, adjacent to Grave Cr.
	34-6-7 segment	Fully Decommission	0.4		
	33-6-19.1	Fully Decommission	0.4		Natural surface
	33-6-33.1	Fully Decommission	0.6		
	34-6-3.1	Fully Decommission	0.6		
	34.6-1	Fully Decommission	0.5		
	34-5-15.2	Fully Decommission	0.4		Natural surface
	34-5-11.1	Fully Decommission	0.2		
	34-5-3.2	Fully Decommission	0.9		Boggy meadow near end
	33-5-35.4	Fully Decommission	0.2		Past jct. with road 35.3

ID No.	Road No.	Proposed Action	Length (miles)	Road Control	Comments
	33-5-27	Fully Decommission	1.1		In Riparian Reserve
	33-5-15 spur	Fully Decommission	0.2		
	33-5-9.1	Fully Decommission	0.2		
	33-5-11.1	Fully Decommission	0.4		
	33-5-10.1 in sec. 14	Fully Decommission	0.4		
	33-5-13 in sec. 24	Fully Decommission	0.4		
	34-4-7.3	Fully Decommission	0.4		
	34-4-7.2	Fully Decommission	0.2		
	34-4-5.1	Fully Decommission	0.3		Road currently not in service
	34-4-5.0	None			No gate at Baker Cr. Rd and Grave Cr. Rd
	34-4-5.0				Gate not functional at King Mtn Rd
	33-5-1424 junction	Install gate			
	33-5-35.3	Install gate			Requested by public to curtail illegal dumping
	34-5-20.1	Install gate			Gate at jct. with 5.0 rd

Appendix Q. Cumulative Hydrologic Parameters, Grave Creek Watershed.

February, 1997

Stream Name	HUC #	% ECA	% CA	% of TSZ	Road Density
Grave Creek above Last Chance Creek	GV0103W	6.8	9.9	23.3	4.0
Last Chance Creek	GV0106W	4.0	10.2	12.3	4.3
Grave Ck below Last Chance Ck, down to and including Little Boulder Ck	GV0109F	11.4	13.8	53.5	5.8
Grave Ck below L Boulder Ck, above Slate Ck	GV0112F	5.6	10.0	12.3	4.4
Slate Creek	GV0115W	8.1	3.6	13.5	3.3
Grave Ck below Slate Ck, above Baker Creek	GV0118F	4.3	8.8	11.4	2.6
Baker Creek	GV0121W	3.9	6.7	7.0	3.0
Grave Creek below Baker Creek, above Boulder Creek (King Mt)	GV0124F	5.8	5.3	17.8	4.7
Boulder Creek (King Mt)	GV0127W	5.2	7.7	10.6	3.7
Grave Ck below Boulder Ck (King Mt), above Clark Creek	GV0130F	6.7	10.5	14.9	5.5
Clark Creek	GV0133W	8.1	4.7	20.6	5.1
Grave Ck below Clark Ck, above Eastman Gulch	GV0203F	4.8	12.7	5.8	6.1
Eastman Gulch	GV0206W	6.5	8.7	23.5	5.5
Grave Ck below Eastman Gulch, above Quartz Mill Gulch	GV0209F	8.4	14.2	41.5	5.8
Quartz Mill Gulch	GV0212W	2.3	1.4	2.6	2.5
Grave Ck below Quartz Mill Gulch, above Tom East Ck (Placer)	GV0215F	6.4	10.0	31.5	4.8
Tom East Creek (Placer)	GV0218W	13.0	7.1	2.6	4.4
Grave Ck below Tom East Ck (Placer), above Benjamin Gulch	GV0221F	4.6	7.4	25.4	4.6
Benjamin Gulch	GV0224W	12.5	5.6	25.6	4.3
Grave Ck below Benjamin Gulch, above Burgess Gulch	GV0227F	2.0	0.6	0.0	0.3
Burgess Gulch	GV0230W	8.2	4.3	8.5	2.7
Grave Ck below Burgess Gulch, above Salmon Ck	GV0303F	33.2	11.3	25.4	6.1
Salmon Creek	GV0306W	5.4	6.8	0.0	6.6
Grave Ck below Salmon Ck, above Rat Creek	GV0309F	66.5	29.1	0.0	29.2
Rat Creek	GV0312W	15.9	8.0	3.8	7.7
Grave Ck below Rat Creek, above Mackin Gulch	GV0315F	37.5	13.2	0.0	4.5
Mackin Gulch	GV0318W	17.1	8.7	0.0	4.2
Grave Ck below Mackin Gulch, above Dog Creek	GV0321F	21.1	9.9	0.0	3.7
Dog Creek	GV0324W	12.0	6.3	0.0	3.4
Grave Ck below Dog Creek, above Flume Gulch	GV0327F	31.2	13.7	0.0	7.2
Flume Gulch	GV0330W	10.5	6.9	3.0	4.5
Grave Ck below Flume Gulch, above Brimstone Gulch	GV0333F	0.0	0.0	0.0	0.0
Brimstone Gulch	GV0336W	13.8	6.3	8.0	5.5
Grave Ck below Brimstone Gulch, above Brushy Gulch	GV0339F	17.6	10.9	0.0	7.2
Brushy Gulch	GV0342W	8.2	4.8	6.4	3.2
Grave Creek below Brushy Gulch, above Tom East Ck (Leland)	GV0345F	14.7	8.1	0.0	6.0
Tom East Creek (Leland)	GV0348W	6.9	3.7	21.1	3.5

Stream Name	HUC #	% ECA	% CA	% of TSZ	Road Density
Grave Ck below Tom East Ck (Leland), above Wolf Ck	GV0351F	10.8	3.6	0.0	4.5
Wolf Creek above Bummer Gulch	GV0403W	8.2	6.1	28.2	5.4
Bummer Gulch	GV0406W	23.6	8.9	58.0	7.5
Wolf Creek below Bummer Gulch, above Hole in the Ground above Hole in the Ground	GV0409F	6.2	4.2	14.8	4.2
Hole in the Ground (Wolf Ck)	GV0412W	10.7	4.0	0.0	5.3
Wolf Creek below Hole in the Ground, above Board Tree Creek	GV0415F	7.7	6.7	21.8	3.5
Board Tree Creek	GV0418W	3.8	3.3	13.7	4.1
Wolf Ck below Board Tree Creek, above Sourdough Gulch	GV0421F	1.8	4.8	0.0	1.2
Sourdough Gulch	GV0424W	16.7	10.9	15.0	5.0
Wolf Ck below Sourdough Gulch, above Coyote Ck	GV0427F	5.5	7.5	0.0	3.6
Coyote Creek above Post Gulch	GV0503W	9.0	6.4	26.5	4.5
Post Gulch	GV0506W	35.4	16.8	5.8	3.2
Coyote Ck below Post Gulch, above Scholey Gulch	GV0509F	15.9	6.8	0.7	4.0
Scholey Gulch	GV0512W	5.0	6.4	23.9	8.1
Coyote Ck below Scholey Gulch, above Miller Gulch	GV0515F	20.3	13.9	47.4	13.1
Miller Gulch	GV0518W	22.5	13.7	31.8	5.8
Coyote Ck below Miller Gulch, above Robinson Gulch	GV0521F	27.1	14.5	0.0	3.2
Robinson Gulch	GV0524W	3.7	7.5	9.0	0.0
Coyote Ck below Robinson Gulch, above Foley Gulch	GV0527F	5.4	6.8	0.0	6.6
Foley Gulch	GV0530W	0.6	4.7	0.0	0.9
Coyote Ck below Foley Gulch, above Colby Gulch	GV0533F	9.1	11.1	0.0	2.7
Colby Gulch	GV0536W	1.2	9.9	33.0	1.6
Coyote Ck below Colby Gulch, above Kennedy Gulch	GV0539F	1.3	2.4	0.0	1.1
Kennedy Gulch	GV0542W	0.3	5.2	33.2	0.0
Coyote Ck below Kennedy Gulch, above Wolf Ck confluence	GV0545F	9.3	5.4	20.9	4.3
Wolf Creek below Coyote Ck, above Farmer Gulch	GV0603F	8.2	9.4	0.0	3.2
Farmer Gulch	GV0606W	1.7	5.0	0.0	1.1
Wolf Creek below Farmer Gulch, above Coon Gulch	GV0609F	5.2	6.5	0.0	2.4
Coon Gulch	GV0612W	2.7	2.6	3.6	0.7
Wolf Creek below Coon Gulch, above Ramsey Gulch	GV0615F	13.1	7.4	0.0	2.6
Ramsey Gulch (Wolf Ck)	GV0618W	5.3	5.6	52.4	0.0
Wolf Ck below Ramsey Gulch, above Water Tank Gulch	GV0621F	9.0	6.9	0.0	3.6
Water Tank Gulch	GV0624W	8.3	5.1	9.7	1.6
Wolf Ck below Water Tank Gulch, above Bear Gulch	GV0627F	16.8	18.7	0.0	17.9
Bear Gulch (Wolf Ck)	GV0630W	2.7	5.7	0.0	1.3
Wolf Creek below Bear Gulch, above Hughes Gulch	GV0633F	45.8	24.1	0.0	5.2
Hughes Gulch	GV0636F	10.4	6.4	20.9	4.2
Wolf Creek below Hughes Gulch, above Grave Ck confluence	GV0639F	8.8	7.4	0.0	8.2
Grave Creek below Wolf Ck, above Butte Creek	GV0703F	16.2	6.0	20.0	5.5
Butte Creek	GV0706W	9.6	5.8	14.6	5.0
Grave Creek below Butte Ck, above Fall Ck	GV0709F	12.1	4.2	0.0	4.8
Fall Creek	GV0712W	11.5	6.0	0.0	3.9

Stream Name	HUC #	% ECA	% CA	% of TSZ	Road Density
irave Creek below Fall Creek, above Dry Creek	GV0715F	23.1	7.1	0.0	6.4
)ry Creek	GV0718W	12.7	5.4	0.0	4.5
irave Creek below Dry Creek, above Poorman Creek	GV0721F	9.2	3.3	0.0	6.1
'oorman Creek	GV0724W	9.5	7.6	33.5	3.4
irave Creek below Poorman Creek, above McKnabe Ck	GV0727F	5.7	2.0	0.0	3.7
IcKnabe Creek	GV0730W	13.8	5.0	5.0	4.9
irave Creek below McKnabe Ck, above Rock Creek	GV0733F	20.1	4.8	0.0	5.2
₹ock Creek	GV0736W	6.8	11.7	36.8	3.4
irave Creek below Rock Creek, above Reuben Creek	GV0739F	10.7	3.9	0.0	2.5
₹euben Creek	GV0742W	9.6	4.6	26.0	2.4
irave Ck below Reuben Ck, above Rogue R confluence	GV0745F	15.0	2.5	12.0	3.3

ECA - Equivalent Clearcut Area
CA - Compacted Area
TSZ - Transient Snow Zone
Road Density is measured in roads/square mile

Appendix R. Glossary and Acronyms

ASQ	Allowable Sale Quantity
BLM	Bureau of Land Management
CHU	Critical Habitat Unit
CWD	Coarse Woody Debris
ECA	Equivalent Clear-cut Area
GFMA	General Forest Management Area
HUC	Hydrologic Unit Code
LSR	Late-successional Reserve
LWD	Large Woody Debris
NEPA	National Environmental Policy Act
NGFMA	Northern General Forest Management Area
NMFS	National Marine Fisheries Service
NFP	Northwest Forest Plan
ODFW	Oregon Department of Fish and Wildlife
PSQ	Probable Sale Quantity
RIA	Rural Interface Area
RMP	Resource Management Plan
ROD	Record of Decision
SGFMA	Southern General Forest Management Area
TPCC	Timber Productivity and Capability Classification
USFWS	US Fish and Wildlife Service
VRM	Visual Resource Management

The terms Coarse Woody Debris, Large Woody Material and Large Down Wood are used interchangeably.

Decay Class 1 down wood has intact bark, twigs are still present, texture is still intact.

Decay Class 2 down wood has bark still intact, twigs are absent, texture is intact to partly soft.

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