

# BEARWALLOW – TRIANGLE LANDSCAPE ASSESSMENT

June 2008

Deschutes National Forest  
Sisters and Bend – Fort Rock Ranger Districts



Cover Photo: Bearwallow – Triangle Landscape Assessment area from Triangle Peak, Steve Markason, photographer.



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# Bearwallow – Triangle Landscape Assessment

## Executive Summary

The Bearwallow – Triangle Landscape Assessment (BTLA) area spans both the Sisters and Bend-Fort Rock Districts of the Deschutes National Forest and includes approximately 12,825 acres of Forest Service land. The area is bounded by private property to the east, the Three Sisters Wilderness to the west, Bridge Creek to the south and Forest Road 1628 to the north. The assessment area is located within T16S, R9E, Section 36; T17S, R9E, Sections 1, 2, 11, 12,13, 24, 25, 36; T17S, R10E, Sections 7, 8, 16, 17, 18, 19, 20, 21, 27, 28, 29, 30, 31, 32, 33, 34; and T18S, R10E, Sections 4, 5, and 6, Willamette Meridian.

The BTLA area is managed under the 1990 Deschutes National Forest Land and Resource Management Plan (DLRMP), as amended by the 1994 Northwest Forest Plan (NWFP). In addition, 6,640 acres within the assessment area are managed under 36 CFR 294: Special Areas; Roadless Area Conservation. The Clean Air Act of 1977 also influences the management of the assessment area by restricting smoke dispersal. These management directions served as sideboards when analyzing the potential opportunities within the assessment area.

Five significant themes emerged during the assessment and it is understood that these themes are important in understanding the BTLA area. They are:

1. Fire and Fuels
2. Community and Urban Growth
3. Lack of Knowledge and Utilization of the Area
4. Recreation
5. Ecosystem Health

Important linkages or connections between these themes were identified, which then highlighted both challenges and opportunities for management within the assessment area. Recognition of these themes and their associated linkages may minimize environmental degradation and user conflicts, and promote community support.

After much discussion, some potential opportunities for management were identified. They included:

1. Mechanical treatments
2. Wildland fire use
3. Prescribed fire
4. Improved recreation infrastructure
5. Improved public relations with general public and user groups

The Sisters and Bend – Fort Rock Ranger Districts have a unique opportunity to be proactive in the management of the BTLA area while improving relations with user groups, educational institutions, and the community of Bend.



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## Introduction

The Bearwallow - Triangle Landscape Assessment (BTLA) has been created by students from Utah State University as a capstone project for the Continuing Education in Ecosystem Management program. The authors of this document are resource professionals gaining graduate education and experience in resource management. For the past two weeks, it has been our privilege to consult with federal and state agencies, volunteers and personnel from educational institutions, business owners, members of various sports clubs, environmental and natural resource groups, and members in communities of interest. We would like to thank them for their support and input without which the depth and detail of this document would not have been possible.

This document is a landscape assessment, which compiles information on the natural resources within the assessment area and nearby communities. The document is not a decision document, it does not make changes in land allocations, and it does not propose specific projects to be implemented. The purpose of the BTLA is to provide the Deschutes National Forest with an analysis of the past and current physical, biological and social condition of the landscape which may also identify opportunities for future projects.

The BTLA area spans both the Sisters and Bend-Fort Rock Districts of the Deschutes National Forest and includes approximately 12,825 acres of Forest Service land. The area is bounded by private property to the east, the Three Sisters Wilderness to the west, Bridge Creek to the south and Forest Road 1628 to the north.

Five significant themes emerged during the assessment and it is understood that these themes are important in understanding the BTLA area. They are:

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After much discussion, some potential opportunities for management were identified. They included:

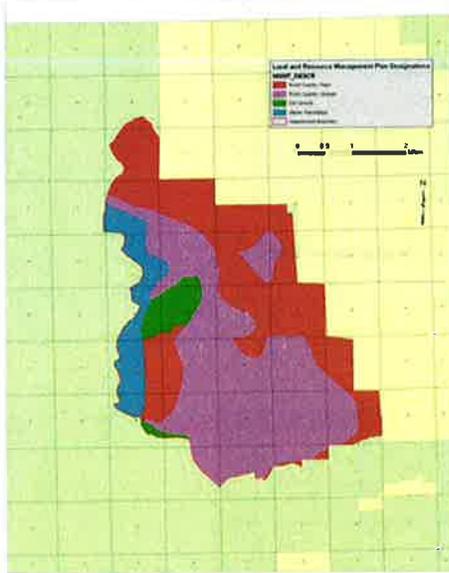
1. Mechanical treatments
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The Sisters and Bend – Fort Rock Ranger Districts have an unique opportunity to be proactive in the management of the BTLA area while improving relations with user groups, educational institutions, and the community of Bend.

## Management Direction

The BTLA area is located entirely within the Deschutes National Forest and includes portions of the Bend-Fort Rock and Sisters Ranger Districts. Management direction for the assessment area is derived from:

- Forest Land and Resource Management Plan (DLRMP)
  - National Wetlands Plan (NWFMP)
  - National Forest Management Act (NFMA); Final Rule (36 CFR Part 294)
  - 77
- Management direction, as each geographic area has at least two layers of information of future projects, all relevant management direction must be



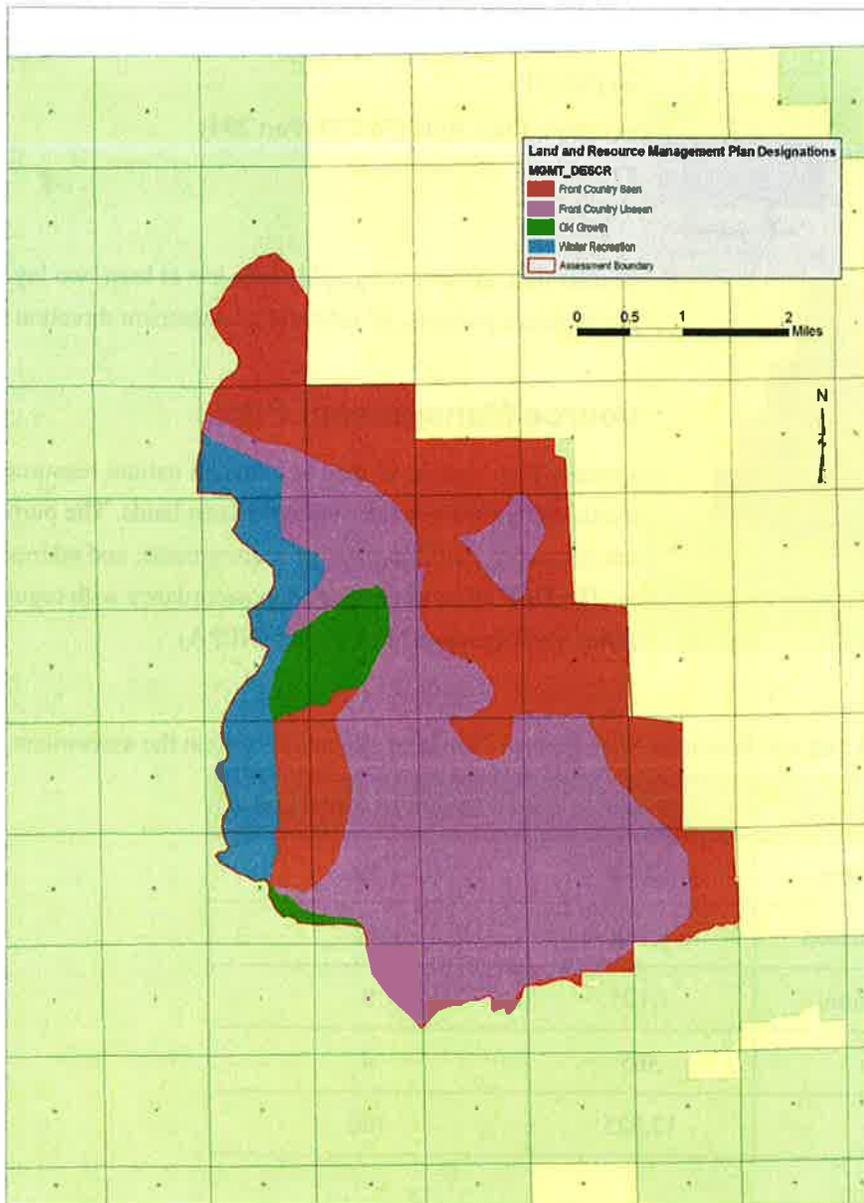
### Resource Management Plan

The Resource Management Plan was developed to guide all natural resource standards and guidelines for National Forest lands. The purpose is to protect forest resources, fulfill legislative requirements, and address local concerns. The DLRMP was developed in accordance with regulations under the National Environmental Policy Act (NEPA).

Table 1. Deschutes Land and Resource Management Plan land allocations within the assessment area.

Designation	Acres	Percentage of Total
Front Country Seen	5,000	39
Front Country Unseen	6,135	48
Winter Recreation	1,125	9
Old Growth	565	4
Total	12,825	100

Figure 1. Deschutes Land and Resource Management Plan land designations within the assessment area.



## **Goals statements from the Deschutes National Forest Land and Resource Management Plan**

This section is a summary of General Themes and Objectives within the assessment area. For Standards and Guidelines refer to DLRMP, 1990.

### **Management Area 13 – Winter Recreation**

This Management Area will provide opportunities for winter recreation activities. Facilities and evidence of man will be present. Roads, vegetation management, and other development activities are permitted but only as necessary to enhance the winter recreation opportunities. Social contact will vary but high social contact could be expected in some areas and during some portions of the winter season. Facilities for tubing and sledding can be developed. Some areas will be closed to motorized use. This area is available for geothermal leasing.

### **Management Area 15 – Old Growth**

This Management Area will be managed to provide (1) large trees, (2) abundant standing and downed dead trees, and (3) vertical structure (multiple vegetative canopy heights), except in lodgepole pine types where a single canopy level is common. Such stands would vary in size and be located so that a wide variety of conditions are represented.

### **Management Area 18 -- Front Country**

This Management Area occupies a place between Scenic Views and General Forest Management Areas. While it calls for a greater emphasis on timber production, the visual quality objective is partial retention.

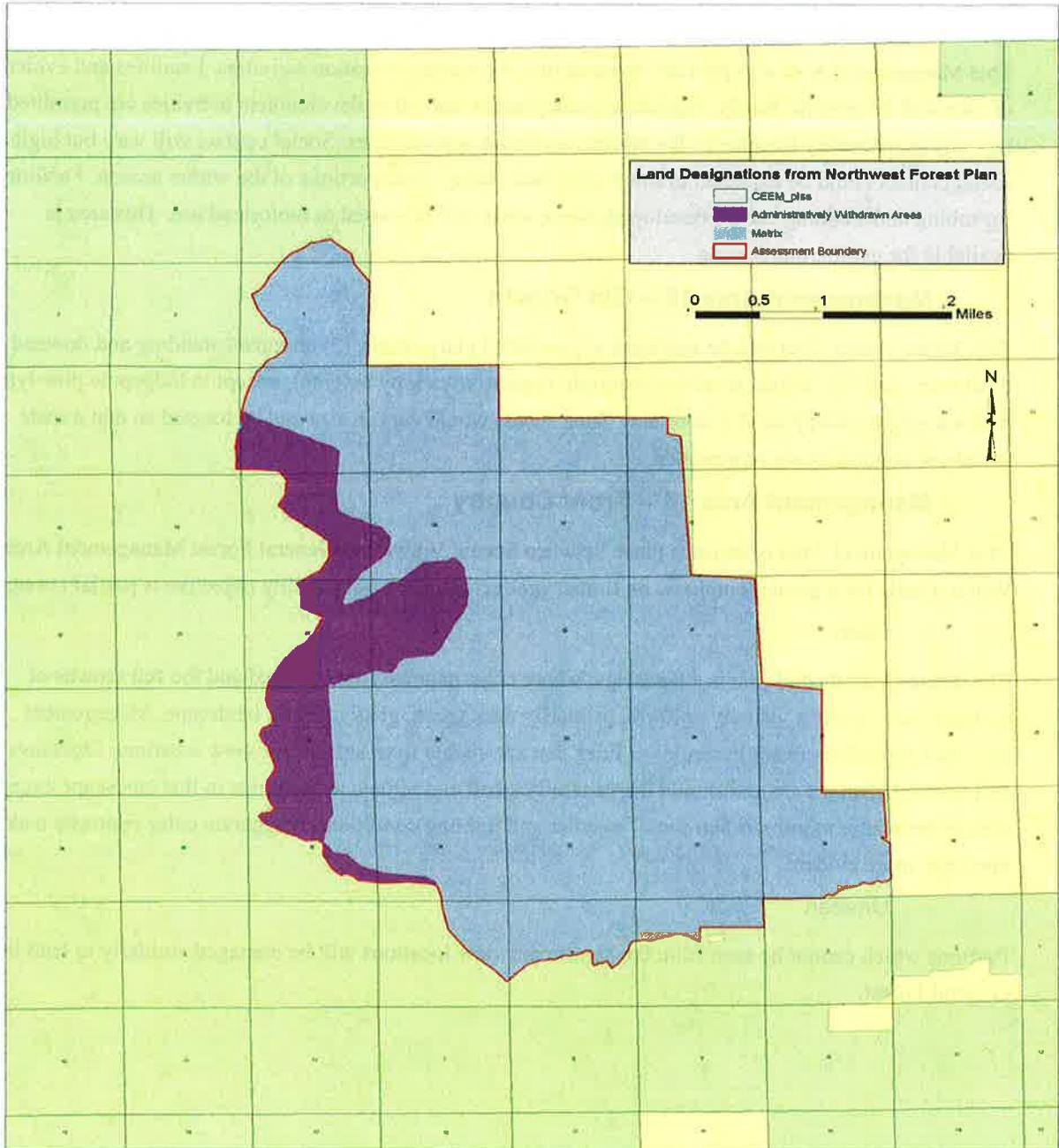
#### **Seen**

The desired visual condition is a landscape where color contrasts are minimal and the full crowns of younger trees create a visually uniform, primarily dark green, gently rolling landscape. Management activities should not result in shapes or lines that are visible from significant view locations. Openings and textural changes are and should be, generally small and remain subordinate in this landscape except during the winter months, when snow, weather and lighting conditions exaggerate color contrasts making openings more evident.

#### **Unseen**

Portions which cannot be seen from the significant view locations will be managed similarly to land in General Forest.

Figure 2. Northwest Forest Plan land designations within the assessment area.



## Northwest Forest Plan

The Northwest Forest Plan is a comprehensive land management strategy for publicly managed lands in the Pacific Northwest and northern California. The Northwest Forest plan was adopted to protect the long-term health of federal forests.

Table 2. Land designations from the Northwest Forest Plan.

Designation	Acres	Percentage
Administratively Withdrawn	1,695	13
Matrix	11,130	87
Total	12,825	100

### Administratively Withdrawn Areas—Summary

Administratively Withdrawn Areas are identified in current Forest and District Plans or draft plan preferred alternatives and include recreation and visual areas, back country, and other areas where management emphasis precludes scheduled timber harvest and which are not included in calculations of allowable sale quantity.

**Interpretation:** Timber harvest may be allowed, however only for specific purposes such as fuels reduction, habitat improvement or ecosystem health. Activities pursued in this area are not part of the scheduled “green program”.

### Matrix—Summary

Most timber harvest and other silvicultural activities would be conducted in that portion of the matrix with suitable forest lands, according to standards and guidelines. Most scheduled timber harvest (that contributing to the probable sale quantity not taking place in Adaptive Management Areas) takes place in the matrix.

**Interpretation:** Active timber management and scheduled timber harvest is allowed. Specific management direction, standards and guidelines, and other constraints can be found in the Northwest Forest Plan.

### Roadless Area Conservation

The final Roadless rule prohibits the cutting, sale, and removal of timber in inventoried roadless areas, except:

1. For the cutting, sale, or removal of generally small-diameter trees which maintains or improves roadless characteristics and:

- a. To improve habitat for threatened, endangered, proposed or sensitive species or
- b. To maintain or restore ecosystem composition and structure, such as reducing the risk of uncharacteristic wildfire effects.

Table 3. Land designations from the Roadless Area Conservation Final Rule.

<b>Designation</b>	<b>Acres</b>	<b>Percentage</b>
1B (No roads)	712	12
1C (Road building allowed)	5,751	88
Total	6,463	100

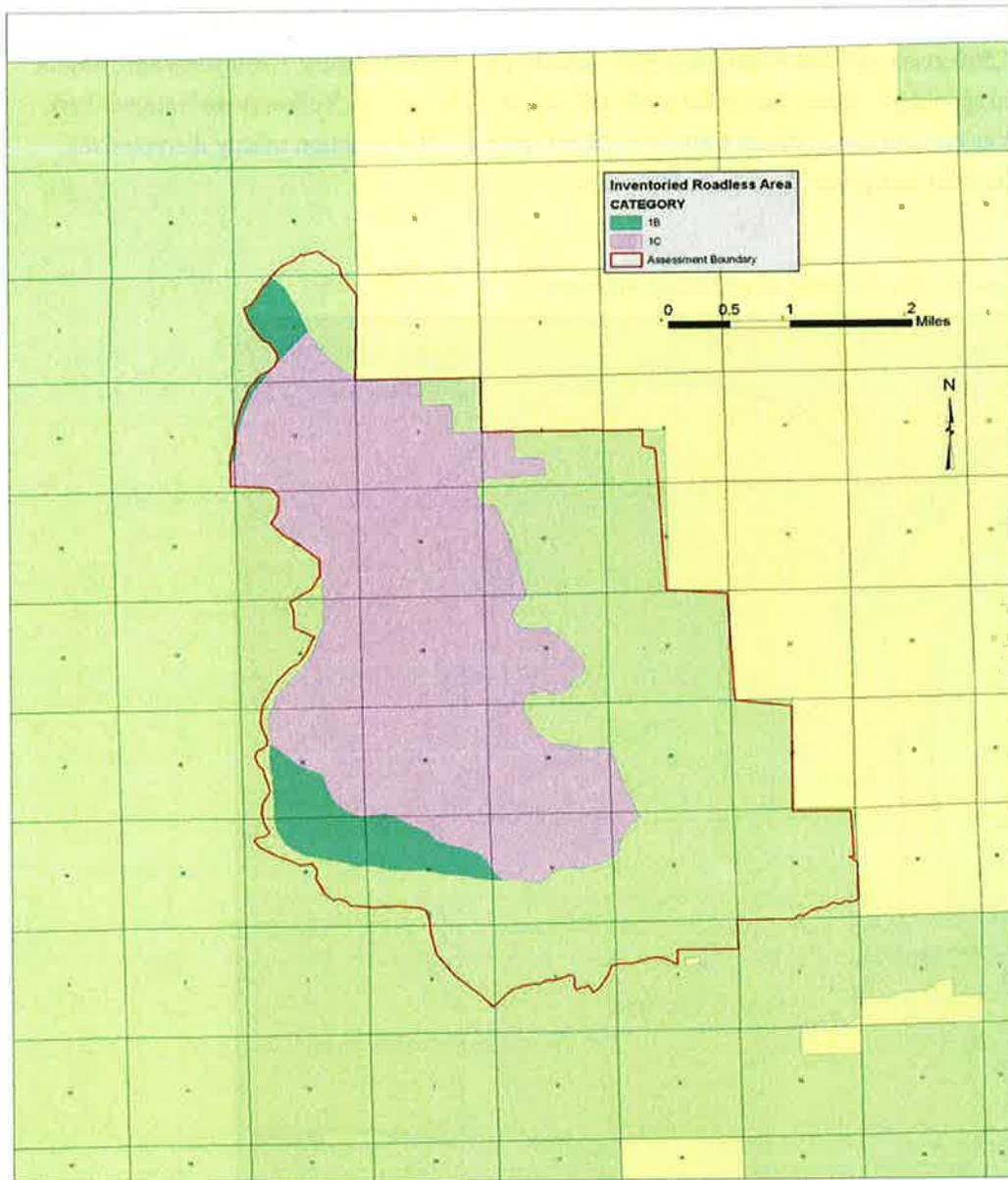
**Summary:** This rule was adopted to establish prohibitions on road construction, road reconstruction and timber harvesting in inventoried roadless areas. The intent is to provide lasting protection for inventoried roadless areas within the National Forest System in the context of multiple-use management. Inventoried roadless areas provide a remote recreation experience without the activity restrictions of Wilderness (for example, off-highway vehicle use and mountain biking.)

**Interpretation:** Fuels reduction and habitat improvement are allowed within lands designated as “roadless,” however alternatives that preclude road use are necessary. Recreation activity, including mountain biking and off-highway vehicle use, is encouraged and allowed.

### **Clean Air Act**

The Clean Air Act designated all Wilderness areas over 5,000 acres and all National Parks over 6,000 acres as Class I airsheds. The Three Sisters Wilderness and Mt. Jefferson Wilderness fall into this category. These areas would be affected by fire activity within the BTLA area. The State of Oregon has also designated Bend as a Smoke Sensitive Receptor Area (SSRA). This additional State designation places Bend under the highest level of protection from air pollution.

Figure 3. Roadless Area Conservation designations within the assessment area.



# Social Analysis

## Prehistoric

The earliest record of Native American peoples in central Oregon was 11,500 years ago around Fort Rock, southeast of Bend, Oregon. Evidence also indicates habitation around Newberry Crater and Odell Lake around 10,500 years ago and 9,500 years ago respectively. Approximately 7,700 years ago, Mount Mazama erupted spewing volcanic ash as far north as Canada, as far east as Yellowstone National Park and as far south as Nevada and northern California (See Figure 4). This eruption mostly disrupted the natives' ability to hunt and gather food for many years.

Figure 4. Ash distribution of Mount Mazama.

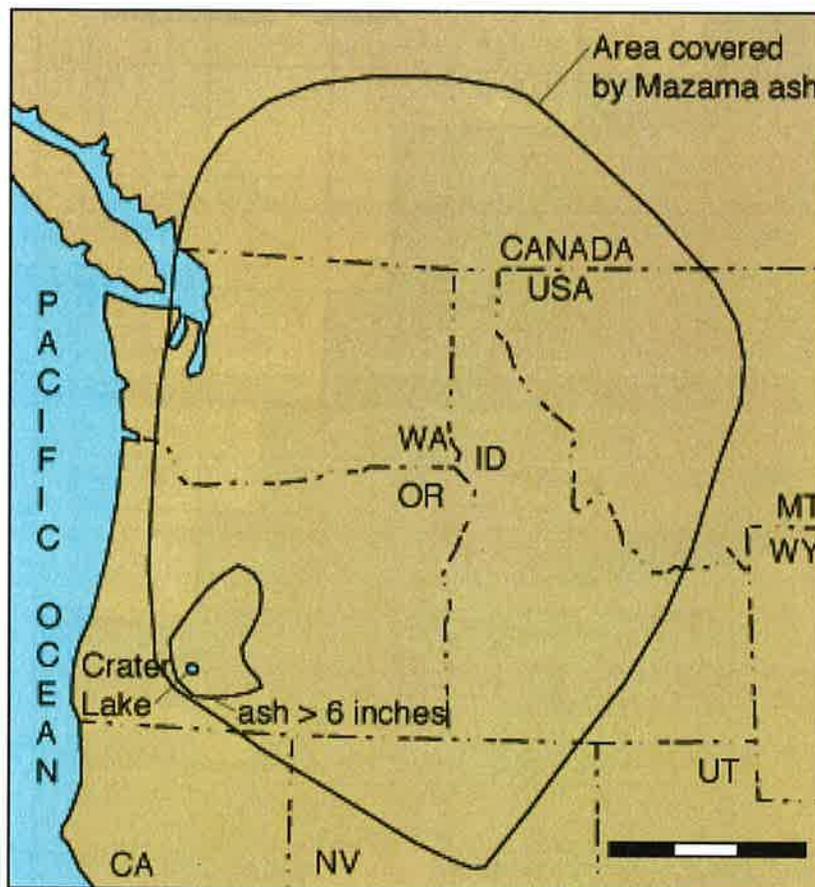


Image from <http://www.accuracyingenesis.com>

The most recent Native American inhabitants of the area, the Northern Paiutes, entered the area around 1800 CE. The Northern Paiutes occupied central Oregon, northern California, and northern Nevada. The Northern Paiutes were comprised of nomadic tribes who migrated throughout their area to gather, hunt

1 and trade with other bands. The particular band that utilized the assessment area is unknown; however, it  
2 was the Northern Paiutes that roamed this area.

### 3 History

4 Central Oregon was first settled in the late 19<sup>th</sup> century by ranchers raising sheep and cattle and  
5 homesteaders soon followed. Shortly after its inception, Bend developed into a functioning town with a  
6 complete infrastructure. This early boom of farmers and homesteaders resulted in town planning by  
7 Alexander Drake and the subsequent incorporation of the city of Bend in 1905. Lumber and resource  
8 interest groups scouted the area for industry opportunities. The timber of economic choice was ponderosa  
9 pine. This tree species was readily abundant around Bend, but the challenge was getting the lumber to the  
10 national markets. This trade dynamic was described by historian Philip Cogswell, "...getting to the trees  
11 was only a relatively easy first step; getting the trees - or more precisely the lumber made from them - to  
12 market was the difficulty. Central Oregon in 1910 was virtually isolated from the rest of the nation,  
13 including other parts of Oregon, as far as volume commercial transportation was concerned, and the  
14 exploitation of *Pinus ponderosa* would have to wait for a railroad" (Cogswell, 1981). The railroad race  
15 between barons started in 1911 and railroad magnate James J. Hill of the Northern Pacific and Great  
16 Northern Railroad came out on top in Bend. This paved the way for mill development along the  
17 Deschutes River and the creation of thousands of jobs.

18 Investors from Minnesota, including the Shevlin-Hixon and Brooks-Scanlon groups, purchased large  
19 tracts of timber lands around Bend. The Shevlin-Hixon and Brooks-Scanlon companies began rapid  
20 timber harvests and lumber milling operations in 1916. Concurrently with industry development in 1905,  
21 the National Forest System was created after public lands were transferred from the Department of  
22 Interior to the Department of Agriculture. On June 13, 1906, Executive Order 816 established the  
23 Deschutes National Forest from parts of the Blue Mountain, Cascade, and Fremont National Forests.  
24 From 1910 through 1917, there were several proclamations and Executive Orders that eliminated and  
25 added lands to the Deschutes National Forest.

26 "In a very real sense, early forestry policies and practices created the problems that early forestry research  
27 would be asked to solve" (Joslin, 2007). "Cultural practices – keeping fire out of the woods and cutting  
28 only large-diameter ponderosa pine (highgrading) - had consequences for the forest environment"  
29 (Robbins, 2004). From 1931 through 1934, fire lookouts were constructed on Lava Butte, Paulina Peak,  
30 and Black Butte which aided an aggressive fire suppression program. The consequences of fire exclusion  
31 resulted in accumulated ground litter, dead and down trees, increased stand densities and augmented  
32 susceptibility to insect and disease problems.

33 The height of the timber production was in 1928. The following year brought the Great Depression  
34 forcing a decline in timber harvesting and lumber production. At this time, the timber industry asked the  
35 Forest Service for increased access to buy Deschutes National Forest timber (Joslin, 2007). The result was  
36 increased timber surveys and sales by the Deschutes National Forest. The long-term stability of the  
37 Brooks-Scanlon Company was now in question. Maps acquired from the Deschutes County Historical

Museum (dated 1944-57) depict private land ownership and timber sales around the Triangle Hill area and on lands to the east of the assessment area. Difficult economic times brought the end of the company’s productivity and its’ selling off of timber lands and lumber mills.

**Bend Today**

The city of Bend lies along the banks of the Deschutes River, which runs between the eastern slopes of the Cascade Mountain Range and the high desert plateaus of Oregon’s central interior. Originally a small mill town, Bend has emerged into a full service city and Oregon’s fastest growing high technology area. For the past decade, Deschutes County has led Oregon in high technology growth (over 270%). Numerous companies from the Silicon Valley, Portland-Vancouver area, and the Puget Sound have relocated. Many of these firms are small but extremely innovative, producing niche-market products from semiconductors to software, and medical instruments to recreational equipment.

Table 4. Deschutes County population over time.

Counties & Cities	1990*	1995	2000*	2004	2005	2006
<b>Deschutes County</b>	74,958	89,500	115,367	135,450	143,481	152,615
<b>Bend</b>	20,469	29,425	52,029	65,210	70,328	75,290

\*U.S. Census Bureau

Table 5. Deschutes County population growth projection.

	2010	2015	2020	2025	% Growth 2010-2025
<b>Bend</b>	81,242	91,158	100,646	109,389	34.60%
<b>Redmond</b>	23,897	29,667	36,831	45,724	91.30%
<b>Sisters</b>	2,306	2,694	3,166	3,747	67.60%

Source: Deschutes County Coordinated Population Forecast

**Employment**

Diversification and economic restructuring have been the ongoing focus of economic development in central Oregon. These efforts have proven largely successful in transforming the region’s industry and employment from a 70-year reliance on forest products, agriculture and tourism to one that has foundations in a variety of manufacturing, high technology, services, and specialty manufacturing.

Table 6. Employment Distributions

Sector	Deschutes County
Total private	63,550
Natural resources, mining & construction	8,300
Manufacturing	5,670
Trade, transportation, and utilities	13,510
Wholesale trade	1,640
Retail trade	10,490
Transportation, warehousing & utilities	1,370
Information	1,710
Financial activities	5,330
Professional and business services	7,820
Educational and health services	8,740
Leisure and hospitality	10,120
Other services	2,350
Government	8,240
Federal government	840
State government	1,160
Local government	6,230
Total nonfarm employment	71,780

1 Source: Oregon Employment Department, 2007

2 **Income Levels**

3 As central Oregon has steadily diversified its employment and economic base, the median income for a  
 4 family of four has increased correspondingly. At \$58,700, Deschutes County median income is virtually  
 5 equivalent to the state's median of \$58,900.

6

7

8 Table 7. Median annual income.

Median Family of Four*					Per Capita**	
	2000	2005	2006	2007	2000	2005
<b>Deschutes</b>	\$41,600	\$57,800	\$58,800	\$58,700	\$26,928	\$32,094
<b>Oregon</b>	\$47,800	\$58,900	\$55,700	\$58,700	\$28,197	\$32,289

1 \*U.S. Department of Housing and Urban Development;\*\* U.S. Bureau of Economic Analysis; 2005 data are the most current  
2 available

3 In central Oregon the living wage for a single adult is \$10.17 an hour, and these rates are higher in Bend.  
4 This is based on what is needed to meet basic needs and provides some ability to deal with emergencies  
5 and plan ahead. The living wage for a single adult with two children is \$21.44 an hour. Thirty-four  
6 percent (34%) of all job openings pay less than the \$10.17 an hour living wage for a single adult. Eighty-  
7 three percent (83%) of all job openings pay less than the \$21.44 an hour living wage for a single adult  
8 with two children. For each job opening that pays at least the \$10.17 an hour living wage for a single  
9 adult, there are six job seekers on average. For each job opening that pays at least the \$21.44 an hour  
10 living wage for a single adult with two children, there are 24 job seekers on average (Sommers, 2004).

### 11 Housing

12 Table 8. Median house purchase price.

	2001	2002	2003	2004	2005	2006
<b>Bend</b>	\$168,950	\$183,500	\$195,000	\$227,500	\$279,900	\$351,978

13  
14 The cost of housing in Bend has increased drastically over the past ten years and seems to have flattened  
15 out for the time being. New construction has slowed relative to its previous pace. Rental homes and  
16 apartments remain available. Nearly 30% of the homes in and around Bend are second homes. As the  
17 population expands and Bend grows, the development continues to spread in all directions, including  
18 towards the BTLA area.

### 19 Wildland Urban Interface

20 There is an expanding Wildland Urban Interface (WUI) as population grows as a result of development.  
21 This development, combined with reduced stand management, fuel buildup and highly effective fire  
22 suppression makes for a potentially dangerous WUI situation. In order to address this concern, Project  
23 Wildfire, a group of homeowners associations, local residents, as well as federal, state, county and city  
24 governments have developed the Greater Bend Community Wildfire Protection Plan.

1 The Greater Bend Community Wildfire Protection Plan has been drafted in order to:

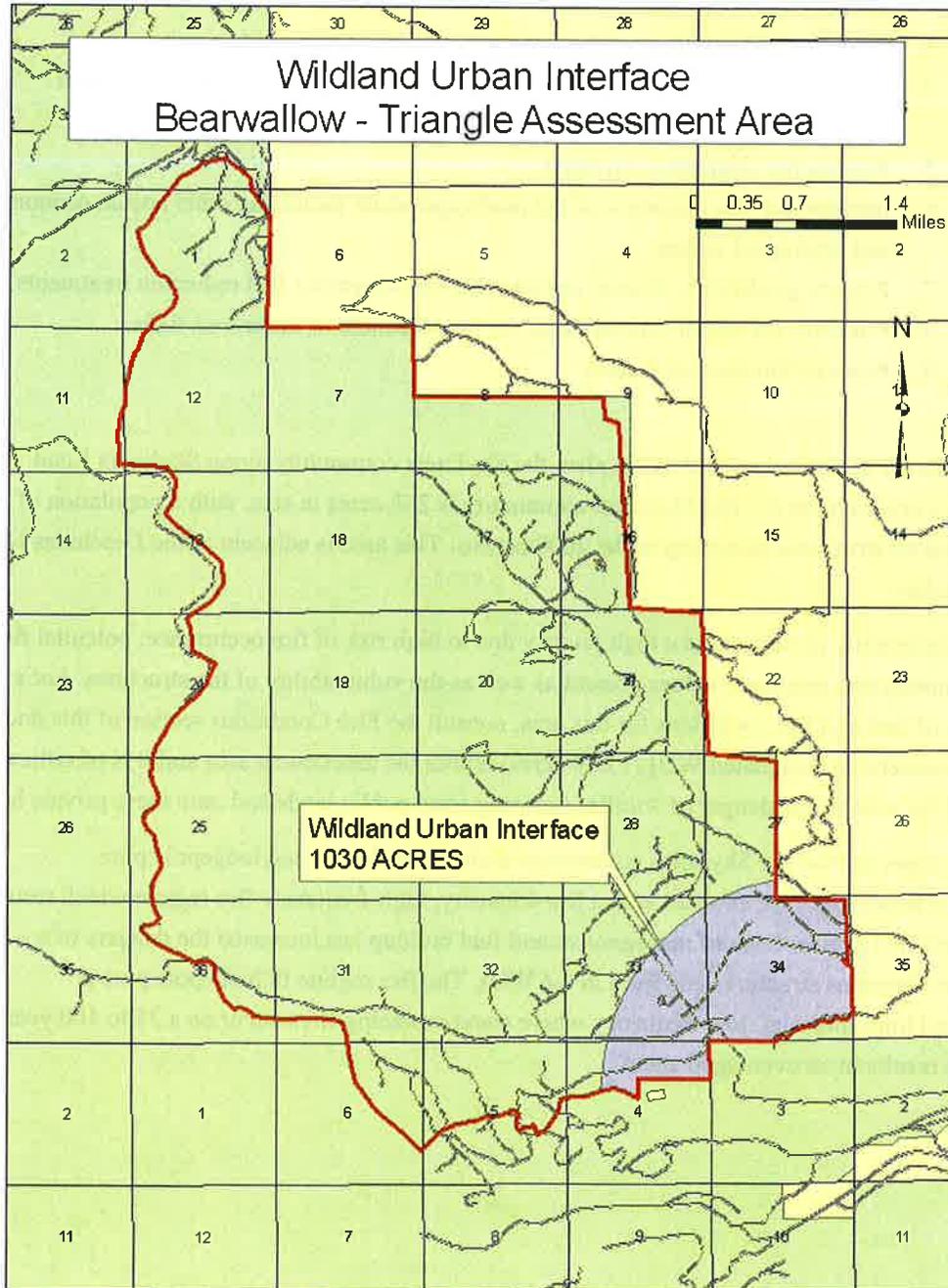
- 2 1. Protect lives and property from wildland fires.
- 3 2. Instill a sense of personal responsibility and provide steps for taking preventative
- 4 actions regarding wildland fire.
- 5 3. Increase public understanding of living in a fire-adapted ecosystem.
- 6 4. Increase the community's ability to prepare for response to and recover from
- 7 wildland fires.
- 8 5. Restore fire-adapted ecosystems.
- 9 6. Improve the fire resilience of the landscape while protecting other social, economic,
- 10 and ecological values.
- 11 7. Provide guidance to federal agencies for implementing fuel reduction treatments.
- 12 8. Prioritize the use of limited funds for the treatment of hazardous fuels.
- 13 9. Promote biomass utilization.

14  
15 One “community at risk” identified in the plan, the Skyliners community along Skyliners Road, is south  
16 of the BTLA area (Figure 5). The Skyliners community is 257 acres in size, with a population of 39  
17 residents and 46 structures according to the 2000 census. This area is adjacent to the Deschutes National  
18 Forest boundary.

19 Skyliners community is considered a high priority due to high risk of fire occurrence, potential fire  
20 behavior, human and economic values present as well as the vulnerability of the structures. For a  
21 description of fuel and fire conditions for this area, consult the Fire Conditions section of this document.  
22 There is considerable designated WUI (1,030 acres) within the assessment area and it is of critical  
23 importance because of the danger of wildfire escaping from public lands and onto these private holdings.

24 Vegetation types around the Skyliners community include ponderosa and lodgepole pine.  
25 Historically, ponderosa pine evolved with a low-intensity, high-frequency fire regime which resulted  
26 in open, park-like stands. Lack of management and fuel buildup has increased the dangers of a  
27 wildfire that threatens structures and lives in the WUI. The fire regime in lodgepole pine is  
28 characterized high-intensity, low frequency where stand-replacing fires occur on a 35 to 100 year  
29 cycle. This results in an even-aged stand.

1 Figure 5. Wildland urban interface in the assessment area.



2

3

1 In order to protect lives, property and natural resource values, a number of grants are available to assist  
2 the implementation of Firefree initiatives, guidelines for creating defensible space. Project Wildfire has  
3 secured funding from the National Fire Plan, Federal Emergency Management Agency and Community  
4 Assistance Grants to achieve their goals. Individual property owners can implement Firefree and  
5 defensible space initiatives on their own or Project Wildfire will work directly with contractors to  
6 complete fuel reduction work. Depending on the priority and nature of the project, Project Wildfire may  
7 require that property owners provide labor as an in-kind match to receive grant funding.

8 According to Project Wildfire, property owners in the Skyliners community are engaged and participate  
9 actively in creation of defensible space through the implementation of the Firefree guidelines. Current  
10 efforts include limbing and trimming existing trees as well as the removal of forest understory vegetation  
11 that can act as ladder fuels to carry surface fires into the forest overstory. After this work is completed,  
12 efforts in the Skyliners community will focus on breaking up the continuity of overstory fuels to reduce  
13 the risk of a crown fire in an adjacent stand from moving into the Skyliners community. The greater Bend  
14 Community Wildfire Protection Plan recommends that the Skyliners community comply with Firewise  
15 and Firefree guidelines; develop a reliable water supply; establish, sign and maintain ingress and egress  
16 routes; and improve signage.

#### 17 Proposed Skyline Community Forest – Potential WUI

18 The 33,000 acres east of the assessment area (Figure 6) were once owned by Crown Pacific, which went  
19 bankrupt in 2002. The land is now an in-holding of Fidelity National Finance, Inc. The area has been  
20 logged in the past. Fidelity has considered the cost-benefits of marketing the timber versus the  
21 development of the property for other purposes. As a result, Fidelity is in negotiations with the Deschutes  
22 Basin Land Trust and state agencies to set aside 28,000 acres as a working community forest in exchange  
23 for support of a 5,000 acre planned development. The area intended for development is in the north end  
24 and the community forest would be located to the south. Viewshed maps illustrate that this property is  
25 highly visible from the City of Bend, with the BTLA area as a backdrop.

26 The Land Trust has worked cooperatively with the Oregon Department of Forestry (ODF) and the Oregon  
27 Department of Fish and Wildlife (ODFW) in support of the successfully passage of legislation to protect  
28 blocks of private forestland in central Oregon and manage these lands for marketable timber. House Bill  
29 2729 was passed in 2005 to create the State’s first community forest authority which allows for low cost  
30 government revenue bonds to help buy and maintain working forests. The premise of HB 2729 is to  
31 “provide the people of the State of Oregon with renewable commercial forest resources that promote  
32 community stability and sound conservation practices”. The primary motivation is to prevent developers  
33 from subdividing large tracts of forestland for development.

34 One key informant interview related that this private tract located between the assessment area and Bend  
35 has always been viewed and used by the public like “National Forest public land”. The area has never  
36 been closed to the general public. There is a high density of trails and roads, resulting from a history of  
37 timber extraction, which has resulted in hiking, mountain biking and equestrian uses. If the State of

1 Oregon and the Deschutes Basin Land Trust succeed in creating the Skyline Community Forest, the plan  
2 would be to manage the 28,000 acres for large-diameter trees, bird species, mule deer habitat and  
3 migration corridors, and trail systems. The area is designated as deer winter range and a primary  
4 migration route for the Tumalo deer herd.

5 The proposed development in the northern tract of land is for approximately 1,000 home sites on a 1,500  
6 acre footprint. This exclusive planned development would be located within a total of 5,000 acres. This  
7 would leave 28,000 acres to the south as the proposed Skyline Community Forest. It is important to note  
8 that the development is not planned as a “destination resort.”

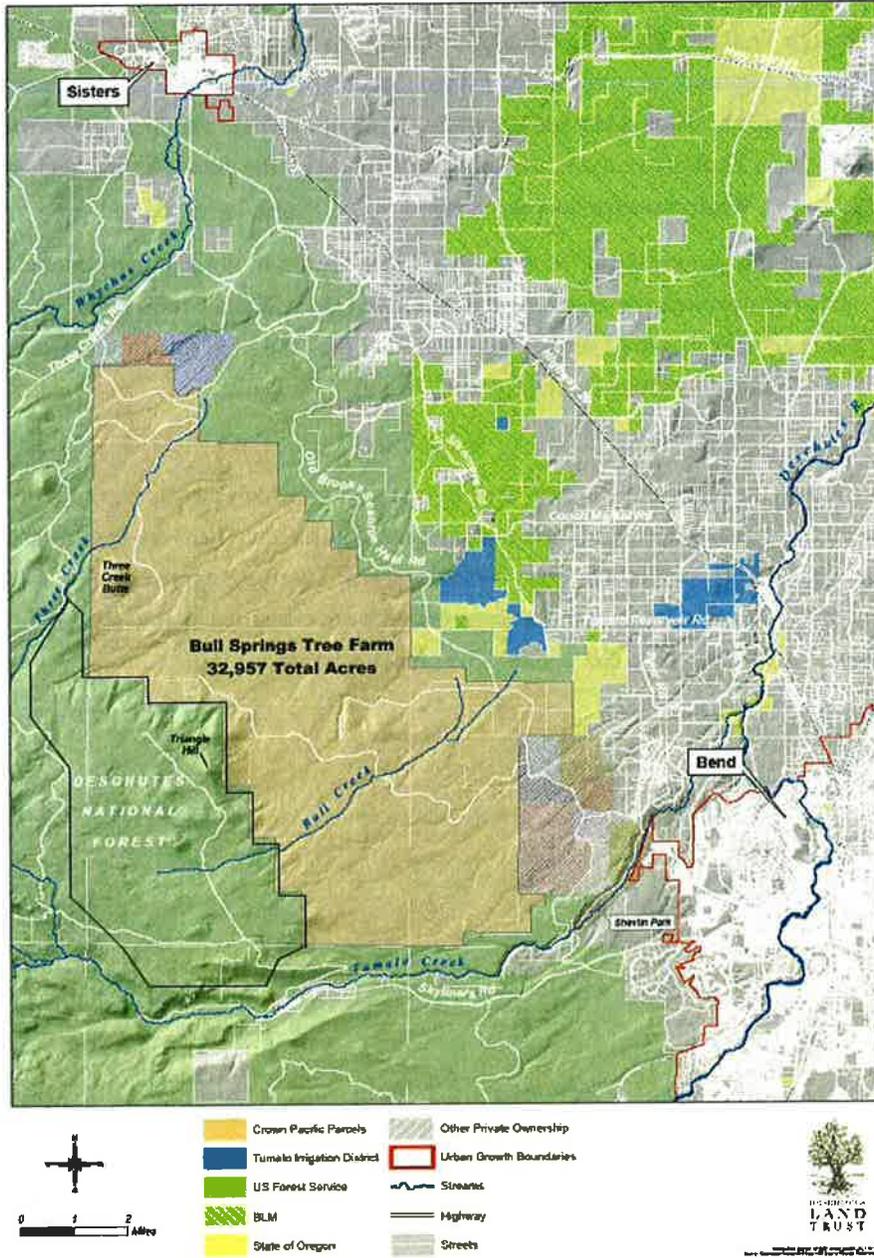
9 One known organization is opposed to any home development within this 33,000 acre private tract of  
10 land. The Central Oregon Land Watch works within local and State policy and believes that there is full  
11 protection from development of the Skyline Community Forest under current zoning. The Central Oregon  
12 Land Watch is not in favor of the collaboration between the Deschutes Basin Land Trust and Fidelity to  
13 development this area.

14 There is concern from all parties involved regarding the forest fuel loading and fire hazard from National  
15 Forest land to the west of the parcel. Fidelity has cut timber along the private west boundary to prepare a  
16 fuelbreak. Fidelity has hired fire-management professionals to assist with designing hazardous fuels  
17 treatments.

18 The decision timeframe for the Skyliner Community Forest is the January 2009 legislative session.  
19 Fidelity National Finance will require public support to move forward. The Deschutes Basin Land Trust  
20 and the State of Oregon are integral components of the collaboration process. Regardless of the final  
21 decision, the adjacent private land use will influence management decisions in the BTLA area

Figure 6. Proposed Skyline Forest.

**Bearwallow-Triangle  
Landscape Assessment –  
area depicted in black west  
of Bull Springs Tree Farm**



06/24/2008

CEEM Landscape Assessment

## **Transportation**

### **Trails**

There are sections of several trails within the BTLA area covering around 22 miles. The Mrazek Trail is an 11.5 mile-long trail of moderate difficulty open to mountain bikers and hikers with trailheads at Shevlin Park and Fremont Meadow. It does not require a Recreation Pass.

The Metolius-Windigo Trail is a 28.2 mile-long horse trail that spans the Deschutes National Forest and crosses the assessment area north to south which is also used by mountain bikers. It is a moderate difficulty trail open from June-November and requires a Recreation Pass. The 370/4601 Road trailhead for the Metolius-Windigo Trail is located in the southwest corner of the assessment area. It is an access point to the Three Sisters Wilderness for horseback riders.

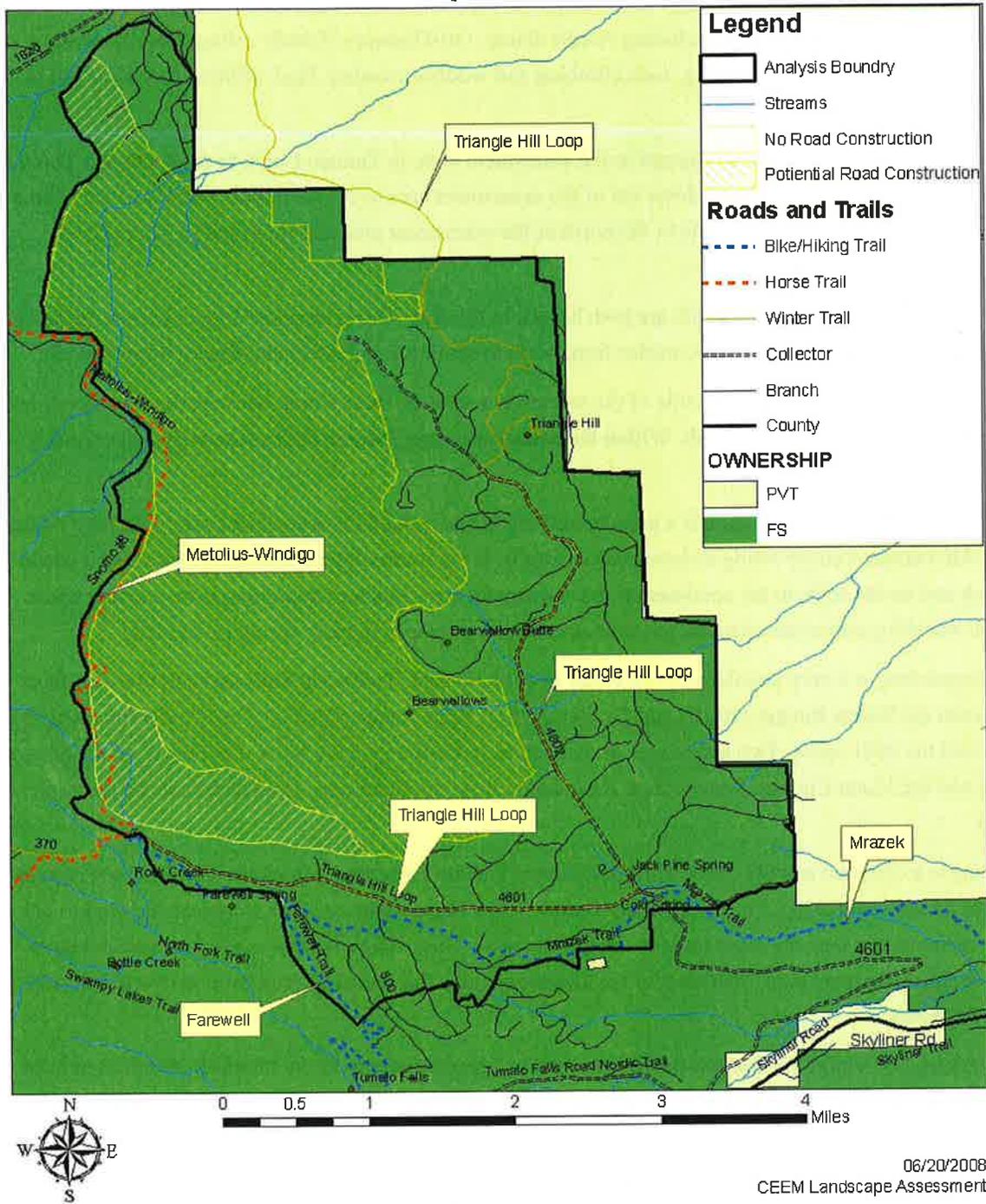
The Triangle Hill Loop is a groomed trail for snowmobiles with non-motorized use allowed. It utilizes the 4601 and 4602 roads and connects the assessment area to the Upper Three Creek Lake Snow-Park. The Cross District Trail is another groomed snowmobile trail that runs the west side of the assessment area on the edge of the Three Sisters Wilderness utilizing the 370 and 4601 Roads.

### **Roads**

The primary access into the assessment area is the Skyliners Road which travels west out of Bend. The roads within the BTLA area are dead-ends and have degraded surfaces. There are spur roads off of the main roads, some signed with road numbers on carsonite posts. There are approximately 44 miles of roads in the assessment area. All main roads in the assessment area are classified as low standard summer roads and established snowmobile routes in the winter. They receive moderate use.

Figure 7. Roads and trails within the assessment area.

### Bearwallow-Triangle Landscape Assessment Transportation



## **Recreation**

A portion of the Bear Wallows Roadless Area lies within the BTLA area. The attractions within the Roadless area include natural forests and limited wildlife. The primary use historically has been big game hunting and snowmobiling. Through interviews with the public, associated clubs and agencies, it has been discovered that other activities including Nordic skiing, Off-Highway Vehicle riding (OHV), hiking, mountain biking, equestrian riding, rock climbing and wildlife viewing. Each of these activities will be discussed in greater detail.

Sport fishing exists in streams adjacent to the assessment area, in Tumalo Creek to the south and Three Creek to the north. Bottle Creek flows out of the assessment area to the south into Tumalo Creek. Three Creek, which lays a tenth of a mile to the north of the assessment area and flows out of Three Creek Lakes is stocked with brook trout.

Mule deer and Rocky Mountain elk are both hunted in the area. The assessment area is known for being summer range as well as a travel corridor from north to south for mule deer and Rocky Mountain elk.

Nordic skiing takes place just outside of the assessment area, in Three Creek Snow Park to the north, and Mt. Bachelor Ski Park to the south. Within the assessment area, there is little ski activity that currently takes place.

Off-Highway Vehicle recreation is a popular activity in and around the assessment area. Dirt bike riding and All-Terrain Vehicle riding is done predominantly to the south of the assessment area along Tumalo Creek and on the trails to the southeast of the assessment area. Much of this riding is on existing roads. Four-wheeling enthusiasts also use the assessment area, primarily in early spring or late fall.

Snowmobiling is a very popular activity in the assessment area. Two main trails serve as thoroughfares between the Sisters Ranger District and the Bend – Fort Rock Ranger District. Those trails run along the 370 and the 4601 roads. Two active snowmobile clubs in the area are the Snow-Go-Fers from the Sisters area and the Moon Country Snowmobile Association from the Bend area. Both clubs use the assessment area.

Hiking is a common activity in the Three Creek and Tumalo Falls area. Mountain biking is very popular on the Metolius-Windigo Trail and on the Mrazek Trail. These trails are more technical and tend to get less maintenance than the other trails in the general area. Three Creek road is used by mountain bikers inside the assessment area. Southeast of the assessment area the Tumalo Creek Trail network is an active site for riders.

Equestrian use within the assessment area is contained predominantly to the Metolius-Windigo trail. In the past the trail was predominantly used by equestrian riders, but more recently it's been shared with hikers and mountain bikers.

A small contingent of local rock climbers is known to climb Cougar Rock, which lies in the northern half of the assessment area. The assessment area is also used by people who enjoy viewing wildlife. Cougars are viewed around the Triangle peak area.

## Biophysical Analysis

### Physical Resources

#### Climate

The BTLA area is located in the High Cascade Mountains physiographic region (Deschutes National Forest, 1990). The climate pattern affecting the area is marine polar. Located directly east of the Cascade mountain range, the assessment area is in the leeward slope in the rain-shadow. Bend receives less rainfall in the summer months, and higher rainfall amounts in the spring and fall. The highest amount of precipitation occurs in the winter months.

The climatic information was obtained from the Western Regional Climatic Center and is for Bend, approximately 20 miles east of the BTLA area at 3,600 feet in elevation. The data set covers the period from 1928 to 2006. This information is being used as a reference for describing general climatic conditions for the assessment area. Corrections should be made for elevation, slope and aspect when applying this information to the assessment area.

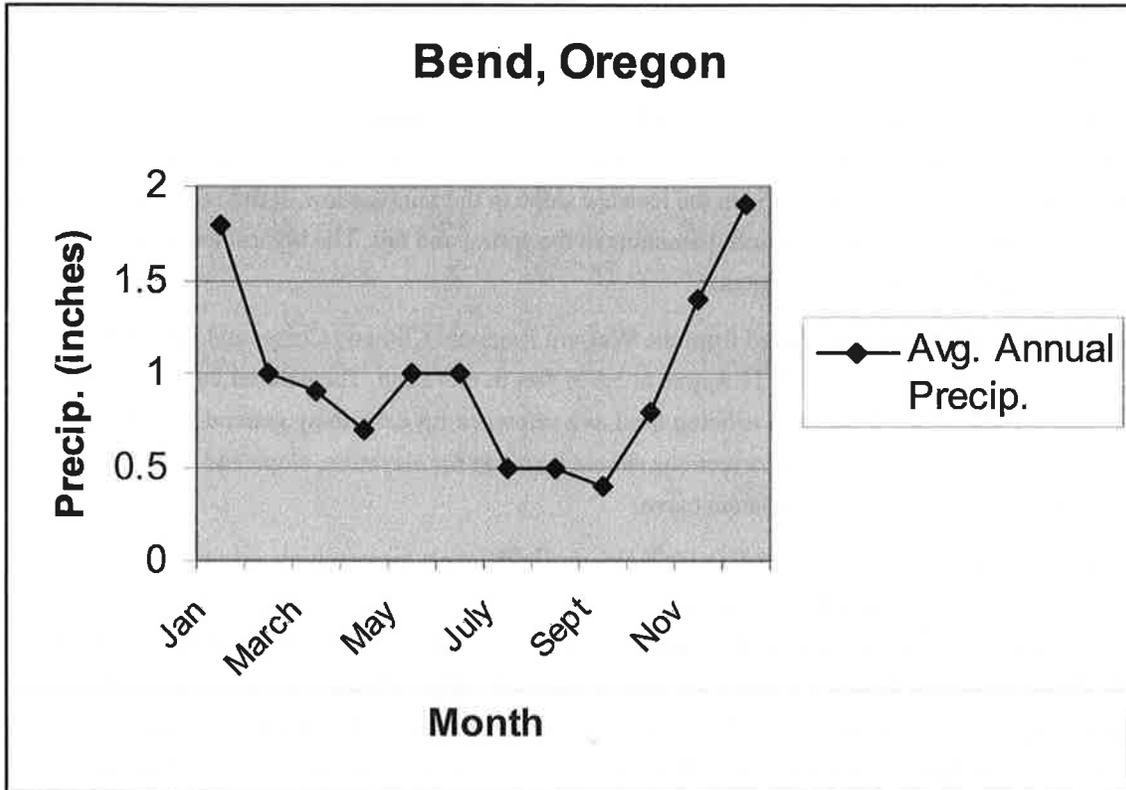
Average temperatures range from 32° F to 60°F seasonally. Highest temperatures occur in July and August and average 81° F and the lowest temperatures occur in December and January averaging 31° F. Central Oregon's weather is influenced by large air masses moving west to east that originate over the Pacific Ocean, typically bringing warm, moist air. Topography plays a major role in wind direction and frontal passages. There can be large variations in temperature and precipitation relative to an area's elevation and proximity to the mountains. There is some variation from the westerly air influence. Occasionally an Arctic air mass will reach the area and cause extreme winter conditions. Each year in Bend there is an average of 130 clear days and 90 partly cloudy days. Many of the remaining 145 days provide some sunshine through thin clouds.

#### Precipitation

Average annual rainfall in Bend is approximately 12-20 inches per year, occurring mostly from November through March. There are thunderstorms in the summer months. Winter snowfall averages 32 inches per year. Yearly totals rise sharply with increases in elevation.

A large portion of the precipitation in the Upper Deschutes Basin falls in the Cascade Range along the western fringe of the basin, making it the principal groundwater recharge area. East of the Cascade Range, there is little or no recharge from precipitation within the basin (Gannett, 2001). Groundwater level fluctuations in the basin are driven primarily by decadal climatic cycles (Gannett, 2001).

Figure 8. Annual precipitation throughout an average year in Bend, Oregon.



### Soils

Soils in the BTLA are influenced by materials deposited by volcanic eruptions including volcanic ash, pumice, and cinders. These materials fell on the previously developed soils to be referred to as “buried soils”. The most extensive soil material in the BTLA area is air-lain dacite pumice lapilli, particles ranging from 4 mm to 32 mm, and volcanic ash, ranging from 0.063 mm to 2 mm, from the eruption of Mount Mazama (Crater Lake) about 7,700 years ago. This material ranges from 12 feet deep at the southern end of the Forest and extends northerly becoming thinner and finer with distance from the source. The assessment area ranges from 10 to 40 inches deep. The buried soils were formed from older geologic materials which include hard basalts and andesites, tuffs, breccias, glacial till, and glacial outwash. A majority of all bedrock materials are extrusive volcanic rocks.

Some of the more common soil problems encountered on the Deschutes National Forest are related to the characteristics of the pumice soils and the hot and dry climate. Surface soil temperatures have been recorded as high as 164°F. These soils are coarse-textured, have low bulk densities, low fertility, and are light colored. On upland positions they are excessively well-drained.

Soil displacement is one of the most readily recognized problems associated with pumice soils. The surface layers are easily removed by mechanical activity. This results in a high visual impact, with the

exposure of the light-colored material, as well as having an impact on the nutrient distribution and soil surface protection by organic matter.

Soil erosion occurs primarily in the form of soil creep, sheet erosion, and dry ravel. Gullies are confined mostly to finer textured soils or in situations where concentrated runoff occurs. However, surface runoff seldom occurs over the pumice soils for more than a short distance due to the rapid infiltration into the soil. Wind erosion is a significant factor when mineral soil is exposed. Dustiness and erosion on unsurfaced roads are common problems.

The nutrient status indicates that nitrogen, phosphorus, and sulphur are generally low, and potassium, calcium, and magnesium are high in most soils. The nutrients are concentrated in only the upper few inches of soil. Soil reaction is slightly acid to neutral in the pine forests. The surface is much more acidic under mountain hemlock.

Naturally occurring hydrophobic soils are common and this condition is most notable under the mountain hemlock and mixed conifer stands. High-intensity forest fires can add the hydrophobicity. There is a soil layer that is usually two to three inches thick and light grayish-brown in color that resists wetting by water. Often associated with the nonwettable soils is a tight mat of needles which also resists water penetration, but is important in keeping the soils from eroding (Larson, 1976).

### **Hydrology**

The BTLA area lies within three fifth-field watersheds. The fifth-field watershed is the largest scale used for watershed analysis within the area. Table 9 describes the area in context of the larger landscape, as well as within the assessment area. Figure 9 provides a visual description of the watersheds in relation to the assessment boundary.

Table 9. Portions of fifth-field watersheds within the assessment area.

<b>Fifth Field Watershed</b>	<b>Acres within Assessment Area</b>	<b>Percentage of Total Watershed</b>	<b>Percentage of Assessment Area</b>
Deep Canyon	9,783	10	76
Tumalo Creek	2,823	7	22
Middle Deschutes	219	>1	2
<b>Total</b>	<b>12,825</b>		<b>100</b>

This analysis also includes a description of the area to the sixth-field watershed level, provided to aid in an understanding of the hydrologic regime and its influence on stream flows and morphology. Table 10 is a description of the sixth-field watershed. Figure 10 is a visual description of the sixth-field watersheds in relation to the assessment area.

Table 10. Sixth field watershed acreages and percent within the assessment area.

<b>Sixth-Field Watershed</b>	<b>Acres</b>	<b>Percentage of assessment area</b>
Three Creek	122	1
Deep Canyon	385	3
Triangle Hill	3,855	30
Bull Creek	5,422	42
Upper Tumalo Creek	1,197	9
Lower Tumalo Creek	1,625	13
Liadlaw Butte	219	2
<b>Total</b>	<b>12,825</b>	<b>100</b>

Figure 9. Fifth-field watersheds in relation to the assessment area.

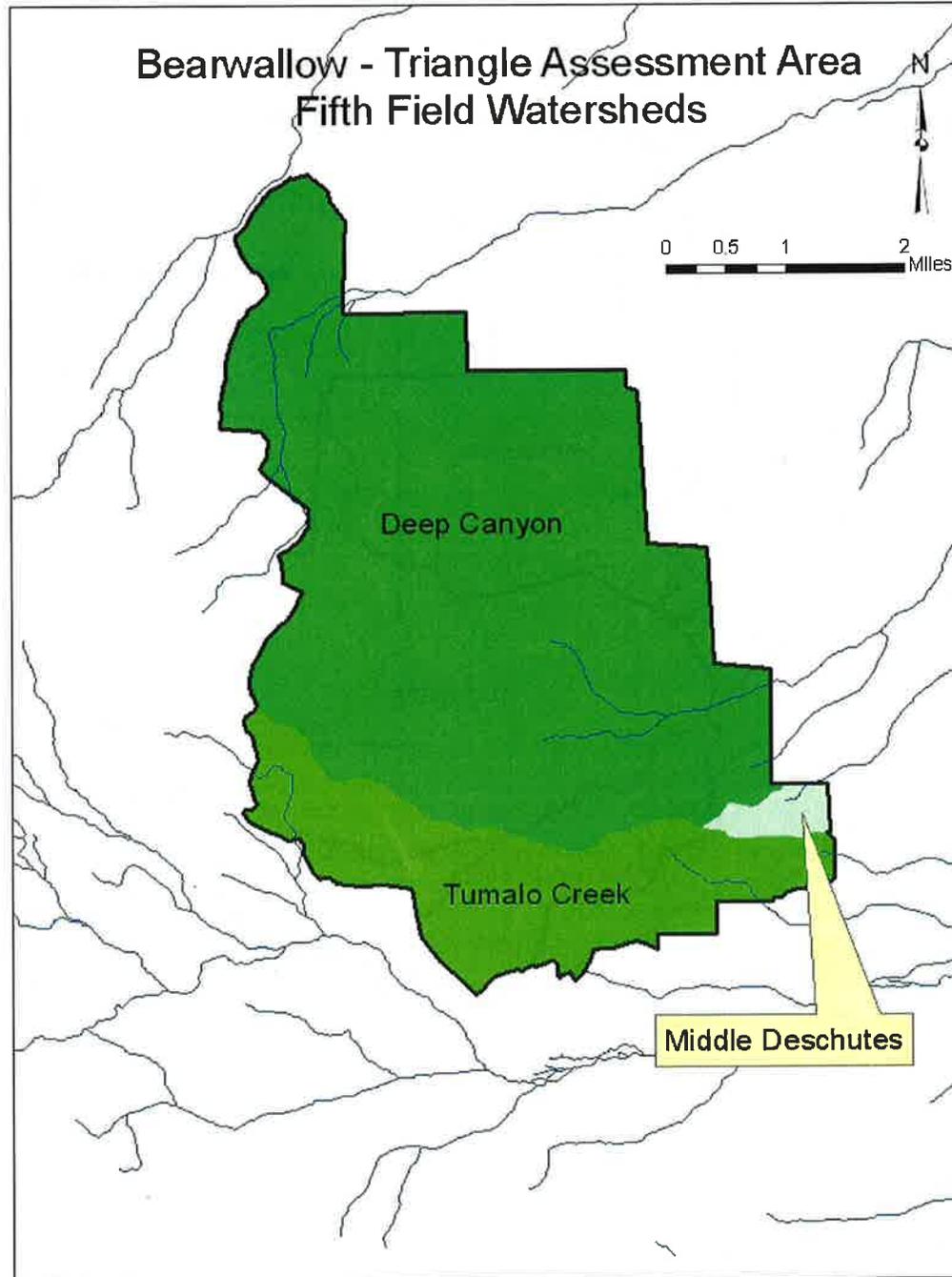
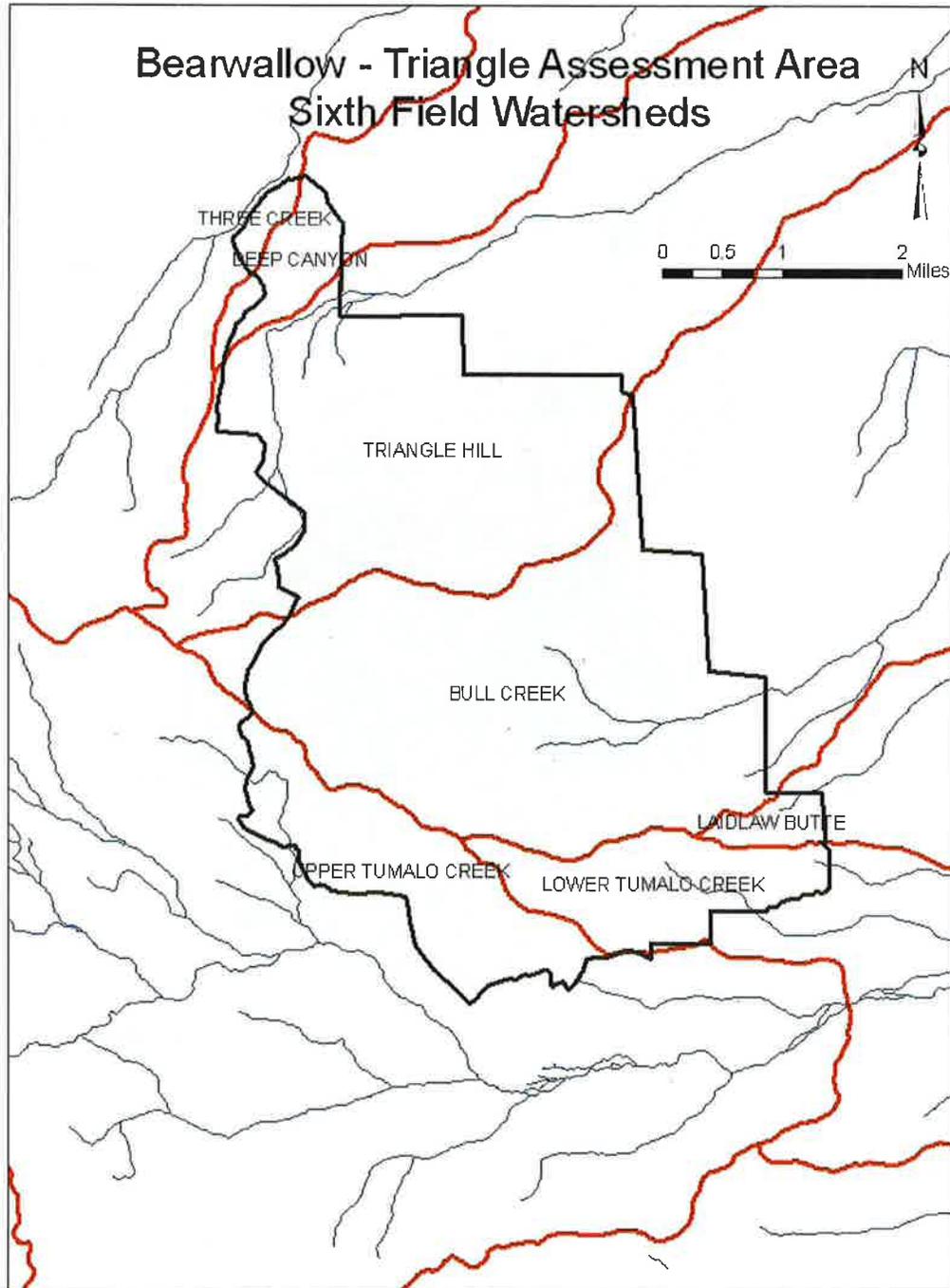


Figure 10. Sixth-field watersheds in relation to the assessment area.



**Streams**

There is approximately a 9.5 mile stream network in the assessment area. The length of stream in each sixth order watershed area appears in Table 11.

Table 11. Miles of streams in sixth-field watersheds of the assessment area.

<b>Sixth Field watershed</b>	<b>Highest stream order</b>	<b>Length (miles)</b>
<b>Triangle Hill</b>	2	3.5
<b>Bull Creek</b>	2	3.6
<b>Upper Tumalo Creek</b>	1	1.0
<b>Lower Tumalo Creek</b>	1	1.1
<b>Laidlaw Butte</b>	1	0.3

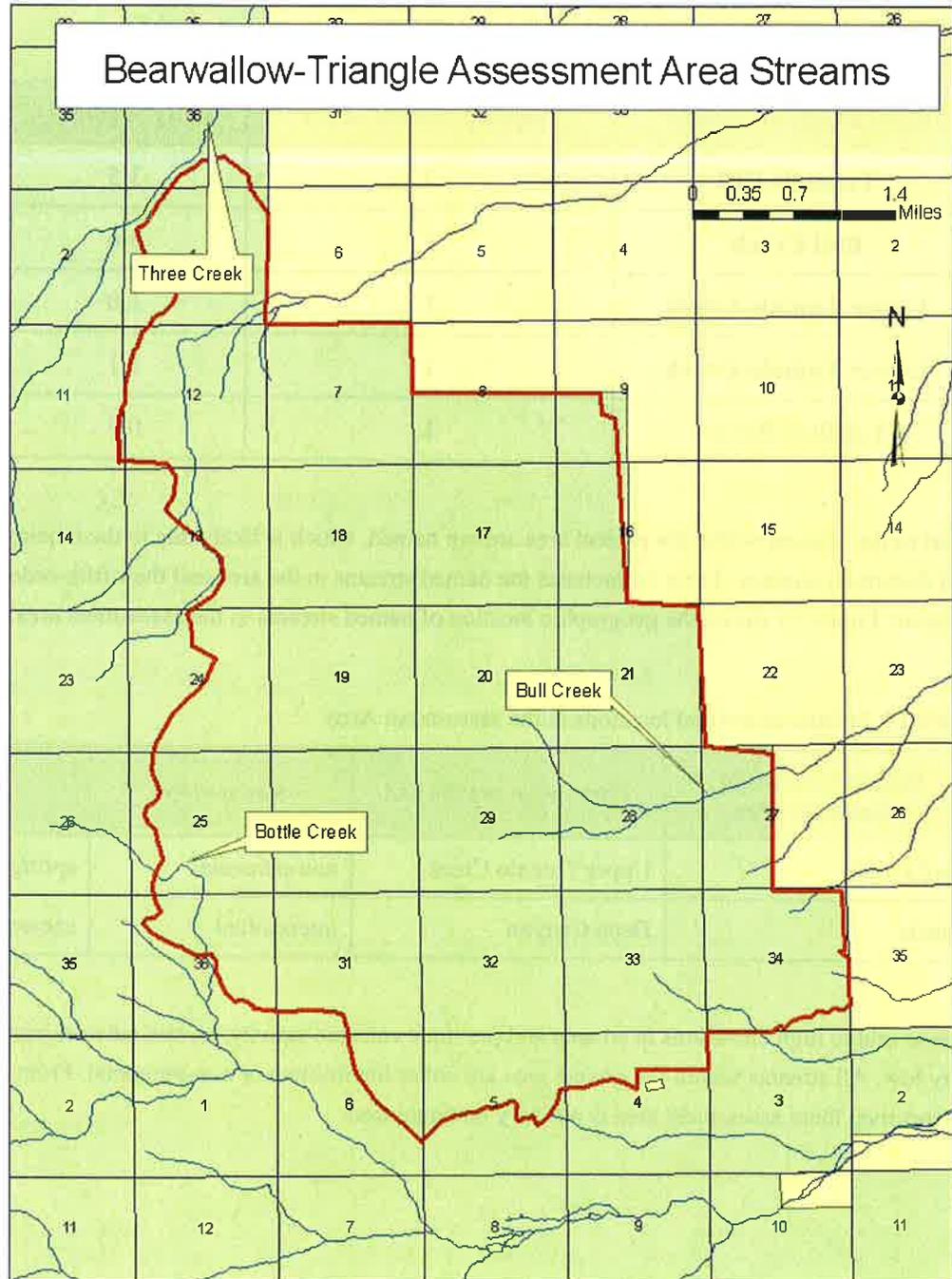
Most of the streams within the project area are not named, which is likely due to them being intermittent and first-order streams. Table 12 includes the named streams in the area and their fifth-order watershed location. Figure 11 shows the geographic location of named streams to the assessment area.

Table 12. Stream names and locations in the assessment Area.

<b>Named streams in assessment area</b>	<b>Fifth order watershed</b>	<b>Stream type</b>	<b>Source</b>
<b>Bull Creek</b>	Upper Tumalo Creek	non-perennial	spring
<b>Bottle</b>	Deep Canyon	intermittent	snowpack

Due to mid to high elevations in an area and previous volcanic activity, stream network concentration is very low. All streams within the project area are either intermittent or non-perennial. From a hydraulic perspective, there assessment area is not very distinguished.

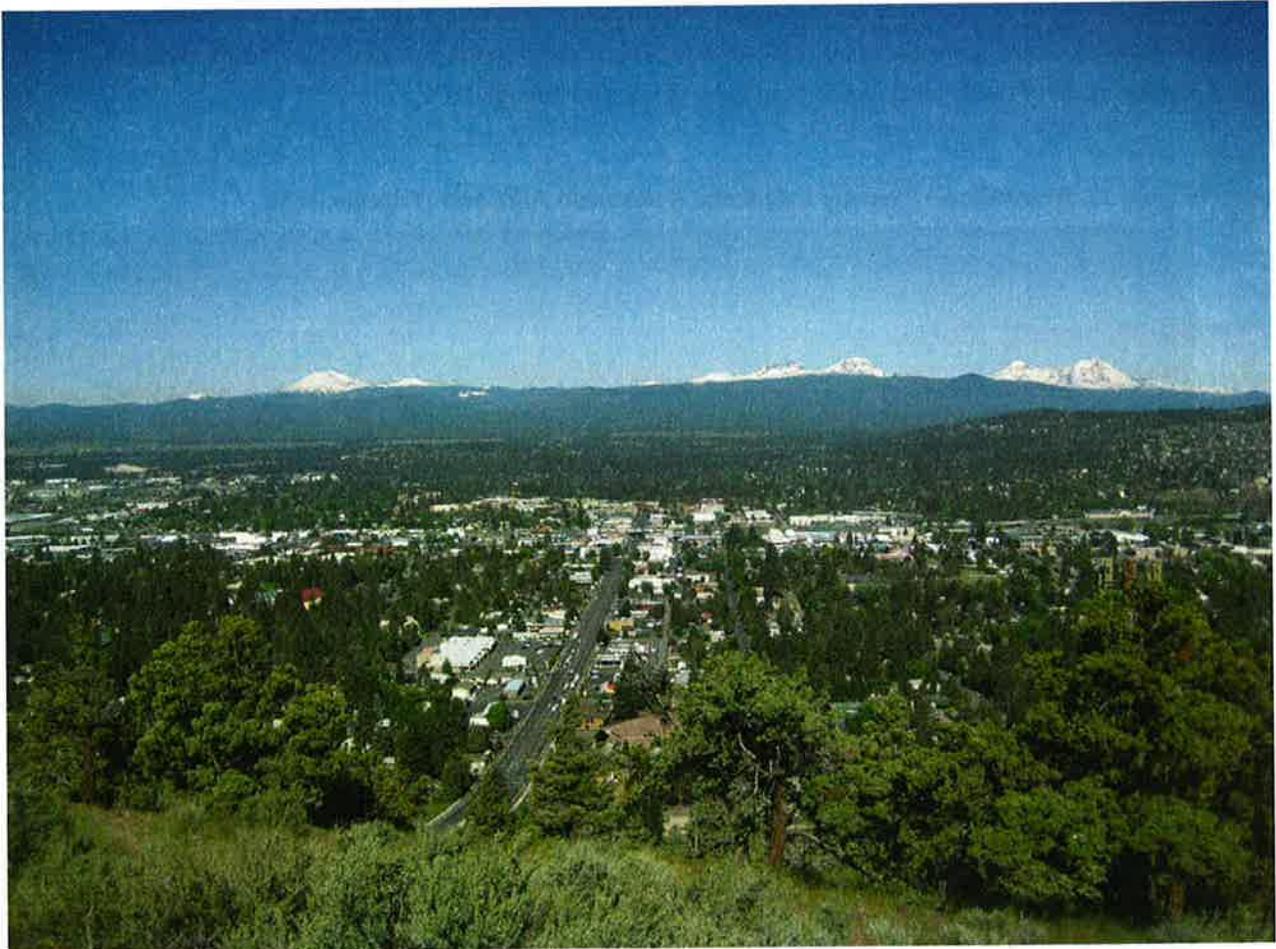
Figure 11. Streams in and around the assessment area



## Visuals

The BTLA area is part of a highly valued viewshed for the community of Bend. Several key informants have stated they would be opposed to management that is detrimental to the viewshed. The natural appearing mountain vistas are a large part of what draws people to Bend. The assessment area can be seen from parts of the city of Bend, with the best visibility from a popular vista point, Pilot Butte. The Three Sisters are a focal point on the landscape, and the assessment area stands out as a red band across the foot of the Three Sisters due to beetle-killed lodgepole pine.

Figure 12. Bearwallow - Triangle Landscape Assessment Area from Pilot Butte, Bend, Oregon



The view from Pilot Butte: the community of Bend in the foreground, with Mount Bachelor to the left, and the Three Sisters peaks to the right. Bearwallow-Triangle Landscape Assessment area lies just below the Three Sisters. Steve Markason, photographer.

By applying a digital elevation model to the local topography, visibility of specific locations within the assessment boundary can be determined. Figure 14 was generated in ArcMap using the technique described above to determine the viewshed of the BTLA from Pilot Butte. Approximately 1/3 of the BTLA area is visible from Pilot Butte, primarily in the southeastern portions. These locations, shown in green in Figure 14, are where management actions should be designed to minimize visibility from the community of Bend. Other vantage points should also be considered, such as Three Creeks Road, Awbrey Butte, and Highway 20, 126, and 242.

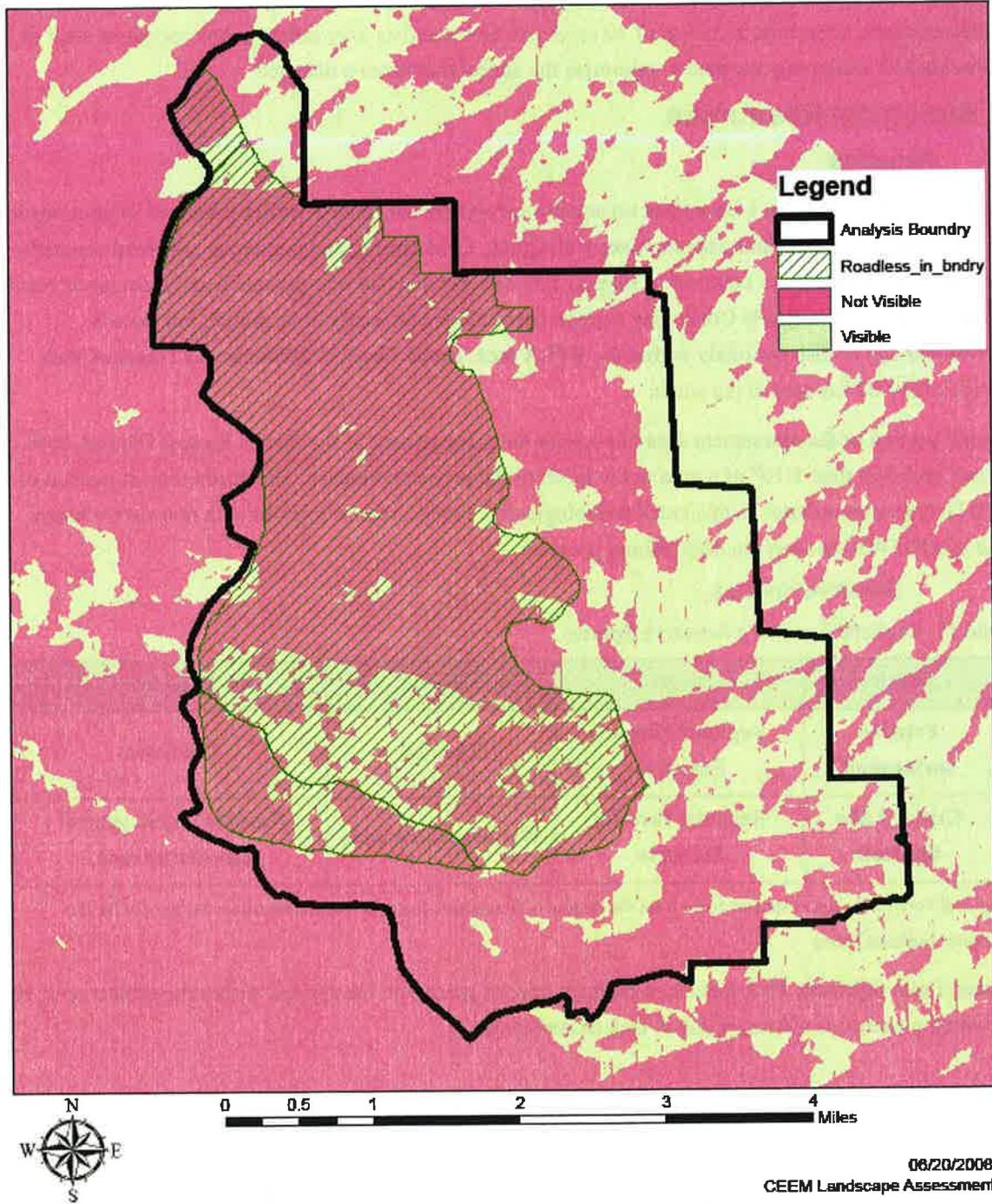
Private land to the east of the BTLA area is identified as being highly visible. This land is proposed for residential development and conversion to a community forest. The National Forest is not involved in management of these private lands. Oregon Department of Forestry is the agency responsible for overseeing timber management on private land. Public concern for potential visual impacts due to management of these lands would need to be channeled through ODF.

Figure 13. Bearwallow - Triangle Landscape Assessment Area from Triangle Butte.



Figure 14. Viewshed Analysis

### Bearwallow-Triangle Landscape Assessment Visibility from Pilot Butte in Bend



Much of the BTLA area lies within Management Area 18, Front Country. This designation aims to maintain natural appearing forested landscapes on the slopes of the Three Sisters. Standards and guides emphasize maintaining a uniform tree canopy, and to minimize openings where the uniform canopy cannot be maintained. An exception to this management guideline is made for epidemic mountain pine beetle outbreaks. Openings in excess of 40 acres can be created as long as mitigation measures such as feathering and scalloping are used to minimize the appearance from a distance.

## **Biological Resources**

### **Aquatics**

Within the BTLA area there have been no aquatic surveys on the Bend-Fort Rock Ranger District portion of the assessment area, which encompasses Bull Creek, Cold Spring, and numerous unnamed channels. None of these channels are believed to support fish because they are non-perennial and most never reach a higher order stream. Bottle Creek may support brook trout seasonally at its mouth, but flow is intermittent and no fish are likely within the BTLA area. Bottle Creek is a tributary to Tumalo Creek outside of the BTLA area to the south.

A small portion of the assessment area falls under the management of the Sisters Ranger District, with Three Creek less than 1/10<sup>th</sup> of a mile to the north of the project boundary. The northernmost portion of the BTLA area contributes to this creek hydrologically. Three Creek is stocked with non-native brook trout by ODFWS but receives little fishing pressure.

### **Sensitive Species**

Table 13. Regional Forester's Sensitive Species.

<b>Species</b>	<b>Status*</b>	<b>Habitat</b>	<b>Presence</b>
<b>Pristine springsnail</b>	Regional Forester Sensitive	Riparian	Unknown
<b>Crater Lake tightcoil</b>	Regional Forester Sensitive	Wet vegetation zone	Possible within general assessment area.

\*Regional Forester Sensitive species come from the Region 6 Threatened, Endangered, and Sensitive species list for the Deschutes National Forest

**Crater Lake tightcoil:** This species of mollusk may be present in the springs within the project area, but the actual presence is unknown due to lack of survey data.

Species of Concern

Table 14. Species of Concern.

Species	Status*	Habitat	Presence
Long-toed salamander	High community interest	Riparian	Unknown

**Long-toed salamander:** The Three Creek long-toed salamander is believed to be a separate sub-species due to a different skull and jaw structure, and unique cannibalistic tendencies. There is currently no official designation as a separate species or sub-species.

**Wildlife**

The Forest Service has a legal requirement to maintain or improve habitat conditions for Threatened, Endangered and Proposed species under the Endangered Species Act. Management actions should minimize negative impacts, promote habitat development or provide habitat protection to some degree for those species that occur within the habitats on federally managed land. Within the BTLA area, there have been no wildlife surveys. The following table lists species potentially using the assessment area, but further study/surveys are needed should management be proposed in the area.

Threatened and Endangered Species

Table 15. Threatened and endangered wildlife species.

Species	Status*	Habitat	Presence
<b>Northern spotted owl (NSO)</b>	Federal Threatened	Old growth mixed conifer forests	Documented dispersal habitat and nesting, roosting, foraging (NRF) habitat in general assessment area;
<b>Oregon spotted frog</b>	Federal Candidate, Regional Forester Sensitive	Stream, marsh	Unknown

\*Federally listed and Regional Forester Sensitive species come from the Region 6 Threatened, Endangered, and Sensitive species list for the Deschutes National Forest;

**Northern spotted owl (NSO):** Of the two species listed above, the NSO is the only species with habitat identified within the assessment area. The habitat has been identified as suitable for nesting, roosting, and foraging (NRF). No surveys have been conducted to determine actual presence of NSO, nor has field verification of the suitability of NRF habitat occurred. Where NSO habitat exists within the assessment area, it be highly fragmented and limited to north facing slopes where white fir and other conifers are growing. In the lodgepole pine, very little canopy remains due to beetle kill.

**Oregon spotted frog:** The presence of the Oregon spotted frog is unknown in the BTLA area, but is unlikely due to the high elevation. Further review is needed to determine the presence of this species (Table 16).

Table 16. Regional Forester's sensitive species.

Species	Habitat	Presence
<b>American peregrine falcon</b>	Riparian, cliff	Unknown
<b>Crater Lake tightcoil</b>	Wet vegetation zone	Possible within general assessment area.
<b>Pacific fisher</b>	Mixed conifer forest, complex forest structure	Unknown
<b>California wolverine</b>	Mixed conifer habitat, high elevation	Unknown
<b>White-headed woodpecker</b>	Pine forests	Possible within general assessment area.
<b>Lewis's woodpecker</b>	Open pine woodlands	Unknown

\*Federally listed and Regional Forester Sensitive species come from the Region 6 Threatened, Endangered, and Sensitive species list for the Deschutes National Forest

Table 17. Management Indicator Species (MIS).

Species	Habitat	Presence
<b>Great gray owl</b>	Mature and old growth forests associated with openings and meadows	Unknown
<b>Northern goshawk</b>	Mature and old-growth forests; especially high canopy closure and large trees	Possible within general assessment area.
<b>Cooper's hawk</b>	Similar to goshawk, can also use mature forests with high canopy closure/tree density	Possible within general assessment area.
<b>Sharp-shinned hawk</b>	Similar to goshawk in addition to young, dense, even-aged stands	Possible within general assessment area.
<b>Red tailed hawk</b>	Large snags, open country interspersed with forests	Possible within general assessment area.

<b>Species</b>	<b>Habitat</b>	<b>Presence</b>
<b>Osprey</b>	Large snags associated with fish bearing water bodies	Possible within general assessment area.
<b>Townsend's big-eared bat</b>	Caves and old dwellings	Unknown
<b>Elk</b>	Mixed habitats	Habitat within assessment area.
<b>American marten</b>	Mixed conifer or high elevation late-successional forests with abundant down woody material	Habitat within assessment area.
<b>Mule deer</b>	Mixed habitats	Habitat within assessment area.
<b>Woodpecker Species</b>		
<b>Red-naped sapsucker</b>	Riparian hardwood forests	Possible within general assessment area.
<b>Downy woodpecker</b>	Riparian hardwood forest	Possible within general assessment area.
<b>Lewis' woodpecker</b>	Ponderosa pine forests, burned forests	Unknown
<b>Williamson's sapsucker</b>	Mature or old growth conifer forests with open canopy cover; weak excavator	Possible within general assessment area.
<b>Hairy woodpecker</b>	Mixed conifer and ponderosa pine forests	Possible within general assessment area.
<b>White-headed woodpecker</b>	Mature ponderosa pine forests; weak excavator	Possible within general assessment area.
<b>Three-toed woodpecker</b>	High elevation and lodgepole pine forests	Habitat within assessment area.
<b>Black-backed woodpecker</b>	Lodgepole pine forests, burned forests	Habitat within assessment area.
<b>Northern flicker</b>	Variety of forest types but more associated with forest edges	Possible within general assessment area.
<b>Pileated woodpecker</b>	Mature to old-growth mixed conifer forests	Possible within general assessment area.

\* MIS = Management Indicator Species come from the Deschutes National Forest Land and Resource Plan [1990]

Heavy woodpecker use is expected in the lodgepole beetle kill. Another avian species expected to benefit is the northern goshawks, due to the buildup of its prey base. Several woodpecker species are eaten by northern goshawks.

Deer and elk use the area as summer range, and concentrate near the riparian areas. This is also where they fawn and rear their young. The low road densities allow the animals to live with little disturbance from humans. Maintaining the current road density in the project area is desirable to the ODFW for those reasons.

The assessment area is used for rifle and bow hunting of elk and mule deer. It is attractive to hunters because of the roadless designation. The ODFW is responsible for management of the populations and regulating the hunting of both species. Generally, hunters are entering the roadless portions of the area on foot. Fewer incidents of poaching are believed to occur in the area because of the low road densities.

Table 18. Species of interest.

<b>Species</b>	<b>Status*</b>	<b>Habitat</b>	<b>Presence</b>
<b>Black bear</b>	High community interest	Forested landscape	Likely
<b>Cougar</b>	High community interest	Forested landscape	Likely

Key informants have brought up two additional species of high community interest, black bear and cougar. Populations of both species were said to have increased with recent changes to hunting regulations. Black bear can no longer be baited, and cougar can no longer be hunted with dogs. This change has resulted in lower hunting success rates.

## **Vegetation**

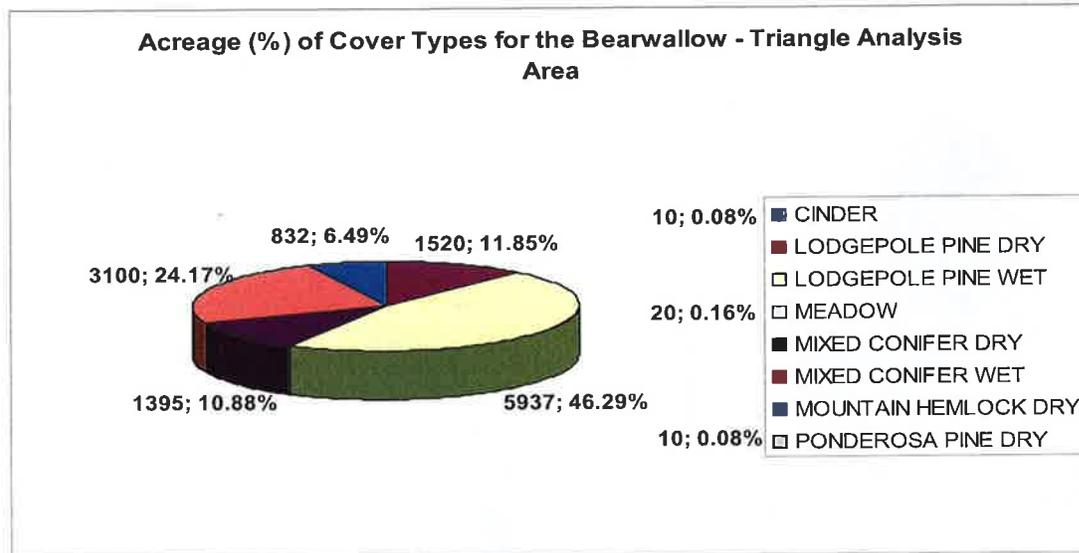
### **Historical Vegetation**

During the 1990’s, logging activities were mostly concentrated in lower elevation ponderosa pine stands. These areas are primarily located to the south and east outside of the assessment area boundary. One key informant interview suggests that there has always been “plenty of lodgepole pine and very little ponderosa pine in the area west of Triangle Hill” due to its higher elevation.

### **Current Forest Vegetation**

The assessment area is comprised of a few forest cover types, classified by the dominant tree species. These types include: lodgepole pine, ponderosa pine, mixed conifer and mountain hemlock communities. These groups are further classified into “wet” and “dry” according to site precipitation. The total acreage and percent of the BTLA area is classified into these cover types Figure 15. In addition to forest cover, the area contains ten acres of cinder mounds that lack significant vegetation and 20 acres of meadows and riparian areas.

Figure 15. Acreage and percent of total forest cover types in the assessment area.

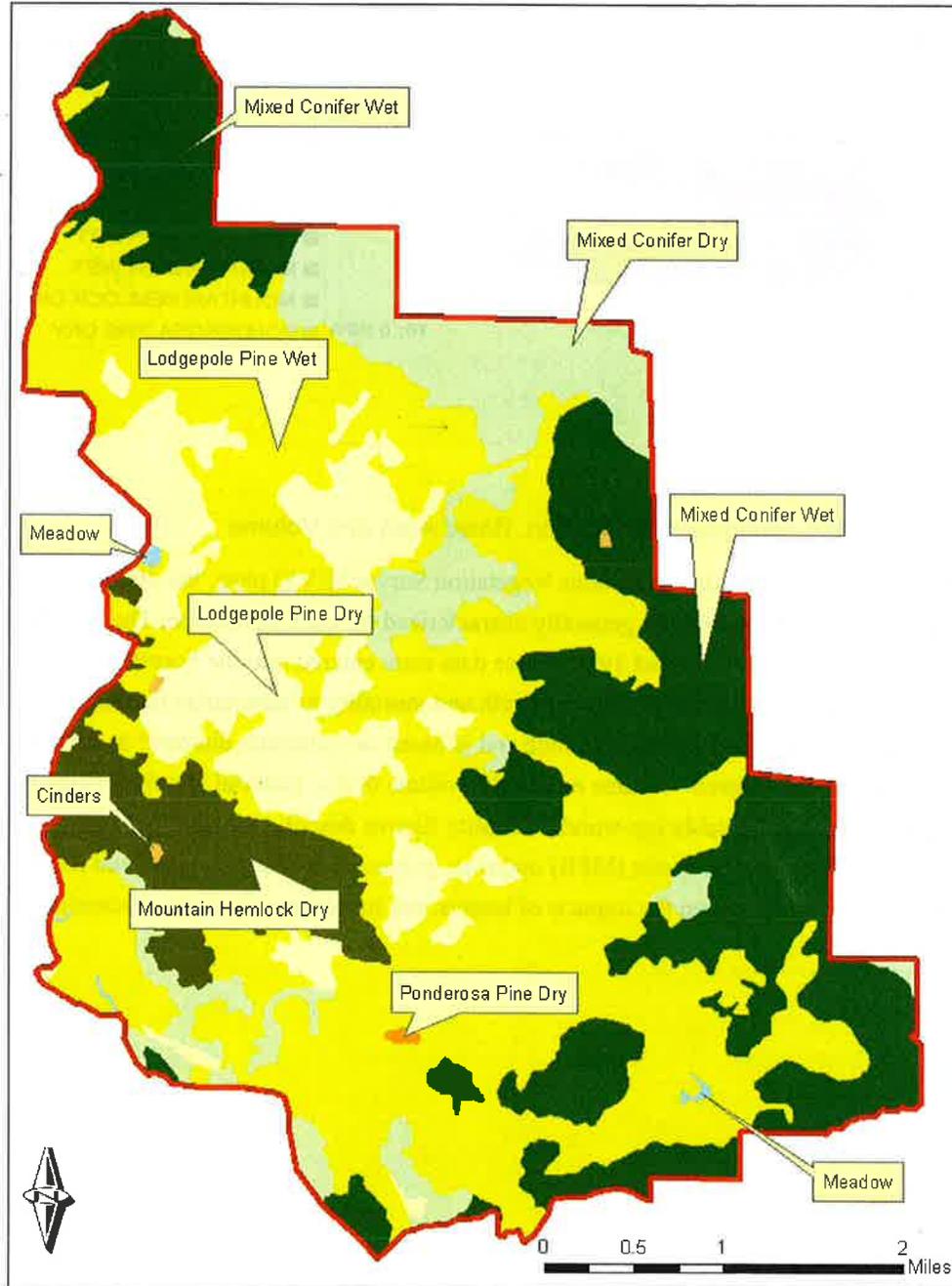


#### Density, Diameter Distribution, Basal Area and Volume

Compiling available data from six Continuous Vegetation Survey (CVS) plots, the diameter distributions, density, basal area and volumes can be generally characterized for each cover type. The plot data were gathered in the years between 1994 and 1996. These data were entered into the Forest Vegetation Simulator (FVS) modeling program to project growth and mortality to summarize current conditions. Merchantable volume represents live tree volume and is based on minimum diameter at breast height (DBH) of 10-inches; “Non-Merch” volume represents volume of live material less than 10-inches DBH and volume from non-merchantable top-wood. Mortality figures describe the trees per acre and total volume lost to the mountain pine beetle (MPB) outbreak (projected by the simulator) and natural mortality. For more information on the impacts of insects, see Insects and Diseases discussion.

Figure 16. Plant association groups within the assessment area.

Plant Association Groups of the Bearwallow - Triangle Analysis Area



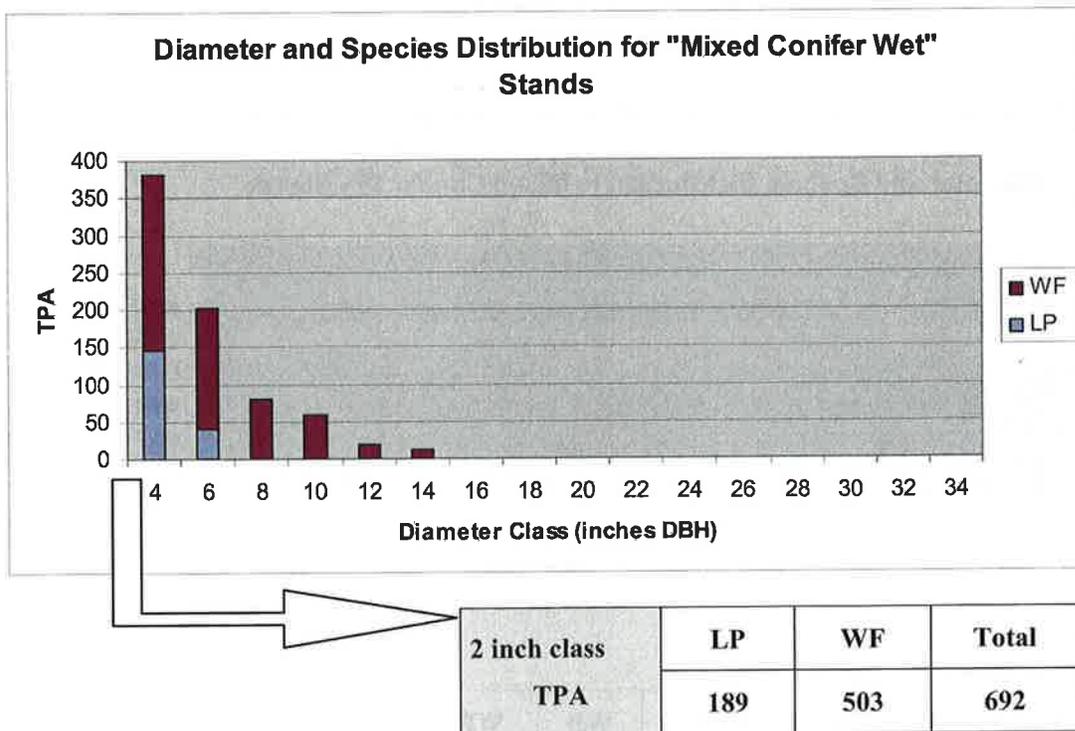
Mixed Conifer Wet

Table 19 summarizes density and volume estimates for the assessment area; and Figure 17 shows the live-tree species and diameter distribution for the mixed conifer wet forest type. Currently these stands are comprised of 26% lodgepole pine (LP) and 74% white fir (WF) based on trees per acre (TPA) estimates.

Table 19. Stand characteristics for mixed conifer on wet sites.

<b>Total Trees Per Acre (live)</b>	<b>1,446</b>
<b>Total Basal Area (Ft<sup>2</sup>/ac)</b>	<b>164</b>
<b>Total Merch. Volume (Ft<sup>3</sup>/ac)</b>	<b>1,253</b>
<b>Non-Merch. Volume (Ft<sup>3</sup>/ac)</b>	<b>2,226</b>
<b>Mortality TPA</b>	<b>124</b>
<b>Mortality Vol. (Ft<sup>3</sup>/ac)</b>	<b>56</b>

Figure 17. Trees per acre by diameter classes and species for mixed conifer on wet sites.



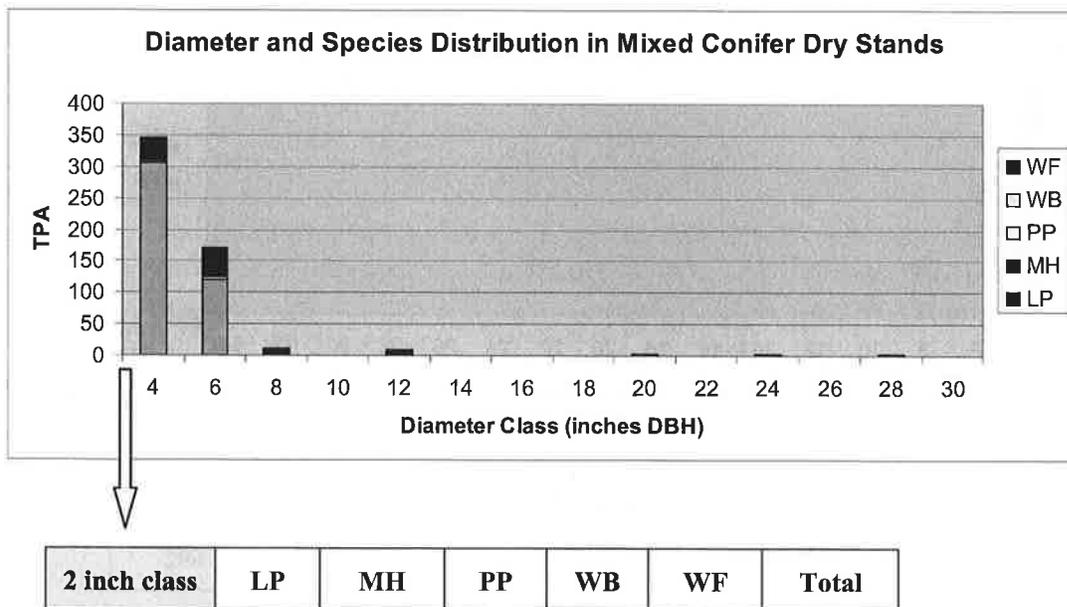
**Mixed Conifer Dry**

Figure 18 shows the live-tree species and diameter distribution for the mixed conifer dry forest type. Currently these stands are comprised of 84% lodgepole pine, <1% mountain hemlock (MH), <1% ponderosa pine (PP), 3% whitebark pine (WB) and 13% white fir based on trees per acre estimates. For this stand it is important to note that there are 24 ponderosa pines per acre greater than 20 inch DBH, and 12 white fir greater than 8 inch DBH that are difficult to make out in the graph.

Table 20. Stand characteristics for mixed conifer on dry sites.

<b>Total Trees Per Acre (live)</b>	<b>3,806</b>
<b>Total Basal Area (Ft<sup>2</sup>/ac)</b>	<b>111</b>
<b>Total Merch. Volume (Ft<sup>3</sup>/ac)</b>	<b>800</b>
<b>Non-Merch Volume (Ft<sup>3</sup>/ac)</b>	<b>1,337</b>
<b>Mortality TPA</b>	<b>375</b>
<b>Mortality Vol. (Ft<sup>3</sup>/ac)</b>	<b>73</b>

Figure 18. Trees per acre by diameter class and species for mixed conifer on dry sites.



TPA	2760	0	0	95	405	3260
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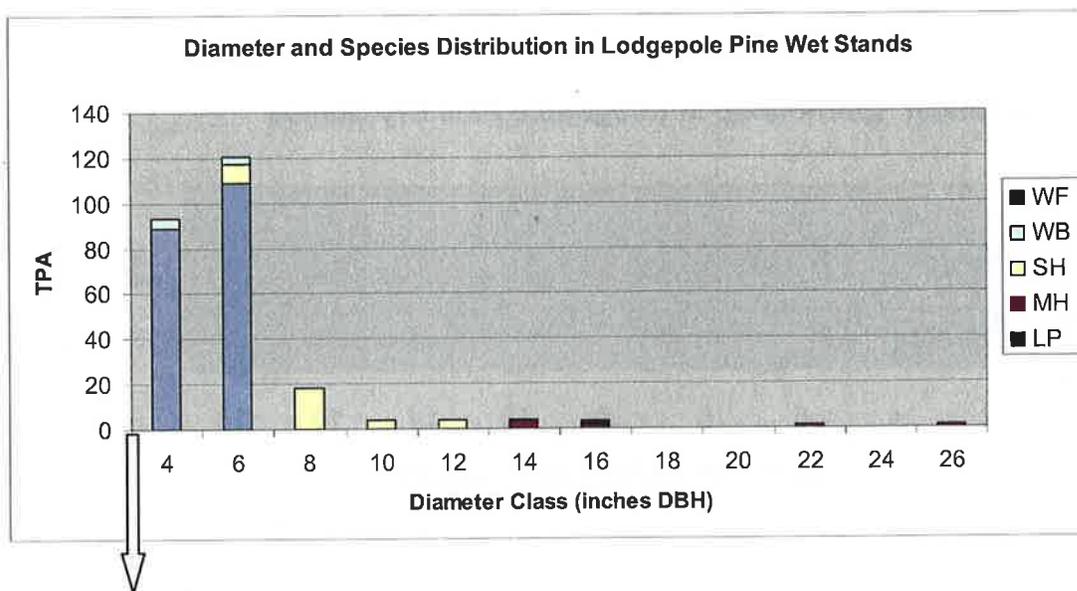
Lodgepole Pine Wet

Figure 19 shows the live-tree species and diameter distribution for the lodgepole pine wet forest type. Currently these stands are comprised of 56% lodgepole pine, <1% mountain hemlock, 28% Shasta red fir (SH), 15% whitebark pine and 1% white fir based on trees per acre estimates.

Table 21. Stand characteristics of lodgepole pine on wet sites.

<b>Total Trees Per Acre (live)</b>	<b>1,366</b>
<b>Total Basal Area (Ft<sup>2</sup>/ac)</b>	<b>63</b>
<b>Total Merch. Volume (Ft<sup>3</sup>/ac)</b>	<b>531</b>
<b>Non-Merch Volume (Ft<sup>3</sup>/ac)</b>	<b>758</b>
<b>Mortality TPA</b>	<b>304</b>
<b>Mortality Vol. (Ft<sup>3</sup>/ac)</b>	<b>51</b>

Figure 19. Trees per acre by diameter class and species for lodgepole pine on wet sites.



<b>2 inch class TPA</b>	<b>LP</b>	<b>MH</b>	<b>SH</b>	<b>WB</b>	<b>WF</b>	<b>Total</b>
	<b>561</b>	<b>0</b>	<b>346</b>	<b>191</b>	<b>19</b>	<b>1,117</b>

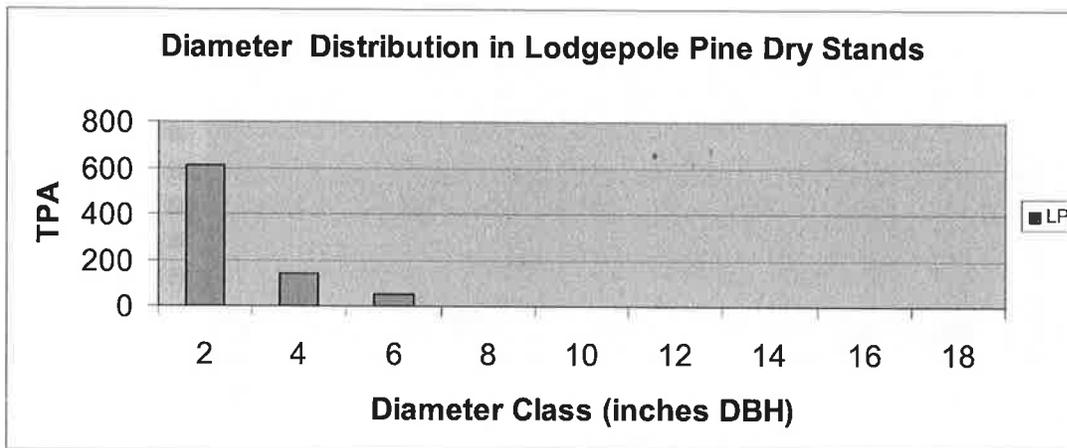
**Lodgepole Pine Dry**

These stands are comprised of 100% lodgepole pine. Model projections show that every tree over 8 inches are killed by MPB. This is not unlikely as trees in these dry sites have less vigorous growth and reduced defensive capability. These stands are only retaining stems 6 inches and less, with 76% of live trees in the 2 inch diameter class, 18% in the 4 inch class and 6% in the 6 inch class.

Table 22. Stand characteristics for lodgepole pine on dry sites.

<b>Total Trees Per Acre (live)</b>	<b>798</b>
<b>Total Basal Area (Ft<sup>2</sup>/ac)</b>	<b>24</b>
<b>Total Merch. Volume (Ft<sup>3</sup>/ac)</b>	<b>0</b>
<b>Non-Merch Volume (Ft<sup>3</sup>/ac)</b>	<b>338</b>
<b>Mortality TPA</b>	<b>265</b>
<b>Mortality Vol. (Ft<sup>3</sup>/ac)</b>	<b>64</b>

Figure 20. Trees per acre by diameter class and species for lodgepole pine in dry stands.



Wet Meadows

These meadows are predominately comprised of one or more mesic sedges or rushes. They cover <1% of the assessment area. Inventory data of these areas were not available. See Potential Natural Vegetation discussion for full description of expected species composition.

Data for composition and structure of the minimal amount of ponderosa pine dry forest types (<1% of the assessment area) and mountain hemlock (6.5% of area) were not available.

Potential Natural Vegetation

Potential Natural Vegetation (PNV) groups are classified by analyzing the environmental conditions that determine which plant communities (plant association groups) will develop on the land over time. These groups are defined by the dominant plant species that would be present at the end, or “climax,” of stand development; and are labeled with the name of the dominant overstory and understory species (e.g. lodgepole pine/sedge-lupine). It should be noted that natural disturbance processes (non-stand replacing events) are assumed when determining the PNV groupings.

Lodgepole pine plays an important, dual role in the development of the forest in the assessment area. It acts as both an early seral and late seral species in stands that are heavily influenced by stand replacing disturbances such as fire. In these stands, it will occupy 25-65% of the forest canopy with limited growth of understory species and shrubs/forbs. These groupings dominate the BTLA area. Table 23 summarizes the species found in late seral lodgepole stands.

Table 23. Percentage of species within lodgepole pine plant association cover types.

Lodgepole Pine/Sedge-Lupine and/or Lodgepole Pine/Sedge-Lupine-Penstemon	
Dominant Species	% Cover
Lodgepole pine	25 - 65
Western needlegrass	<1 – 5
Long stolon sedge	<1 – 12
Glaiycos penstemon	3 – 20
Lupine (Anderson’s or silvery)	0 – 20

\*PNV data were adopted from: “Plant associations of the Central Oregon Pumice Zone,” USDA Forest Service, Pacific Northwest Region, Sept. 1988.

Other understory and grass/forb species that may be found in the lodgepole pine PNV groups include squirreltail, goldenweed, skeleton weed, rabbitbrush, greenleaf manzanita, wax currant, prince’s pine,

Idaho fescue, blue wildrye, Nutall violet, *kelloggia*, strawberry, and stickweed. The lodgepole PNV groups represent approximately 7,500 acres or 58% of the BTLA area. Site specific conditions will influence the presence and abundance of individual species.

Generally, ponderosa pine and lodgepole pine are the dominant tree species in the mixed conifer group early in stand development. The stands become truly “mixed” as white fir, Shasta red fir, sugar pine, incense cedar and Douglas-fir grow into the understory. As these stands continue to develop under the natural frequent, low intensity fire regime, fire adapted species like ponderosa pine; Douglas-fir and sugar pine become the dominant component of the climax community. Mixed conifer stands represent approximately 4,500 acres or 36% of the assessment area. The shrubs and grasses forbs associated with this community are listed in Table 24:

Table 24. Percentage of species within mixed conifer plant association cover types.

<b>Mixed Conifer/Snowbrush/Sedge-Brackenfern</b> <b>Mixed Conifer/Snowbrush-Manzanita</b> <b>Mixed Conifer/Snowbrush/Sedge</b>	
<b>Dominant Species</b>	<b>% Cover</b>
Ponderosa pine	10 – 60
Lodgepole pine	~10
White fir	<1 – 30
Greenleaf manzanita	<1 – 11
Snowbrush	<1 – 40
Western needlegrass	<1 - 10
Long-stolon sedge	<1- 35
Glayoys penstemon	<1 - 60

\*PNV data were adopted from: “Plant associations of the Central Oregon Pumice Zone,” USDA Forest Service, Pacific Northwest Region, Sept. 1988.

Mountain hemlock PNV groups develop under the canopy of the early seral lodgepole pine. As the stand reaches climax, the lodgepole canopy has been replaced, as a result of competition and/or disturbance, with mountain hemlock and a small amount of Shasta red fir. The mountain hemlock group occupies 830 acres of the assessment area (~6.5%) and is comprised of other species noted in Table 25.

Table 25. Percentage of species within Mountain Hemlock/ Grouse Huckleberry plant association.

<b>Mountain Hemlock/Grouse Huckleberry</b>	
<b>Dominant Species</b>	<b>% Cover</b>
Mountain hemlock	30 - 70
Shasta red fir	0 - 10
Lodgepole pine	0 - 5
Grouse huckleberry	2 - 10
Prince's pine	0 - 5
Long stolon sedge	0 - 5

Wet meadow vegetation is dominated by mesic sedges and rushes. Colonies of reedgrass are occasionally heavy in these sites. A thick litter layer develops atop moist or wet soils that can have peat like characteristics. Table 26 summarizes species found in the 20 acres of wet meadows in the BTLA area.

Table 26. Percentage of species within wet meadow plant association cover type.

<b>Wet Meadow</b>	
<b>Dominant Species</b>	<b>% Cover</b>
Slender bog sedge	0 - 55
Chamisso sedge	0 - 24
Buxbaum sedge	0 - 40
Nebraska sedge	0 - 5
Tufted hairgrass	0 - 12
Baltic rush	5 - 70
Northern reedgrass	0 - 15
Orange arnica	<1 - 25
Watson willowweed	0 - 1

\* PNV data were adopted from: "Plant associations of the Central Oregon Pumice Zone," USDA Forest Service, Pacific Northwest Region, Sept. 1988.

Ponderosa pine types account for less than 0.1% of the assessment area and will therefore not be discussed in detail.

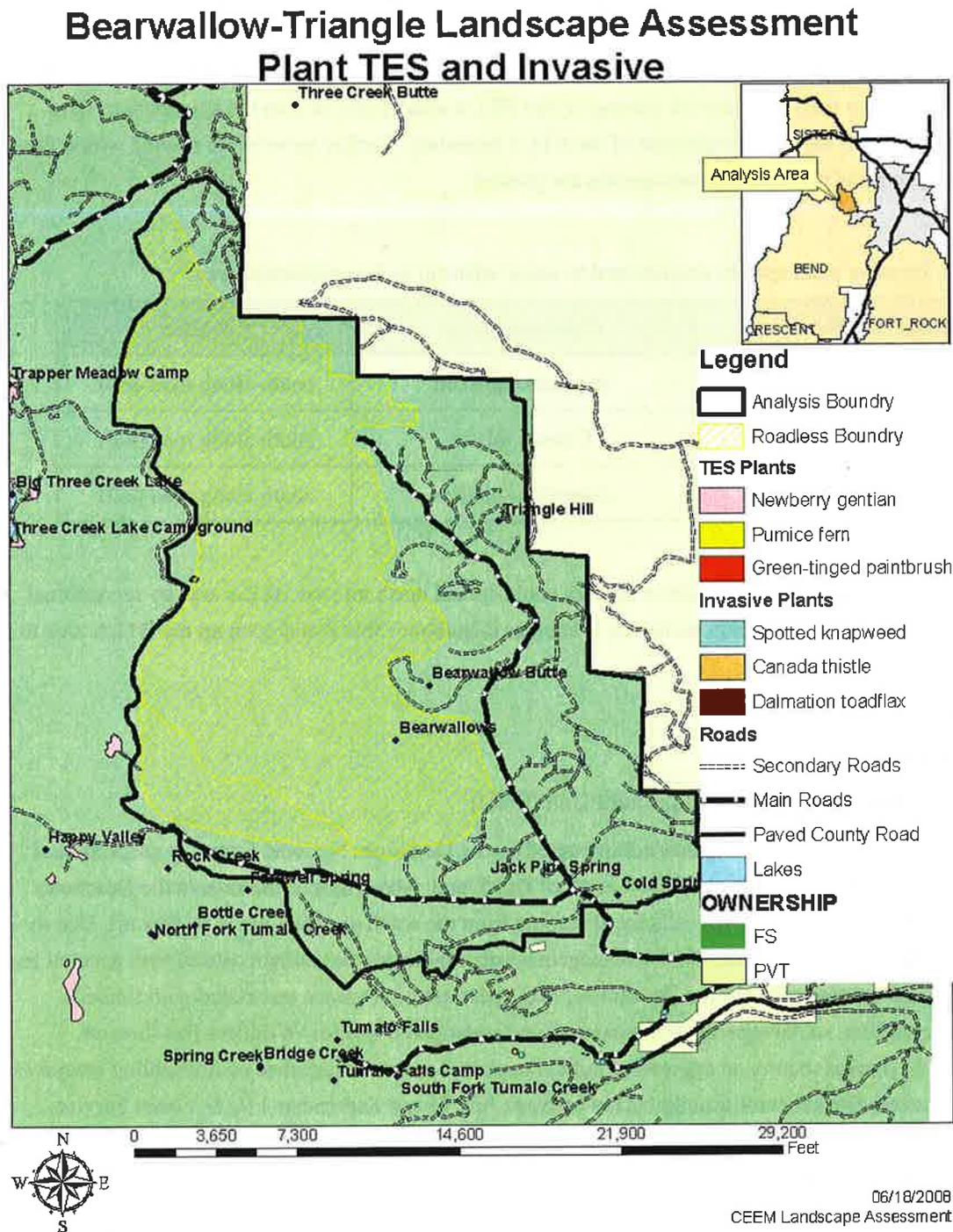
**Rare Plants**

The Forest Service Manual states that habitats for all existing TES plant species should be managed, at minimum, to maintain viable populations for each species. The Region 6 Regional Forester’s Sensitive Species List was officially updated on January 31, 2008. Currently, the Deschutes National Forest Sensitive Plant List includes 31 taxa, either known or suspected to occur on the Forest. These taxa are included in the USFS Region 6 Sensitive Species List, last revised in 2004. From this list, three species may have the potential of occurring west of Bend in the BTLA area: *Gentiana newberryi* (Newberry gentian), *Botrychium pumicola* (pumice fern), and *Castilleja chlorotica* (green-tinged paintbrush). Of these, *Gentiana newberryi* is known to occur in swales within the BTLA area. Newberry gentian occurs within the range of eastern and western Cascades of Oregon in alpine to subalpine mixed conifer openings, wet to dry montane meadows, and sometimes adjacent to springs, streams, or lakes. *Botrychium pumicola* is documented or suspected in alpine-subalpine ridges, slopes and meadows. In addition, pumice fern is found in montane forest openings, in basins with frost pockets, and pumice flats. This species has a low probability of occurrence within the project area. *Castilleja chlorotica* is found in ponderosa and lodgepole pine stand openings and with mid to late seral stage sagebrush and bitterbrush in shallow, rocky soils.

Table 27. Sensitive plant species on the Deschutes National Forest and the assessment area.

<b>Scientific Name</b>	<b>Common Name</b>	<b>Project Status</b>
<i>Gentiana newberryi</i>	Newberry gentian	present west
<i>Botrychium pumicola</i>	pumiced fern	not present
<i>Castilleja chlorotica</i>	green-tinged paintbrush	not present

Figure 21. Locations of Threatened, Endangered and Sensitive plants and invasive plant species.



**Invasive Species**

The DLRMP (1990) includes general and specific directives regarding noxious weed management. The 1998 Deschutes National Forest Noxious Weed Environmental Assessment includes a Noxious Weeds List. Twenty-seven taxa of invasive plant species are currently known to occur on Deschutes National Forest. There have been no botanical surveys of the BTLA area. Table 28 lists the species that occur within two miles to the south/south-east of the BTLA boundary. Further surveys are needed within the BTLA to determine if invasive plants species are present.

Table 28. Invasive plant species documented to occur adjacent to the assessment area.

<b>Scientific Name</b>	<b>Common Name</b>	<b>Location</b>
<i>Centaurea biebersteinii</i>	spotted knapweed	south along road 4601
<i>Cirsium arvense</i>	Canada thistle	south along road 4601
<i>Linaria dalmatica</i>	dalmation toadflax	south along road 4601

Based on expert opinion, these invasive species could spread north into the BTLA area by recreational OHV, bicycles, and hikers. Large scale fire is another disturbance that could open up the BTLA area to noxious weed invasion.

**Disturbance**

**Fire**

**Deschutes Fire Management Unit (FMU)**

The Deschutes FMU consists of lands administered by the Deschutes National Forest. It encompasses 1,313,017 acres of USFS land and 70,854 acres of BLM land. About half of the fires in the Deschutes FMU are lightning caused. Storm cells usually come from the south and then move northward. Due to high recreational use in the unit, the fire management plan indicates that human caused fires account for 48% of the annual total. Within the Deschutes FMU, there are high values associated with timber, wildlife, recreation, social aspects and threatened and endangered species. Wildfires that threaten identified WUI areas require an aggressive initial attack and extended response of firefighting resources. The most severe fire behavior usually occurs between July 15 and September 1 (U.S. Forest Service, 2008).

**Current Management Direction**

The fire management goal of the Deschutes National Forest is to, “Provide a well managed fire protection and prescribed fire program that is cost efficient, responsive to land stewardship needs, and resource management goals and objectives” (Deschutes National Forest, 1990).

The fire management objectives, standards and guidelines include:

1. All wildfires will receive a timely and energetic suppression response that minimizes suppression cost plus resource losses, and best meets multiple use standards/guidelines for each management area. Those fires that threaten life, private property, public and fire fighter safety, improvements or investments shall be given high priority and suppressed to minimize losses.
2. Objectives for burned acres and constraints are identified for each management area. The fire suppression organization shall strive to keep the resource losses caused by wildfire to a level that will not adversely affect resource outputs.

#### Fire in the Wilderness

Wilderness areas on the Deschutes National Forest, Ochoco National Forest and Wilderness study areas (WSA) on the Prineville BLM District are combined to make up the Wilderness FMU. This FMU includes the Three Sisters Wilderness that borders the western edge of the BTLA area.

Management goals and constraints for the Wilderness FMU:

1. Protect improvements and structures.
2. Ensure there are no unacceptable impacts to cultural resources or T&E species.
3. Resource advisors will be requested for any fire expected to have extended initial attack.
4. Earth moving equipment within WSA can only be utilized with the approval of the District Manager.
5. Attempt to utilize natural barriers and fuel breaks to contain fires.
6. Follow guidelines for fire suppression in WSA as outlined in District WSA Fire Management Plan.
7. Minimize suppression impacts, use minimum suppression tactics (MIST).
8. Wilderness areas 5,000 acres or more are Class I airsheds as described in the Clean Air Act.

#### Air quality concerns

Oregon has a total of 12 Class I airsheds within the state. Three Class I airsheds are to the west and north of the assessment area. These airsheds are comprised of the Three Sisters, Mt. Jefferson, and Mt. Washington wilderness areas. The two airsheds that would most likely be impacted by smoke generated from a fire in the assessment area would be the Mt. Washington and Three Sisters wilderness areas. Sections 169A and 169B of the Clean Air Act require states to protect and improve visibility in Class I areas. Congress identified National Parks over 6,000 acres and Wilderness areas over 5,000 acres in size as Class I airsheds. They cited visibility in these areas as an important value. Class I airsheds are subjected to the tightest restrictions on additional air pollution. The Class I airsheds affecting the BTLA area are declared mandatory and can never be re-designated to another air quality classification (National Wildlife Coordinating Group, 2001)

The Oregon smoke management plan (OAR 629-043-0043) considers the Mt. Washington and Three Sisters Wilderness areas as smoke sensitive areas because of their Class I designation. The state has issued a protection period lasting from July 1 until September 15. During this period prescribed burning will cease in these areas with only minor exceptions for research burns, conversion burns, and Willamette National Forest burns above 5000 feet. This exclusion will promote burning in the spring and fall months during which visitation to the area has decreased and fuel moistures are higher (Oregon Department of Forestry)

The city of Bend is considered a Smoke Sensitive Receptor Area (SSRA) by the State of Oregon. The State designates areas as SSRAs because of past history of smoke incidents, density of population or other special legal status related to visibility. Prescribed burning near Bend poses a significant challenge in regards to smoke dispersion issues associated with predominant westerly winds and lowering temperatures at night that will push smoke down drainages and into the city. This designation subjects Bend to the highest level of protection under SSRA regulations (Oregon Department of Forestry).

#### Wildland Fire Use

It is apparent under the air quality conditions associated with the assessment area that the use of prescribed fire is limited in scope. Another viable option under these air restrictions is Wildland Fire Use (WFU). Wildland Fire Use is described as "fire ignited by natural sources (lightning, volcanoes, etc.) within any federally managed lands which are permitted to burn within predetermined conditions outlined in the land manager's fire management plan". These prescribed natural fires are used for resource benefits and are not covered by the State plan for visibility improvement. The Oregon Department of Environmental Quality and the ODF will work in conjunction with federal land managers in drafting WFU plans to meet fuels treatment objectives. Currently there is a WFU plan for the nearby Brothers Management Area. The Management Ignited Prescribed Fire in the Wilderness Plan is currently being developed to allow both natural and planned/managed human ignitions. The State encourages the research and development of non-burning alternatives to prescribed fire. The Bend-Fort Rock District is actively using mechanized equipment to mow wildlands to reduce fuel loading (Oregon Department of Forestry).

#### Fire Occurrence

Fire occurrence has been minimal with no large fires occurring within the landscape assessment area. There was one large fire that occurred adjacent to the landscape assessment area, the Bridge Creek fire in 1979. The fire behavior experienced on this fire may be an indication of expected fire behavior on similar terrain within the assessment area. The Bridge Creek fire started July 24, 1979, and burned 3,364 acres north of Tumalo Creek. (T17 and 18S, R10E, Willamette Meridian). The sources used for historical background on the Bridge Creek Fire came from an annual report authored by the Redmond Smokejumpers, a Wildland Fire Report from the web based FIRESTAT, and a phone interview with former Bend District Fire Management Officer, Bruce Chaney.

### Bridge Creek Fire History

An escaped campfire started the Bridge Creek fire and quickly began to burn in heavy dead and down litter. According to Mr. Chaney’s first-hand accounts, this fire was driven by a light westerly breeze and progressed downhill from west to east. Several downhill spot fires were reported which came together and were then drawn into the main fire creating a surging effect. Once the fire made its way into the canopy it erupted into a crown fire and decimated the old growth ponderosa pine forest that inhabited its perimeter. In contrast to this, the FIRESTAT report showed the cover class to be lodgepole pine 5-11” diameter at breast height. Approximately 200,000 gallons of fire retardant was applied on this incident. This was just 14,000 gallons shy of the retardant used by the Redmond Air Center during the entire fire season of the previous year. A load of retardant was accidentally dropped directly into Tumalo Creek and the water source had to be shut off to human use for 2 days. Mr. Chaney noted the extensive use of aerial resources was due to the high visibility of the fire and its close proximity to homes. No structures were lost in this fire.

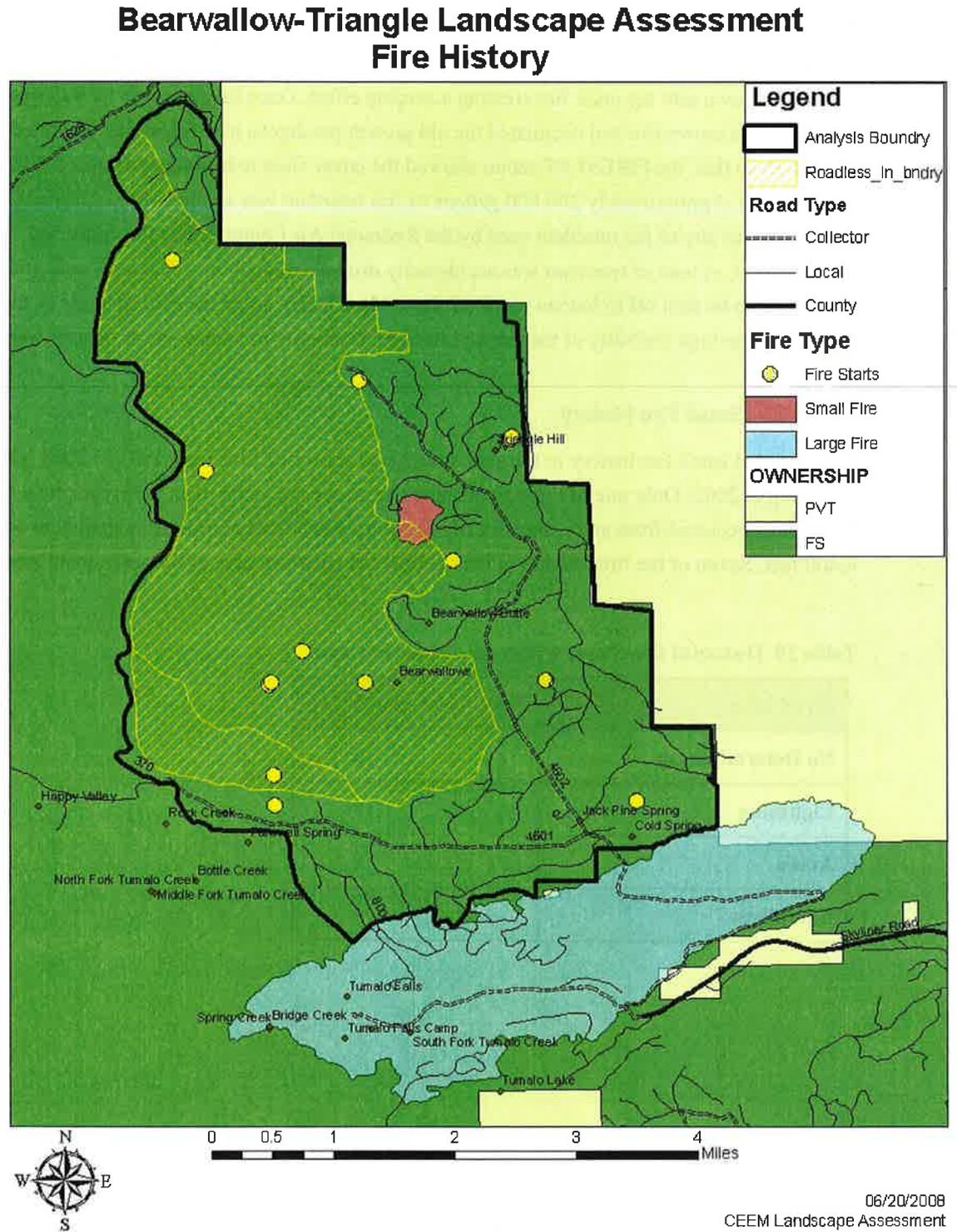
### Small Fire History

The recorded small fire history in the assessment area shows 15 fires from 1981 to 2008 with the last start occurring in 2002. Only one of these fires had a size above one tenth of an acre reaching a total of 4 acres. These fires occurred from early June to early October. Associated elevations ranged between 5,000 and 6,400 feet. Seven of the fires started in the roadless management area of the assessment area.

Table 29. Historical fire causes within the assessment area.

<b>Fire Cause</b>	<b>Number of Starts</b>
<b>No Determination</b>	5
<b>Lightning</b>	5
<b>Arson</b>	1
<b>Campfires</b>	4

Figure 22. Historical fire locations within the assessment area.



### Potential Fire Characteristics

The assessment area is made up of fire regimes II, III, and IV. Fire regime IV makes up the majority of the area and constitutes 62% of total acreage. This fire regime is defined as having a 35-100+ year interval of fire occurrence with stand-replacing intensity. This regime is characterized by stands of lodgepole pine and dry shrubs. The landscape is considered a seral community that arises from infrequent stand-replacing fires. All of the classifications associated with this fire regime have surface fuel models consistent with crown fire potential. The presence of a MPB outbreak in the BTLA area compounds both the risk and severity of potential wildfires. Private areas that could be threatened by wildfire originating in the assessment area include the holdings bordering to the east and south. Continuous fuels connect these parcels to the public lands.

Table 30. Fire regime summary for Deschutes National Forest and the assessment area.

Fire Regime	Description	BTLA acres in regime	BTLA % of total acres
I	0-35 yr return, low intensity. Dry forest types (i.e. pine). Large stand-replacing events can occur under certain weather conditions but are extremely rare events	0	0
II	0-35 yr return, lethal severity(i.e. rangeland)	0	0
III	35-100+ yr return, mixed severity (i.e. mixed con)	4113	32%
IV	35-100+ yr return, lethal severity (i.e. lodgepole) stand-replacing	7968	62%
V	>200 yr return, lethal severity. Rarely burns, if ever (i.e. high elevation)	771	6%

Figure 23. Fire Regimes within the assessment area.

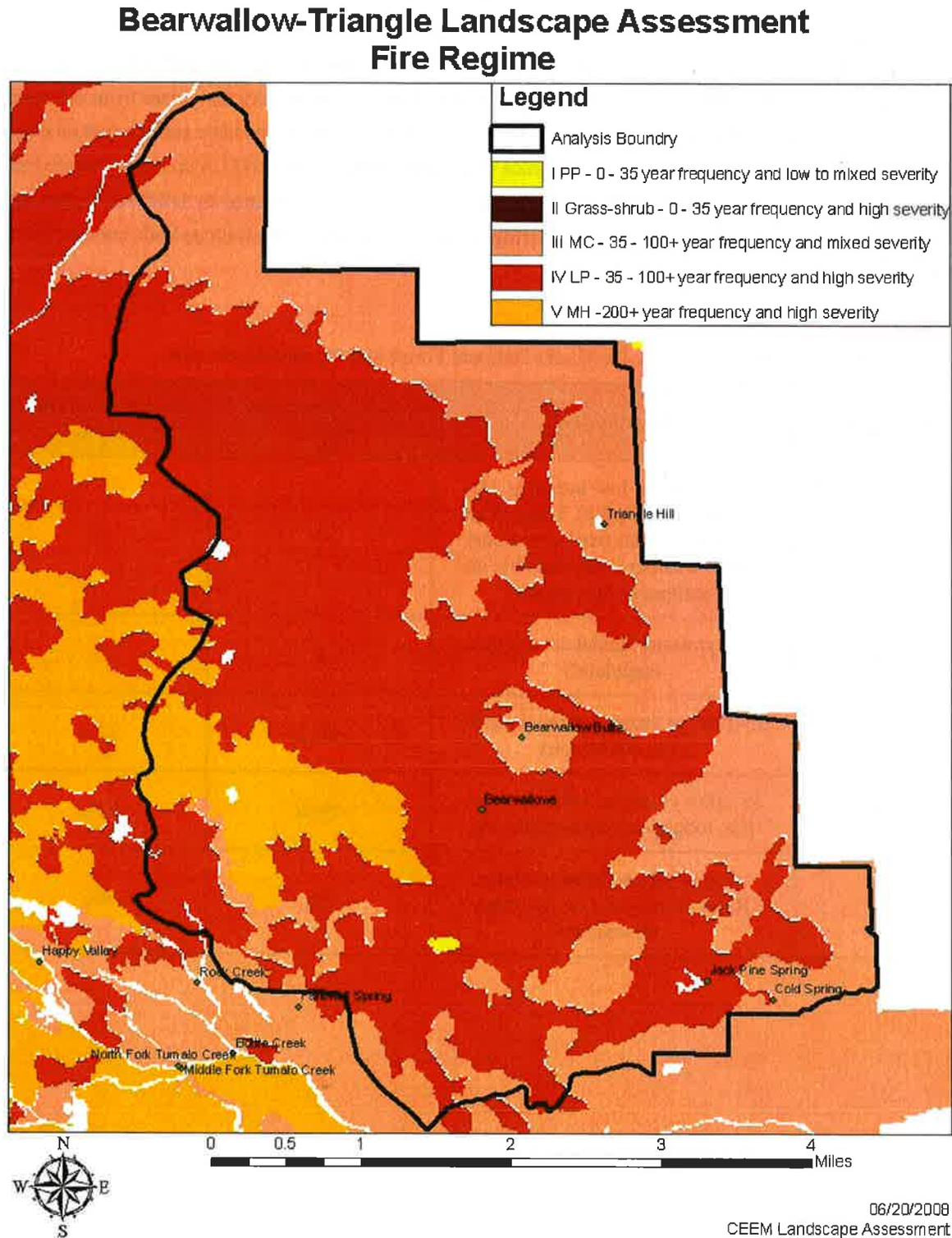
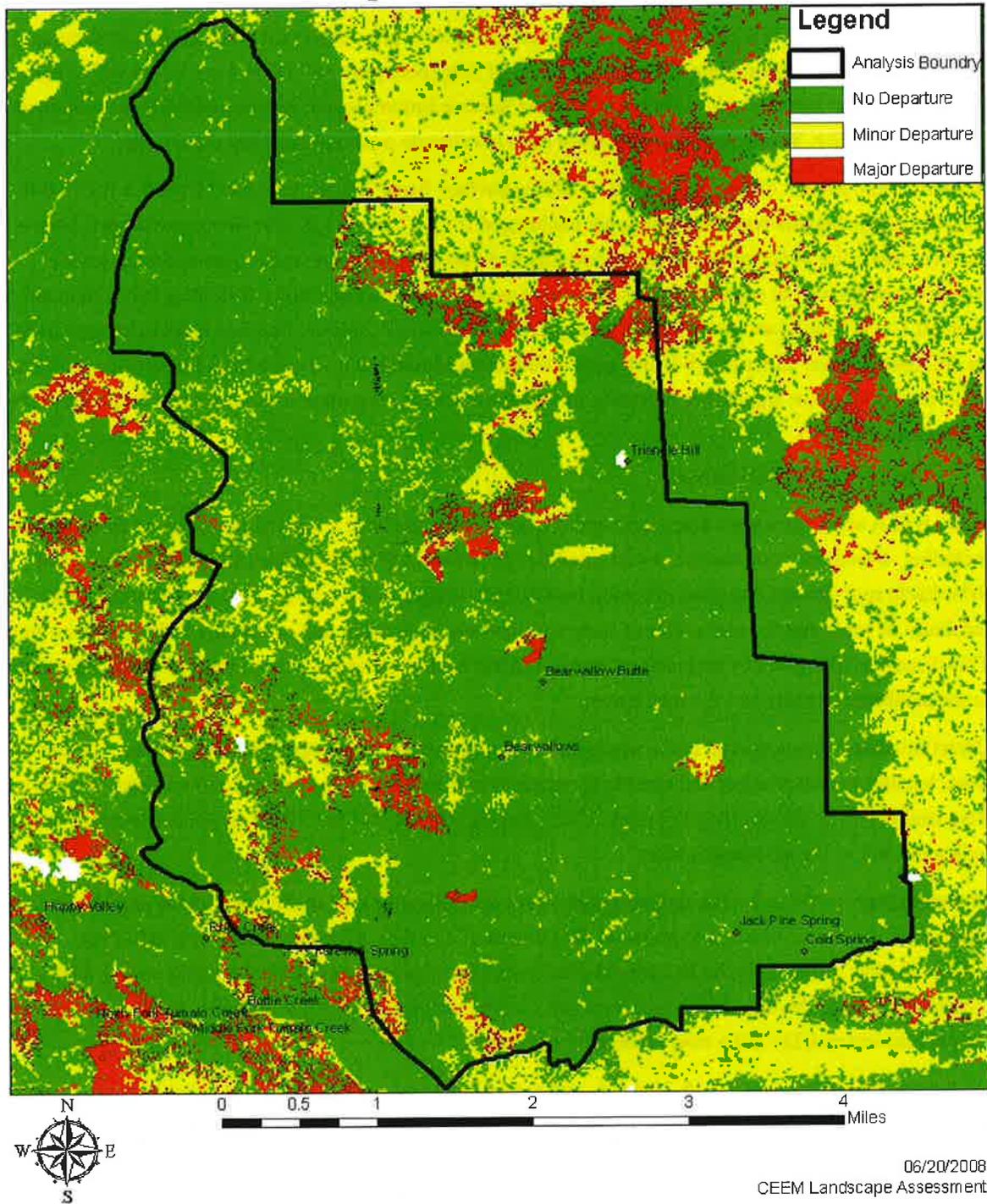


Figure 24. Fire Regime Condition Classes within the assessment area.

### Bearwallow-Triangle Landscape Assessment Fire Regime Condition Class



### **Fire Conditions**

It is important to understand how fire conditions have recently changed as a result of the recent MPB outbreak. Using the Fire and Fuels Extension of FVS, potential fire was modeled before and after the mortality caused by the MPB. This was done to determine current and future fire behavior in stands with considerable fuel. A MPB outbreak was simulated using 1996 pre-outbreak data from the Continuous Vegetation Survey. To simulate the outbreak, 80% of lodgepole pine >6" DBH were killed with a bias against the larger stems. Andy Eglitis, U.S. Forest Service Entomologist, recommended these parameters for MPB mortality. Simulated 2006 data were used to estimate post outbreak fire conditions.

Between pre-outbreak and post-outbreak, potential surface flame lengths increased from 2.3 ft to 5.0 ft and total flame heights remained relatively unchanged from 47 ft to 45 ft. The fire type changed from a passive crown fire under pre-outbreak conditions to an active crown fire under post-outbreak severe weather conditions, but remained as a surface fire under moderate conditions. Torching index changed from 10.1 to 6.7 mi/hr and crown index changed from 20.2 to 19.7 mi/hr. The fuel model changed from an 8-Closed Timber Litter to a 5-Brush post-outbreak and finally to a 10-Litter and Understory by 2016. Wildfire would cause significant mortality in lodgepole stands regardless of weather and fuel conditions (Anderson, 1982).

### **Insects and Disease**

In the BTLA area, there are a few insect and disease issues that have a significant effect on forest health, including *Armellaria* root disease, dwarf mistletoe (DM) and MPB. There are isolated occurrences of *Armellaria* root disease, the most common root disease fungus in the region. This fungus attacks the cambium of roots and the root collar of trees with low vigor, girdling and eventually killing the host tree. This disease is identified by resinosis at the base of the host tree and fan shaped mats of white mycelium in the cambium of roots and the root crown.

Dwarf mistletoe was observed in the assessment area. Dwarf mistletoe can reduce growth on infected trees, leading to loss of vigor and eventually death. It is identified by the presence of witches' brooms, stem cankers or by the swelling of stems. There was significant DM identified on ponderosa pine, and lodgepole and in the assessment area.

Mountain pine beetle is, by far, the most significant forest health issue in the assessment area. Mountain pine beetle is a native beetle that preys on the phloem of a variety of mature pine trees, including lodgepole pine. Attacks can be identified by the presence of pitch tubes on the bole and boring dust around the base of the tree. Individual trees can survive isolated attacks but multiple attacks can destroy the phloem and quickly kill a tree, essentially girdling it.

Outbreaks generally occur for 15-20 years, and are followed by a period of 30-40 years with little beetle activity. Between outbreaks, beetle populations stay at extremely low levels, during that time, beetles are hosted by individual trees unable to prevent attack due to injury or disease. The early years of an outbreak are characterized by an arithmetic increase in beetle numbers as well as numbers of trees killed. Dominant

and codominant trees are killed in groups of 2-3 rather than the injured or diseased individuals that are attacked between outbreaks.

From this point, the outbreak reaches a critical mass and expands rapidly. The beetles are able to take trees of virtually any size, crown class or health condition. Trees are killed in larger and larger groups and kill very large numbers of trees until beetle populations are more abundant than the food supply. At this point, generally around 10 years after the initial onset of the outbreak, beetle populations begin a downward trajectory. At this time, beetles generally attack any small patches, or other individuals that might have been spared by the initial outbreak. The result is large stands of standing dead trees with an understory of saplings in smaller size classes.

### History

The lodgepole pine stands surrounding Bend have been hosts to several MPB outbreaks in recent history. In the early 1920s, a large outbreak killed 100-300 of the largest lodgepole pine trees per acre across the landscape, leaving the smaller trees in the suppressed and intermediate crown classes. By the end of the 1920s the outbreak had subsided and surviving trees had accelerated growth due to improved water, light and nutrient availability. This release will show up on the tree rings of trees alive during that era.

Between the late 1920s and the late 1960s, surviving trees grew rapidly under these conditions. Trees surviving the previous outbreak had moved into the overstory and the forest had a more closed canopy. By 1970, conditions were ideal to support another MPB outbreak, and between 1970 and 1980, populations of MPB began to climb and a subsequent outbreak ensued. In the early and mid 1980s, mortality reached maximum levels and the beetle populations and associated mortality began to decline into the late 1980s.

### Recent Activity

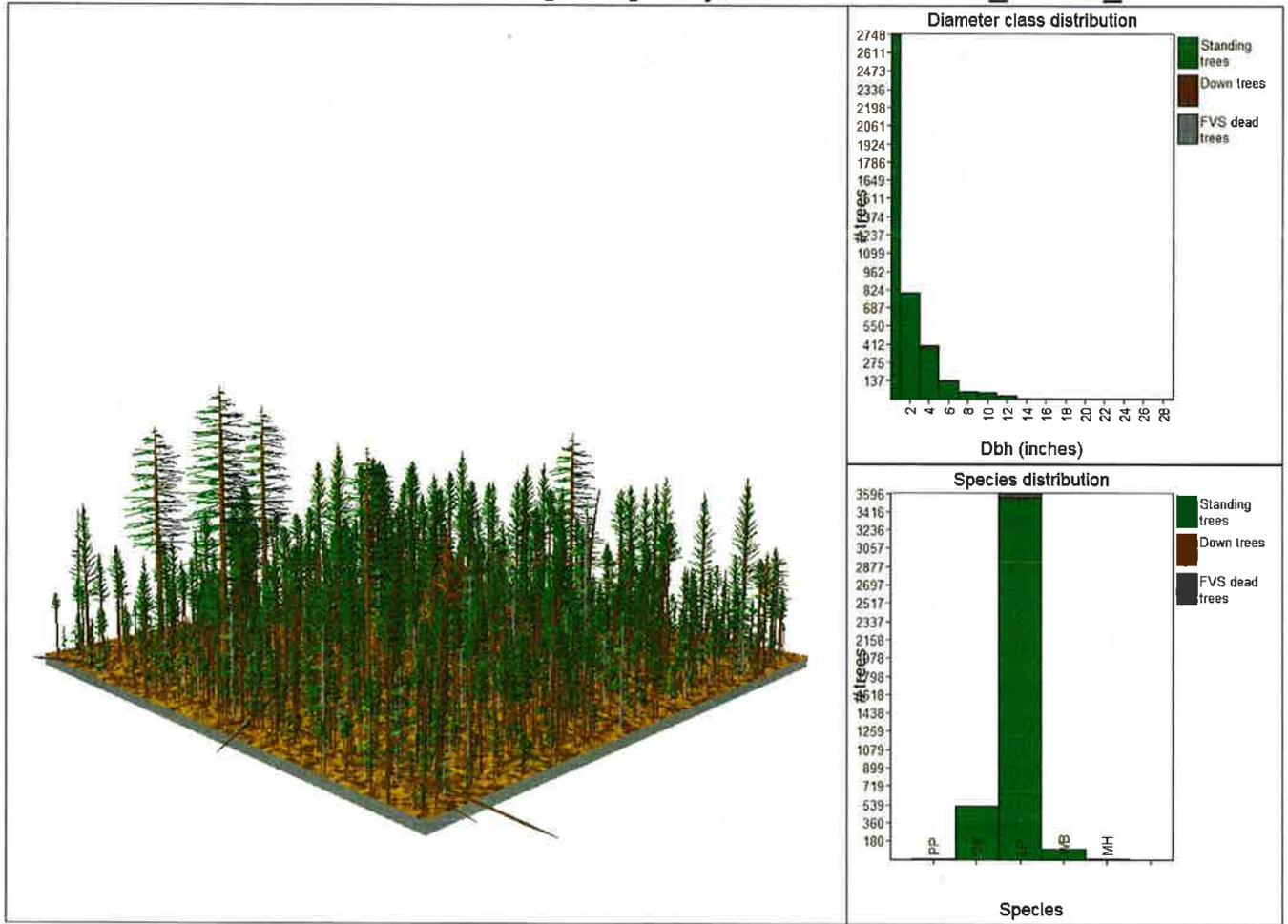
Currently, beetles are active within the BTLA area. An infestation, first observed in 2002, has spread rapidly and has reached the majority of the BTLA area. Beetle populations are rapidly increasing. Because MPB outbreaks are only slowed by the lack of available host trees, this outbreak has the potential to infect many more acres.

Stand data from the CVS plots located within the BTLA area were analyzed. Using FVS, a MPB outbreak, similar to the epidemic currently in the BTLA area was simulated by killing 80% of trees across all pine species greater than 6" DBH with a bias towards the larger trees. These assumptions of a MPB outbreak are supported by Page and Jenkins (2007a, 2007b) and Mitchell (undated). Tables 19 – 21 describe post-outbreak stand data collected from 1994-1996 and simulated to 2006.

Between 1996 and 2006, the simulated MPB outbreak killed 245 trees per acre (TPA). Basal area of pine was reduced from 137 ft<sup>2</sup> to 42 ft<sup>2</sup> per acre. These results are very consistent with results from other MPB outbreaks that have occurred locally (Mitchell, undated) and regionally (Page and Jenkins 2007a 2007b). Figure 25 and Figure 26 provide a visualization of the effect of MPB on these stands. Implications of this outbreak with regard to fire danger are considered in the Fire Conditions section of this document.

Figure 25. Representation of lodgepole pine stand pre MPB outbreak.

Stand=2089182 Year=1996 Beginning of cycle

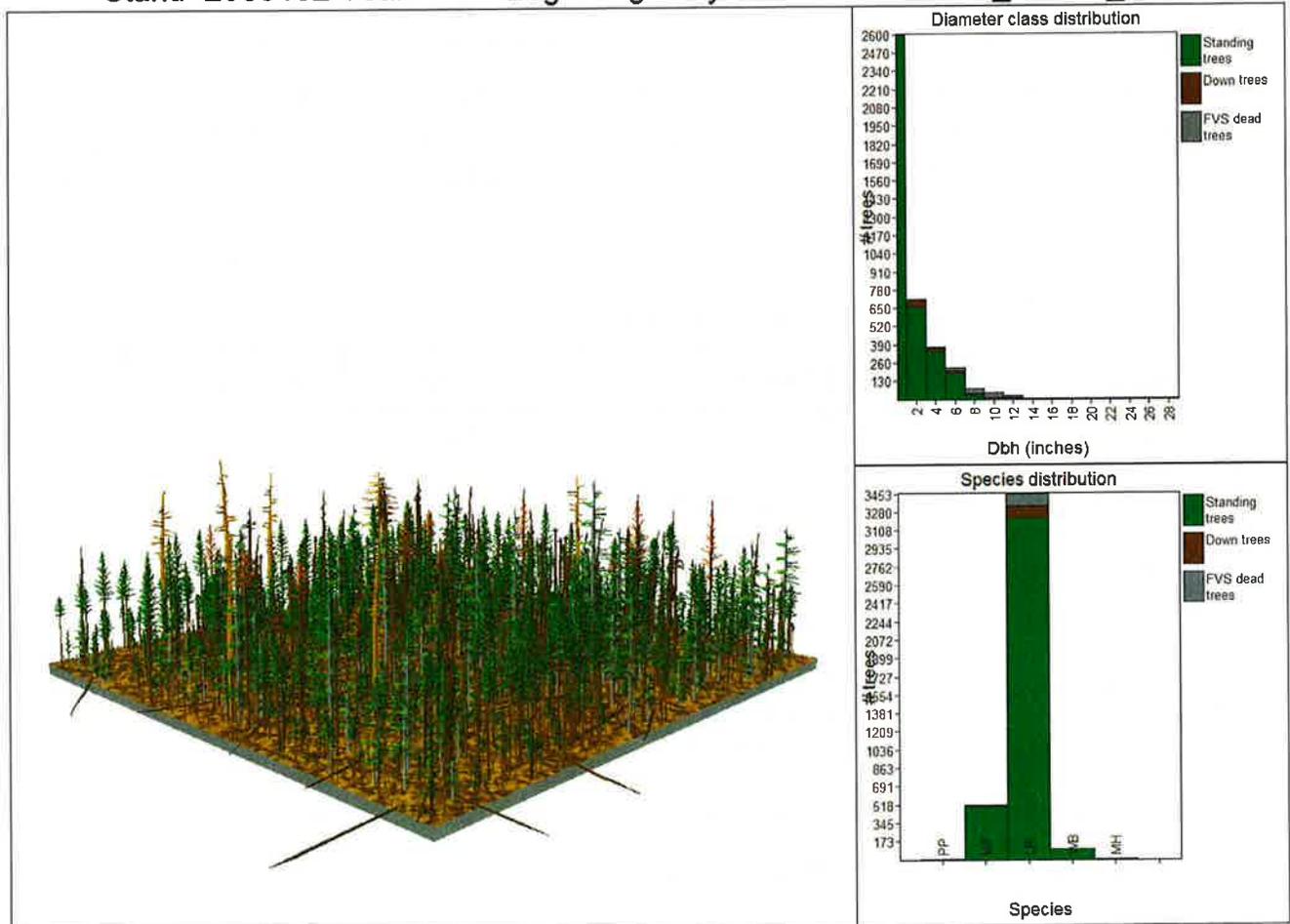


\*Data obtained from Continuous Vegetation Survey plots and generated from FVS.

Figure 26. Representation of lodgepole pine stand post MPB outbreak.

Stand=2089182 Year=2006 Beginning of cycle

CEEM\_LPSIM\_021.svs



\*Data obtained from Continuous Vegetation Survey plots and generated from FVS.

Managed stands which have undergone thinning or other means to control stocking tend to be more healthy and vigorous. Thinning to minimize the risk of a future MPB outbreak is most successful in younger stands, generally under 50 years old. Vigorous trees are either avoided by the beetles, are able to pitch beetles out, or can otherwise survive injury caused by MPB. Individual stands can be managed so that a smaller proportion of trees are susceptible to MPB. Landscapes can be managed to create a mosaic of stands each with a different age and a MPB risk rating. An approach such as this may limit the possibility of the MPB developing into a landscape level forest health issue. Management strategies may include mechanical or hand thinning as well as prescribed burning.

### Logging

The Bend- Fort Rock Ranger District Timber Sale Administrator mentioned that there was light firewood cutting activity in the eastern roaded region of the assessment area during 1993-94. There was not heavy

use due to the condition of the 4601 road and the subsequent challenges of hauling firewood by vehicle. The District has discussed fire wood permitting in the future. The sale administrator mentioned that this area would be most suitable for a commercial wood cutting permittee.

There has been timber management activity within the assessment area dating back to 1971. Table 31 displays the most recent timber management activities within the BTLA. It is apparent that only a relatively small amount of the east side of the BTLA area was managed by the Forest Service and that no activity has taken place in the past ten years.

Table 31. Recent timber management in the assessment area.

<b>Activity</b>	<b>Sale Name</b>	<b>Date</b>	<b>Acres</b>
Coppice Cut	Sisters Boundary	1971	284.7
Stand Clear Cut	Bearwallow White Fir	1973	72.8
Stand Clear Cut	Bearwallow White Fir	1974	16.6
Shelterwood Cut	Walla Bear	1993	27.4
Single Tree Selection Cut	Walla Bear	1996	352.7
Full Planting/Site Prep	Walla Bear	1998	146.0
Full Planting/Site Prep	Bearwallow Lodgepole	1977	96.8
Full Planting/Site Prep	Bearwallow White Fir	1977	83.6

\*Information obtained from the Forest Activity Tracking System (FACTS).

## **Synthesis**

### **Themes**

Five significant themes emerged while compiling information on the assessment area and these were used to identify linkages and potential future management opportunities for the assessment area.

#### **Fire and Fuels**

The analysis of the BTLA area suggests that the potential for extreme fire behavior associated with current and future fuel accumulations is high, with public concern and awareness of this potential also increasing. The possibility of a stand replacement fire escaping this area exists and will become more likely if its current condition is not mitigated. Some key issues affecting fuels management are airshed restrictions, increased pressure of an expanding WUI, markets for wood products, and limited access into the area. A more detailed analysis of this area will produce a better picture of the fuel and fire behavior that exists in this landscape.

#### **Community/Urban Growth**

A major theme influencing the management of the BTLA area is the potential for continued community and urban growth. The city of Bend and its surrounding communities have seen large population growth and trends indicate continued growth into the foreseeable future. This is due in part, to the potential development of private land located to the northeast and the south of the assessment area. This potential development may increase the need for WUI management due to the proximity of the proposed new community to the BTLA area. Recreation is also expected to be affected by increases in the local population. With increases in population, the need for additional recreation opportunities will push people into areas that have not traditionally seen much use. The assessment area is such a place. Analysis indicates that currently the BTLA area has recreation opportunities. An escalation in use may create an increased need for WUI and recreation management in the assessment area and surrounding communities.

#### **Lack of Knowledge and Utilization of the Area**

One theme that presented itself in the analysis of the assessment area is the underutilization by the public and the agency, and the lack of data about the area. Several factors could account for the assessment area being characterized as a “no man’s land”. Poor access up a steep-rocky road, and a lack of attractions such as rivers, lakes, or scenic forests all contribute to low public use. There has been no reported past or current conflict with public user groups in the area. Wildlife species that utilize the assessment area benefit from the low use and current management designations. The assessment area has a large Roadless designation bordered by the Three Sisters Wilderness to the west and private timberland to the east. Until the most recent MPB epidemic, concurrent with the expanding population of the local community, there was little compelling reason to take a hard look at management in the area. For those reasons, there has been minimal to no surveys or data collection to date. Much of the information needed to make sound management decisions still needs to be gathered.

## **Recreation**

Though currently underutilized, pressure on the recreation resource within the BTLA area will continue to grow as the population of Bend increases. Reasons for underutilization of this area recreationally include: (1) a lack of Agency-designated and maintained trails and (2) abundance of recreational opportunities nearby in more aesthetically desirable settings. Currently, there are few conflicts among user groups, however, this is likely to change as pressure on currently available recreation resources increases and demands grow as population rises. Due to the increasing populations, popularity of outdoor activities in the area, proximity to Bend and a general lack of opportunities for some user groups, there may be a need to develop and manage the following recreation opportunities:

1. Off-Highway Vehicle (OHV) riding
2. Equestrian use
3. Guided recreation
4. Dispersed camping
5. Hunting
6. Snowmobiling

## **Ecosystem Health**

The area has been impacted by MPB activity. It may be suggested that beetles are doing the work that fire suppression has excluded from the area. However, the insect epidemic will not complete the fuels reduction processes like prescribed or natural fire would. The fuel loading resulting from insect activity when the dead trees finally fall is not acceptable for many values (ecological, social, etc.). Though the area is not critical habitat for TES species, it is important as a travel corridor and summer range for deer and elk. The two known occurrences of sensitive plant species must be protected, while the risk of invasive species establishment must be mitigated. The roadless area designation and other management policy (i.e. air quality standards) restrict the available tools managers can use to implement projects. The “roadless” designation itself, conjures the feelings and values associated with Wilderness areas for many people. The area is in the viewshed from town and adjacent recreation areas and Bendites “really enjoy seeing their green carpet up into the mountains.”

## **Linkages**

The lodgepole pine ecosystem that dominates the BTLA area is mature. Lodgepole pine is short-lived, and regenerates after a stand-replacing disturbance (e.g., fire). In this case, the stand-replacing event is a MPB outbreak that is killing much of the 80-year-old overstory. In approximately 6-8 years, these recently beetle-killed trees will begin to fall, increasing the heavy surface fuel loading. In a different land management context, this fuel build up and the increasing likelihood for a catastrophic wildfire might be of little concern because it follows the natural successional trajectory for this type of stand.

With the close proximity to the rapidly expanding community of Bend, the threat to human health and safety due to increased fire behavior become serious issues. Half of the fires started in the assessment area

from 1981 to 2002 were human caused; with the increased use of the area, human fire starts are expected to increase. Standing snags and receptive fuels will also increase the risk of lightning caused fires. Within the next decade, modeled fire behavior suggests a change from passive crown fire to active crown fire, and the potential for this sort of extreme fire behavior will exist for at least 20 years without treatment. This has implications for fire suppression capabilities. Firefighter's ability to contain fires during the initial attack period is reduced, and tactics shift from direct to indirect attack. This would result in larger fires, increased fire severity, and the possibility for escape into the WUI.

To the south, development along Skyliners Road continues. To the east, a potential residential development in the Skyline Forest would border the assessment area. This proximity increases the risk to life and private property. Another effect of a severe wildfire would be impacts from smoke to human health. This would affect the adjacent residential areas, and increase the likelihood of evacuation due to health implications of breathing smoke. Smoke would also impact the air quality of surrounding communities and the city of Bend. The assessment area also has value as a viewshed, being in the foreground of the Three Sisters Wilderness. If it burned, the fire scar would be visible from several locations and degrade scenic quality. The direct and indirect effects of a wildfire threatening the WUI would be long term and detrimental to the community.

Another impact of the expanding population will be an increased demand for outdoor recreational opportunity on the National Forest. The population of Bend is projected to increase by 35% from 2010 to 2025. People moving to Bend are attracted by the recreational opportunities and embrace their outdoor lifestyle. The existing trails near Bend are already heavily used. To avoid crowds, people may begin to look for new areas to recreate in such as the BTLA area. Unmanaged recreation can bring a host of problems such as user conflicts, environmental degradation, and a less enjoyable outdoor experience.

Proactive management in the assessment area would minimize the impending challenges of the expanding population. Potential conflicts, associated with links between wildfire and the mountain pine beetle outbreak, and unmanaged recreation resulting from the increased population, is on the horizon. These issues are linked to the landscape and require an integrative approach to maximize future opportunities.

## **Future Opportunities**

### **Fuels**

The use of fire by managers in the BTLA area, whether ignited naturally or by humans, is severely limited by current air quality standards. Currently there are multiple airsheds that are strictly regulated by the Clean Air Act and a State designation of Bend and Redmond as SSRAs. Working within these regulations will continue to challenge managers. A common misconception is that the Wilderness Class I designation is the most limiting air quality issue. The State designation of the SSRA is in fact the most constraining factor for fuels management with regard to smoke. Regardless of the circumstances and challenges faced by fire management, it is imperative to address the critical issues regarding the threat of wildfire and its relation to WUI protection.

### Mechanical Treatment

The information collected supports the need and opportunity for strategic and integrated mechanical fuel reduction efforts. Areas of concern for WUI include the Skyliners community and proposed development on private lands east of the assessment area. The Roadless designation would not prohibit any of the following treatments on the majority of the assessment area. The treatments listed below could create fuel breaks if planned appropriately. Areas of opportunity would include roadside or residential fuel reductions on adjacent lands.

**Chipping:** Treatment option for small diameter and low quality trees. This practice would reduce fuel loading and provide funding for project cost. Local and regional co-generation energy plants would utilize the commercial product. Community acceptance of green power opportunities could encourage the use of this practice.

**Commercial or private fire wood collection:** Administer permits for collection of predetermined tree sizes, wood volume, and harvest location. Commercial product would be sold locally, project cost would be partially offset by permits fees, and fuel loading would be reduced in strategic locations.

**Post and Pole Production:** Administer permits for collection of predetermined tree sizes, wood volume, and harvest location. Collection of higher quality valued timber would generate increased revenue compared to other practices. Post and Pole would leave significant low quality/low value material in the stand potentially requiring additional fuel reduction treatments. Project cost would be partially offset by permit fees, and fuel loading would be reduced in strategic locations.

**Masticate/Mow:** Mastication will mitigate ladder fuel accumulation; however surface fuels will increase as residual fuels are left on site. No commercial product will be produced but low operational cost makes this a potentially cost effective treatment. Residual fuels onsite will provide nutrient and moisture retention. Vertical fuels continuity will be disrupted thus reducing the potential for crown fire activity. The Roadless designation does not interfere with this treatment.

### Wildland Fire Use

There is currently a plan being developed to address planned management ignition in the Wilderness areas on the Deschutes National Forest. The Management Ignited Prescribed Fire in the Wilderness Plan is slated for NEPA analysis by the year 2009. There are no provisions that allow fires to move across wilderness boundaries onto adjacent National Forest lands. Opportunities would present themselves if fire managers could find a way to include a provision in the plan allowing for fire ignited by management in the wilderness to move onto non-wilderness lands administered by the Forest Service. This provision could be an appropriate management response if smoke considerations are addressed and public support is acquired.

Due to the substantial smoke limitations in the area of Bend, the use of human ignited prescribed fire and WFU is limited in scope in the assessment area. The drainages adjacent to the assessment area would funnel smoke down into Bend at night. It was stated by acting Fuels Fire Management Officer (FMO) on

the Bend-Fort Rock District that only during a weak cold front would smoke dispersion be enough to not impact Bend. The Fuels FMO also stated that you would be lucky to work under these circumstances a few days out of the year. With these constraints, burning could be limited to pile ignition of fuels that were treated in proposed fuel break projects. It is important to note that the Class I airshed and SSRA constraints do not exclude prescribed fire or WFU. However, public support for both prescribed fire use and WFU is essential.

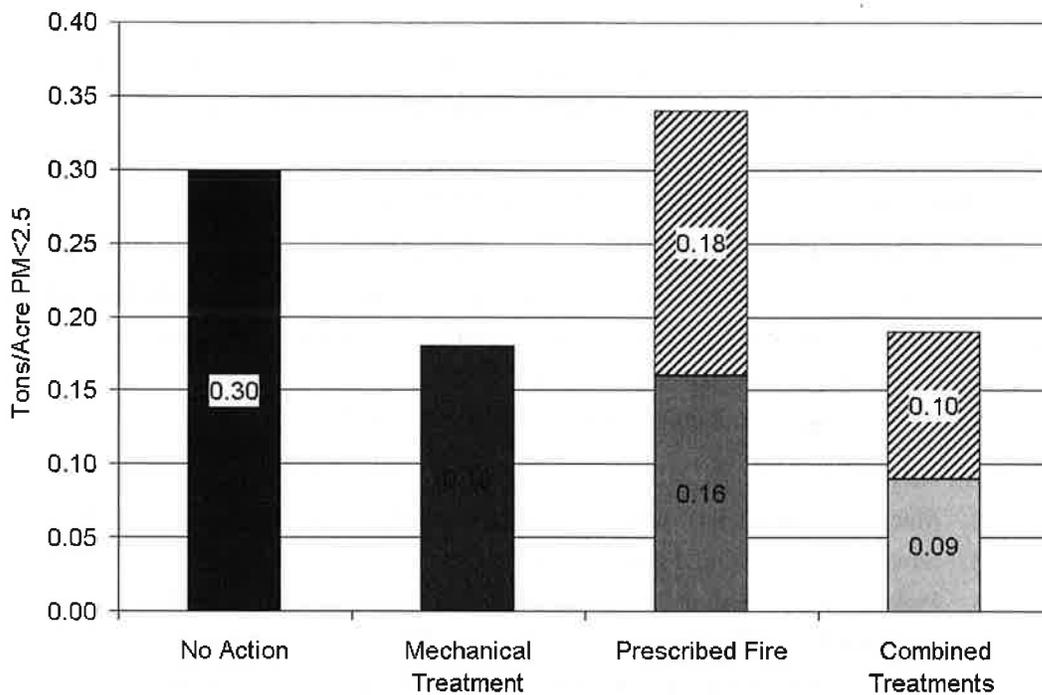
#### Effects of Treatment Options on Particulate Production

Because of Bend's classification as an SSRA, it is important to consider the implications of potential smoke produced by wildfire. It is also important to explore opportunities to mitigate or reduce this air quality hazard. Using the Fire and Fuels Extension of FVS, a wildfire was simulated under severe conditions (windspeed 20 mph, dry fuel conditions, and temperature 70 degrees). A report was generated on the smoke produced by a wildfire under these four management scenarios:

1. No treatment
2. Mechanical treatment – removal of 90% of standing dead material and sound down and dead material greater than 4" DBH
3. Prescribed fire – Fall prescribed fire under moderate conditions, 70 degrees windspeed 10 mph, with moist fuels
4. Mechanical treatment and prescribed fire – Combination of two above treatments

Figure 27 demonstrates the effect of the four alternatives on smoke production. The simulated wildfire, following no prior fuel treatment produced the most particulate matter less than 2.5 microns in size (PM<2.5) per acre as a result of no action. Both the mechanical thinning and the prescribed fire produce substantially less PM<2.5 than the no treatment option and were similar in their effect. Combined treatments further reduced the wildfire PM<2.5 to less than a third of the no treatment alternative.

Figure 27. Particulate matter emitted (tons/acre PM <2.5) by a simulated wildfire.



Hatched bars in Figure 27 represent the PM<2.5 produced as a result of the prescribed burn treatment. This particulate production is distinct from the contribution from wildfire. Though the combined PM<2.5 of the prescribed burn added to the wildfire exceeded the no treatment particulate production, it is important to note that prescribed proportion of the total particulate production can be scheduled under optimal conditions for smoke dispersal or mitigation. The particulate contribution of prescribed fire could occur in increments to reduce large amounts of smoke. Pile burning would produce less smoke than broadcast burning and would allow for the incremental treatment of fuels.

The most effective strategy for reducing the particulate production of a wildfire event was the combined treatments option. Use of this strategy would depend on a cost-benefit analysis of the return in air quality for the additional investment in treatment capital. This simulation is a demonstration of potential benefits of proactive fuel reduction. Further work is needed to more accurately quantitatively assess this benefit.

Reduction in smoke is associated with reduction in fire intensity. Under the no treatment alternative, fire type changes from active crown fire to passive crown fire during a twenty year simulation period. Fuel reduction treatments changed the fire type from active crown fire to surface fire during the same time period.

It is important to be proactive in the management of forest fuels. There is currently a window of opportunity that may diminish over time. Proposed treatments could reduce smoke pollution from a

wildfire and prescribed fire, and decrease resistance to control. Ultimately these treatments will improve firefighter safety and WUI protection.

### **Recreation**

There are many recreational opportunities available for development within the BTLA area. Population growth in the greater Bend area will drive changes in recreational use and resource impacts. Through adaptive recreation management and planning, recreation use can be developed and impacts minimized as local population and uses increase. User groups can be involved through educational and cooperative management strategies and with self-regulation. Partnership opportunities exist with Cascade Science School at the end of Skyliners Road to educate and interpret natural resource management activity to a range of people. The local Oregon State University-Cascade campus has programs directly related to resource management. The opportunity to partner with the school and reduce District costs associated with recreation and resource management could be explored.

#### **Adaptive Recreation Management Opportunities:**

1. With the lack of information known about recreation in the assessment area, cooperation with local user groups is of utmost importance in order to properly assess and manage recreation into the future.
2. The current lack of conflict provides a less contentious planning environment and greater proactive management opportunities.
3. Upcoming travel management updates could encompass projected future uses of the area while identifying local concerns for access and parking.
4. Infrastructure development such as staging areas, trail and interpretive information and established trails will become important as use increases.
5. If recreation and/or ecosystem management actions occur in the area, outreach and interpretive efforts could increase public involvement, knowledge, support and success of these projects.

A more comprehensive inquiry would be beneficial to ascertain the suitability of various types of recreation. This type of adaptive management of the assessment area will provide for sustainable recreational use on the Deschutes National Forest. Failure to understand current and future uses and manage the recreational resource in the assessment area will likely result in undesirable uses, degradation of the area and potential future user conflicts.

## Appendix

### Bearwallow – Triangle Landscape Assessment Contact List

Group	Called	Interviewed
Blue Mtn Biodiversity Project	Yes	No
Oregon Wild	Yes	Yes
Sierra Club/Oregon Chapter	Yes	No
Sierra Club/ Juniper Group	Yes	Yes
Sierra Club/ Juniper Group	Yes	No
Wanderlust Tour	Yes	Yes
American Forest Resource Council	Yes	Yes
Deschutes County Forester	Yes	No
Oregon League of Conservation Voters	No	No
Central Oregon Environmental Center	No	No
Deschutes Basin Land & Trust	Yes	Yes
Natural Areas Association	No	No
Central Oregon Trail Alliance (COTA)	Yes	Yes
Bend Chamber of Commerce	No	No
Klah Klahnee Cycling Club (Sunnyside Sports)	No	No
Tumalo Langlauf Club (Nordic skiing)	Yes	Yes
Oregon State Snowmobile Association	Yes	No
Cascade Science School	Yes	Yes
Oregon Equestrian Trails	Yes	No
Central Oregon Recreation Association	No	No
REI Bike Shop	Yes	Yes
Central OR Motorcycle & ATV Club- Motorcycles	Yes	No
Central Oregon Motorcycle & ATV Club- ATV	Yes	Yes
Central Oregon Nordic Club	Yes	Yes
OR Partnership for Wildfire Risk Reduction	No	No
Deschutes County Planning Division	Yes	Yes
Oregon Department of Fish & Wildlife	Yes	Yes
Moon Country Snowmobile Association	Yes	Yes
Oregon Hunting Association	Yes	No
Central Oregon Land Watch	Yes	Yes
Deschutes County Four Wheelers	Yes	Yes
USFS Botanist	Yes	Yes

USFS Forester	Yes	Yes
USFS Fuels Technician	Yes	Yes
USFS Fuels Specialist	Yes	Yes
USFS Fuels AFMO	Yes	Yes
USFS Acting Fuels FMO	Yes	Yes
USFS Recreation	Yes	Yes
USFS Timber Sale Administer	Yes	Yes
USFS Wildlife/Fisheries Biologist	Yes	Yes
USFS Fish Biologist	Yes	Yes
USFS Supervisory Wildlife Biologist	Yes	Yes
USFS Entomologist	Yes	Yes
USFS Pathologist	Yes	Yes
Project Wildfire	Yes	Yes
Deschutes County Historical Society	Yes	Yes

## Works Cited

- Anderson, H. E. (1982). *Aides to determining fuel models for estimating fire behavior*. Ogden: USDA For. Serv. Gen. Tech. Rep. INT-122, 22p. Intermt. For. and Range Exp. Stn.
- Cogswell, P. J. (1981). *Deschutes County Pine Logging*. Portland: Oregon Historical Society.
- Deschutes National Forest. (1990). *Land and Resource Management Plan*. Portland: USDA, Forest Service, R6.
- Gannett, M. K. (2001). *Ground Water Hydrology of the Upper Deschutes Basin, Oregon. Water Resources Investigation Report*. 00-4162. U.S. Geological Surey.
- Joslin, L. (2007). *Ponderosa Promise: A History of US forest Service Research in Central Oregon*. Portland: US Department of agriculture.
- Larson, D. M. (1976). *Soil Resource Inventory, Deschutes National Forest*. Bend: Deschutes National Forest.
- Mitchell, R. G. (1987). *Anatomy of a Mountain Pine Beetle Outbreak in Central Oregon*. Bend: Deschutes National Forest.
- National Wildlife Coordinating Group. (2001). *Smoke Management Guide for Prescribed and Wildland Fire*. Boise: PMS 420-2.
- Oregon Department of Forestry. *Visibility Protection Plan for Class I Areas*. Portland: Oregon Department of Forestry.
- Robbins, W. (2004). *Landscapes of Conflict: The Oregon Story, 1940-2000*. Seattle: University of Washington Press.
- Society, D. C. (2004). *Bend, Oregon: 100 Years of History*. Pediment Publishing.
- Sommers, P. (2004). *Northwest Job Gap Study*. Seattle: Northwest Foundation of Community Organizations.
- U.S. Forest Service. (2008). *Central Oregon Fire Management Plan*. Portland: USDA.
- Wnnemucca, O. (1951). 1951 Northern Paiute Testimony. (E. C.G. Lindquist, Interviewer)